

SYLLABUS
(Effective from academic session 2020-21)

FOR THE DEGREE

OF

Master of Computer Applications
Four-Semester Full Time Programme

SCHOOL OF BASIC SCIENCES



MANIPAL UNIVERSITY
JAIPUR

ELIGIBILITY OF THE CANDIDATES:

Passed BCA / Bachelor Degree in Computer Science Engineering or equivalent Degree

OR

Passed B.Sc./ B.Com./ B.A. with Mathematics at 10+2 level or at Graduation Level (with additional bridge courses as per the norms of the concerned university)

Obtained at least 50% marks (45% marks in case of candidates belonging to reserved category) in the qualifying examination

Program specific outcomes for Master of Computer applications (MCA) program:

[PSO.1.] To work productively as IT professional both at supportive and leadership roles.

[PSO.2.] To advance successfully in their chosen career path utilizing technical abilities, leadership qualities, communication and interpersonal skills with high regard to legal and ethical responsibilities.

[PSO.3.] To build their profession adaptable to the changes in the technology with lifelong learning.

Master in Computer Applications

Year	FIRST SEMESTER						SECOND SEMESTER					
	Sub. Code	Subject Name	L	T	P	C	Sub. Code	Subject Name	L	T	P	C
I	MA 6117	Discrete Mathematics	3	1	0	4	MA 6206	Graph Theory & Applications	3	1	0	4
	CA 6101	Web Technologies	3	1	0	4	CA 6202	Design & Analysis of Algorithms	3	1	0	4
	CA 6105	Programming & Problem Solving using C	3	1	0	4	CA 6203	Computer Networks & Protocols	3	1	0	4
	CA 6106	Relational Database Management Systems	3	1	0	4	CA 6204	Object Oriented Programming using Java	3	1	0	4
	CA 6107	Operating System	3	1	0	4	CA 6240-44	Program Elective-I	3	0	0	3
	CA 6130	Web Technology LAB	0	0	2	1	XX XXXX	Open Elective-I	3	0	0	3

	CA 6133	Programming & Problem Solving using C LAB	0	0	2	1	CA 6232	Computer Networks & Protocols LAB	0	0	2	1
	CA 6134	Relational Database Management Systems LAB	0	0	2	1	CA 6233	Object Oriented Programming using Java LAB	0	0	2	1
			15	5	6	23			18	4	4	24
	Total Contact Hours (L + T + P)		26				Total Contact Hours (L + T + P)		26			
	THIRD SEMESTER						FOURTH SEMESTER					
II	CA 7104	Unix & Shell Programming	3	1	0	4	CA 7270	Major Project	0	0	0	24
	CA 7105	Android Application Development	3	1	0	4						
	CA 7106	Software Engineering & Project Management	3	1	0	4						
	CA 7146-48	Program Elective-II	3	0	0	3						
	CA 7149-51	Program Elective-III	3	0	0	3						
	CA 7131	Minor Project	0	0	4	2						
	CA 7132	Unix & Shell Programming LAB	0	0	2	1						
	CA 7133	Android Application Development LAB	0	0	2	1						
				15	3	8	22			0	0	0
	Total Contact Hours (L + T + P)		24				Total Contact Hours		24			

Programme Electives –I

CA 6240 DATA SCIENCE

CA 6243 CRYPTOGRAPHY AND NETWORK SECURITY

CA 6244 CLOUD COMPUTING & INFRASTRUCTURE SERVICES

Programme Electives –II

CA 7146 DATA MINING & WAREHOUSING

CA 7147 INTERNET OF THINGS

CA 7148 ARTIFICIAL INTELLIGENCE

Programme Electives –III

CA 7149 FORMAL LANGUAGE & AUTOMATA THEORY

CA 7150 SOFTWARE DEFINED NETWORKS

CA 7151 DISTRIBUTED SYSTEMS

Master of Computer Applications

First Semester

MA 6117: DISCRETE MATHEMATICS [3 1 0 4]

Set Theory: sets, subsets, set operation, Cartesian product, relation (properties, equivalence relation, and partition) and function (different types of functions and composite function). Principal of inclusion and exclusions (statement only and simple problems), Generating Functions recurrence relation. Order relation and Structures: Partially order, algebraic structures and POSET, Lattices, distributive, and complemented lattices, Boolean Lattice, Uniqueness of Boolean Lattices Boolean expression & function. Semi group & Group: Binary operation, semi- groups, product and quotients, groups products and quotients, Bernside theorem (statement only and simple problems) coding & decoding. Mathematical Logic: Statement and notations, connectives, normal forms, well-formed formulas, implication, Tautology, Predicate calculus.

References:

1. C.L. Lui, *Elements of Discrete Mathematics*, (4e) Houghton Mifflin, 2017
2. J.P.Tremblay& R. Manohar, *Discrete Mathematical Structure with Applications to Computer Science*, (1e) McGraw Hill Education, 2017

CA 6101 WEB TECHNOLOGIES [3 1 0 4]

Introduction : Concept of WWW, Internet and WWW, HTTP Protocol : Request and response, Web browser and Web servers, Features of Web 2.0, Web Design: Concepts of effective web design, Web design issues including Browser, Bandwidth and Cache, Display resolution, Look and Feel of the Website, Page Layout and linking, User centric design, Sitemap, Planning and publishing website, Designing effective navigation, JavaScript : Client side scripting with JavaScript, variables, functions, conditions, loops and repetition, Pop up boxes, Advance JavaScript: Javascript and objects, JavaScript own objects, the DOM and web browser environments, Manipulation using DOM, forms and validations, DHTML : Combining HTML, CSS and Javascript, Events and buttons, XML : Introduction to XML, uses of XML, simple XML, XML key components, DTD and Schemas, Using XML with application. Transforming XML using XSL and XSLT, PHP : Introduction and basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP, PHP and MySQL : Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs. Introduction to Angular JS4

References:

1. R. Moseley &M. T. Savaliya, *Developing Web Applications*, (2e) Wiley-India, 2013Team at Kogent Learning Solutions Inc., *Web Technologies, Black Book*, (1e) Dreamtech Press, 2009
2. Team at Kogent Learning Solutions Inc., *HTML 5, Black Book*, (2e) Dreamtech Press, 2011
3. J. Sklar, *Web Design Principles*,(5e)Cengage Learning, 2012
4. Harwani, *Developing Web Applications in PHP and AJAX*, (1e) McGrawHill, 2010
5. P.J. Deitel& H.M. Deitel, *Internet and World Wide Web How to program*, (4e) Pearson, 2007

CA 6105 PROGRAMMING & PROBLEM SOLVING USING C [3 1 0 4]

An overview: Algorithms & flowcharts; Characteristics of a good program. Rules/ conventions of coding, documentation, naming variables; Top down design; Bottom-up design. **Fundamentals of C Programming:** History of C; Structure of a C Program; Data types; Constant & Variable, naming variables; Operators & expressions; Control Constructs – if-else, for, while, do-while; Case switch statement; Arrays; Formatted & unformatted I/O; Type modifiers & storage classes; Ternary operator; Type conversion & type casting; Priority & associativity of operators. **Modular Programming:** Functions; Arguments; Return value; Parameter passing – call by value, call by reference; Return statement; Scope, visibility and life-time rules

for various types of variable, static variable; Calling a function; Recursion – basics, comparison with iteration, types of recursion, when to avoid recursion, examples. **Advanced Programming Techniques:** Special constructs – Break, continue, exit(), goto & labels; Pointers - & and * operators, pointer expression, pointer arithmetic, dynamic memory management functions like malloc(), calloc(), free(); String; Pointer v/s array; Pointer to pointer; Array of pointer & its limitation; Function returning pointers; Pointer to function, Function as parameter; Structure – basic, declaration, membership operator, pointer to structure. **Introduction to Data Structures:** Contiguous implementations of stack& queues, various operations on stack& queues.

References:

1. Kerninghan & Ritchie “The C programming language”, PHI
2. Schildt “C: The Complete reference” 4th ed TMH.
3. Cooper Mullish “The Spirit of C”, Jaico Publishing House, Delhi
4. Kanetkar Y. “Let us C”, BPB.
5. Tennenbaum A.M. & others: Data Structures using C & C++; PHI

CA 6106 RELATIONAL DATABASE MANAGEMENT DATABASE MANAGEMENT SYSTEMS [3 1 0 4]

Introduction: Database-System Applications, Relational Databases, Database Design, Data Storage and Querying, Transaction Management, Database Architecture; **Relational Algebra:** Fundamental Relational-Algebra Operations, Extended Relational-Algebra Operations, Null Values, Modification of the Database; **SQL:** Data Definition Language, Data manipulation language , SQL Data Types and Schemas, Integrity Constraints, Basic Structure of SQL Queries, Set Operations, Aggregate Functions, Null Values, Nested Sub-queries, Complex Queries, Views, Modification of the Database, Joined Relations, Authorization, Overview of the Design Process; **The Entity-Relationship Model:** Constraints, Entity-Relationship Diagrams, Entity-Relationship Design Issues, Weak Entity Sets, Extended E-R Features; **Normalization:** Anomalies, Referential integrity, 1NF, Functional Dependency, 2NF, 3NF, BCNF; **Hashing Techniques:** Dynamic Hashing; **Transactions:** Transaction State, Implementation of Atomicity and Durability, Concurrent Executions, Serializability, Recoverability, Implementation of Isolation, Testing for Serializability, Lock-Based Protocols, Log-Based Recovery, Recovery algorithms.

References:

1. S. Korth, *Database System Concept*, Mc-GrawHill, (6e), 2011.
2. R. Elmasri and S. Navathe, *Fundamentals of Database Systems*, (6e) Pearson Education, 2006.
3. T. Connolly, C. Begg, *Database Systems–A Practical Approach to Design, Implementation and Management*, (3e) Pearson Education, 2002.

CA 6107 OPERATING SYSTEM [3 1 0 4]

Introduction to System Programs & Operating Systems, Evolution of Operating System (mainframe, desktop, multiprocessor, Distributed, Network Operating System, Clustered & Handheld System), Operating system services, Operating system structure, System Call & System Boots, Operating system design & Implementations, System protection, Buffering & Spooling. Types of Operating System: Bare machine, Batch Processing, Real Time, Multitasking & Multiprogramming, time-sharing system. File: concepts, access methods, free space managements, allocation methods, directory systems, protection, organization ,sharing & implementation issues, Disk & Drum Scheduling, I/O devices organization, I/O devices organization, I/O buffering, I/O Hardware, Kernel I/O subsystem, Transforming I/O request to hardware operations. Device Driver: Path managements, Sub module, Procedure, Scheduler, Handler, Interrupt Service Routine. File system in Linux & Windows Process: Concept, Process Control Blocks (PCB), Scheduling criteria Preemptive & non Preemptive process scheduling, Scheduling algorithms, algorithm evaluation, multiple processor scheduling, real time scheduling, operations on processes, threads, inter process communication, precedence graphs, critical section problem, semaphores, classical

problems of synchronization. Deadlock: Characterization, Methods for deadlock handling, deadlock prevention, deadlock avoidance, deadlock detection, recovery from deadlock, Process Management in Linux. Memory Hierarchy, Concepts of memory management, MFT & MVT, logical and physical address space, swapping, contiguous and non-contiguous allocation, paging, segmentation, and paging combined with segmentation. Structure & implementation of page table. Concepts of virtual memory, Cache Memory Organization, demand paging, page replacement algorithms, allocation of frames, thrashing, demand segmentation. Unit V Distributed operating system:-Types, Design issues, File system, Remote file access, RPC, RMI, Distributed Shared Memory(DSM), Basic Concept of Parallel Processing & Concurrent Programming. Case study of Unix, Linux & Windows.

References:

1. Silberschatz ,”Operating system”, Willey Pub.
2. Stuart,”Operating System Principles, Design & Applications”,Cengage Learning
3. Tannanbaum, “Modern operating system”,PHI Learning
4. Dhamdhare, ”Operating System”,TMH.
6. William stalling, “operating system” Pearson Edu.
7. Deitel & Deitel, “Operating Systems”, Pearson Edu.
8. Flynn & Mchoes, “Operating Systems”, Cengage Learning
9. Haldar, “Operating System”, Pearson Edu.

CA 6130 WEB TECHNOLOGY LAB [0 0 2 1]

Implement forms using HTML, Frames and CSS. Use of XML Tags, PHP : Use of basic syntax of PHP, decision and looping with examples, PHP and HTML, Arrays, Functions, Browser control and detection, string, Form processing, Files, Advance Features: Cookies and Sessions, Object Oriented Programming with PHP, PHP and MySQL : Basic commands with PHP examples, Connection to server, creating database, selecting a database, listing database, listing table names, creating a table, inserting data, altering tables, queries, deleting database, deleting data and tables, PHP myadmin and database bugs.

References:

1. R. Moseley & M. T. Savaliya, *Developing Web Applications*, (2e) Wiley-India, 2013
2. Team at Kogent Learning Solutions Inc., *Web Technologies, Black Book*, (1e) Dreamtech Press, 2009
3. Team at Kogent Learning Solutions Inc., *HTML 5, Black Book*, (2e) Dreamtech Press, 2011
4. J. Sklar, *Web Design Principles*, (5e) Cengage Learning, 2012
5. Harwani, *Developing Web Applications in PHP and AJAX*, (1e) McGrawHill, 2010
6. P.J. Deitel& H.M. Deitel, *Internet and World Wide Web How to program*, (4e) Pearson, 2007

CA 6133 PROGRAMMING & PROBLEM SOLVING USING C LAB [0 0 2 1]

Simple C Programs (expression oriented operations); Programs to illustrate various operators in C. Programs using branching constructs (if, if-else-if, switch-case); Programs using looping constructs (for, while, do-while, continue, break) ; Programs on 1D Arrays; Programs on 2D Arrays; Programs on strings; Programs using functions (with and without recursion), passing parameters by value and reference. Operations on Stacks: Push, Pop, Queues.

References:

1. Kerninghan & Ritchie “The C programming language”, PHI
2. 2. Schildt “C:The Complete reference” 4th ed TMH.
3. 3. Cooper Mullish “The Spirit of C”, Jaico Publishing House, Delhi
4. 4. Kanetkar Y. “Let us C”, BPB.
5. 5. TennenBaum A.M. & others: Data Structures using C & C++; PHI

CA 6134 RELATIONAL DATABASE MANAGEMENT SYSTEMS LAB [0 0 2 1]

Experiments on DDL and Basic SQL, Advanced SQL, ER diagrams using DIA tool, Data Integrity Constraints and Built-in Functions, Design and Implementing the data requirements of a simple DB application, Experiments on Basic PL/SQL, PL/SQL Exceptions and Transactions, PL/SQL Cursors, PL/SQL Procedures, Functions and Packages, Project (DB application development with Java as front end).

References:

1. S. Korth, *Database System Concepts*, (6e) Mc-GrawHill, 2011.
2. R. Elmasri and S. Navathe, *Fundamentals of Database Systems*, (6e) Pearson Education, 2009.

Second Semester

MA 6206 GRAPH THEORY AND APPLICATIONS [3 1 0 4]

Graphs: Introduction, Isomorphism, Sub graphs, Walks, Paths, Circuits, Connectedness, Components, Euler graphs, Hamiltonian paths and circuits, Trees, Properties of trees, Distance and centers in tree, Rooted and binary trees. **Trees, Connectivity & Planarity** Spanning trees, Fundamental circuits, Spanning trees in a weighted graph, cut sets, Properties of cut set, all cut sets, Fundamental circuits and cut sets, Connectivity and separability, Network flows: Isomorphism, Combinational and geometric graphs, Planer graphs, Different representation of a planer graph. **Matrices, Coloring and Directed Graph.** Chromatic number, Chromatic partitioning, Chromatic polynomial, Matching, Covering, Four color problem, Directed graphs, Types of directed graphs, Digraphs and binary relations, Directed paths and connectedness, Euler graphs. **Permutations & Combinations:** Fundamental principles of counting, Permutations and combinations, Binomial theorem, combinations with repetition, Combinatorial numbers, Principle of inclusion and exclusion, Derangements, Arrangements with forbidden positions.

References:

1. N. Deo, *Graph Theory: With Application to Engineering and Computer Science*, (New Edition) Prentice Hall of India, (1e), 2003.
2. R.P. Grimald *Discrete and Combinatorial Mathematics: An Applied Introduction*, (5e) Addison Wesley, 2003.

CA 6202 DESIGN AND ANALYSIS ALGORITHMS [3 1 0 4]

Introduction to Data structures: Linked list, Trees, Graphs and operations on it, **Algorithm Analysis:** A priori and a posteriori Analysis, Time Space Tradeoff, Asymptotic Notations, Properties of asymptotic notations, Recurrence equations, Solving recurrence equations using Substitution method and Master's method, **Divide and Conquer:** Binary Search, Merge Sort, Quick Sort, Matrix Multiplication, **Greedy Algorithms:** Knapsack Problem, Job Sequencing with deadline, Optimal Merge Pattern, Single Source Shortest Path, Minimum Cost Spanning tree; **Dynamic Programming:** Multistage Graphs, Matrix Chain Multiplication, All-Pair shortest paths, Optimal binary search trees, 0/1 Knapsack, Travelling salesperson problem, Graph Traversals, Connected Components, Bi-connected components

References:

1. E. Horowitz, S. Sahni and S. Rajasekaran, *Computer Algorithms*, (2e), University Press, 2007.
2. T. H. Cormen, C. E. Leiserson, R. L. Rivest, and C. Stein, *Introduction to Algorithms*, (3e), MIT press, 2009.
3. Horowitz and Sahini, *Fundamental of Computer Algorithms*, (2e) Galgotia Publications, 2008

CA 6203 COMPUTER NETWORKS AND PROTOCOLS [3 1 0 4]

Network introduction: Classful addressing, other issues, Subnetting Classless addressing, variable length blocks, Subnetting, address allocation, Network Address Translation. Encapsulation, operation Data Link Layer: ARP package & RARP- Introduction, packet format Encapsulation, RARP server datagram , fragmentation , options, checksum, Network Layer: IP Package Types of messages, message format, error reporting, Query, Checksum, Debugging tools; Transport Layer: Process to process communication, User datagram, checksum, UDP operation UDP package Introduction, TCP services, TCP features, segment, TCP connection, State transition diagram, Flow control, Error control, Congestion control, TCP timers, options, TCP package; TCP Variants: SCTP services, SCTP features, packet format, association, state transition diagram, flow control, error control, congestion control, TCP RENO, Dynamic routing protocols : RIP,OSCF & BGP; Domain name Space (Application Layer): Name space, distribution of name space, DNS in the internet, resolution, DNS messages, controlling the server, out of band signaling, escape character. Transition from IPv4 to IPv6. Introduction to VLAN concept, Wireless Network protocols: WAP Architecture introduction. Introduction to MANET & VANET

References:

1. W. R Stevens, *TCP/IP Illustrated, Volume 1: The Protocols*, (2e) Addison-Wesley, 1994.
2. P. Loshin, *IPV6 Clearly Explained*, (4e) Morgan Kauffman, 2003.
3. C. E. Perkins, *Mobile IP Design Principles and Practices*, (1e) Addison-Wesley, 2008.
4. B. A. Forouzan, *TCP/IP Protocol Suite*, (2e) TMH, 2005.

CA 6204 OBJECT ORIENTED PROGRAMMING USING JAVA [3 1 0 4]

Introduction to Object Oriented Programming. Applets & AWT: Applet Architecture, Handling Events, HTML Applet Tag, User Interface Components, Building, User Interface with AWT, Class Hierarchy, Layouts and Layout Manager, Container. Swing: Concepts of Swing, Java Foundation Class (JFC), Swing Packages and Classes, Working with Swing, Swing Components. JSP and Servlets: Java Server Pages (JSP) – Introduction, What is needed to write JSP based web application? How does JSP look? How to test a JSP? Servlets – Introduction, History of Web Application, Web Architecture, Servlet Life Cycle. JDBC: Database Management; Mechanism for connecting to a back end database; Loading the ODBC driver. Networking: Networking in Java; URL Objects.

Reference

1. H. Schildt, *The Complete Reference Java Eight Edition*, (8e) Tata McGraw-Hill, reprint 2011.
2. S. Holzner, *Java 2 programming black book*, (5e) Dream Tech, New Delhi, reprint: 2005.

CA 6232 COMPUTER NETWORKS AND PROTOCOLS LAB [0 0 2 1]

IPv4 addressing – Classful, CIDR, subnetting and Super netting, Switch and Router Introduction, Switch and Router's Components, Switch and Routers basic configuration commands, IOS User modes- User mode and Privileged mode, Dynamic configuration, Static and Dynamic Routing protocol, OSPF, VLAN, Network Address Translation. Flow control protocols, error detection and correction techniques, Bit stuffing and character stuffing. Implementation of link state routing protocol, distance vector routing protocol and other routing protocols. TCP and UDP socket programming.

References:

1. W. R Stevens, *TCP/IP Illustrated, Volume 1: The Protocols*, (1e) Addison-Wesley, 1994.
2. P. Loshin, *IPV6 Clearly Explained*, (2e) Morgan Kauffman, 2003.
3. C. E. Perkins, *Mobile IP Design Principles and Practices*, (2e) Addison-Wesley, 1998.
4. B. A. Forouzan, *TCP/IP Protocol Suite*, (3e), TMH, 2005.

CA 6233 OBJECT ORIENTED PROGRAMMING USING JAVA LAB [0 0 2 1]

Control statements and arrays, Stacks and Lists, Strings, Classes and methods, Inheritance, Packages, Interfaces, Exception Handling, Threads, Input/Output, Network Programming, Event Handling, Applets, involving Swing, AWT Applications, Programs involving Swing, JSP and Servlets

References:

1. P.Radhak, *Object Oriented Programming Through Java*, (1e), Universities Press, 2006
2. H. Schildt, *The Complete Reference Java Eight Edition*, (8e) Tata McGraw-Hill, reprint 2011.
3. S. Holzner, *Java 2 programming black book*, (5e) Dream Tech, New Delhi, reprint: 2005.

Program Elective-I

CA 6240 DATA SCIENCE [3 0 0 3]

Introduction to core concepts and technologies: Introduction, Terminology, data science process, data science toolkit, Types of data, Example applications. Data collection and management (ETL): Introduction, Sources of data, Data collection and APIs, Exploring and fixing data, Data storage and management, Using multiple data sources, Data analysis: Introduction, Terminology and concepts, Introduction to statistics, Central tendencies and distributions, Variance, Distribution properties and arithmetic, Samples/CLT, Basic machine learning algorithms, Linear regression, SVM, Naive Bayes. Data visualization: Introduction, Types of data visualization, Data for visualization: Data types, Data encodings, Retinal variables, mapping variables to encodings, Visual encodings. Applications of Data Science: Technologies for visualization, Bokeh (Python) Recent trends in various data collection and analysis techniques, various visualization techniques, application development methods of used in data science.

References:

1. Cathy O'Neil and Rachel Schutt. *Doing Data Science, Straight Talk From The Frontline*, .O'Reilly, 2e, 2017
2. Jure Leskovek, AnandRajaraman and Jeffrey Ullman. *Mining of Massive Datasets. v2.1*, Cambridge University Press, (2e), 2016

CA 6243 CRYPTOGRAPHY AND NETWORK SECURITY [3 0 0 3]

Elements of Number Theory : Euclid Algorithm, Prime Number Theorem, Euler's, Fermat's Little theorems, Entropy ; Classical Cipher Techniques: Caesar, Affine, Mono-alphabetic, Transposition, Polyalphabetic Ciphers; Security Attacks: Active V/S Passive, Security Services; Symmetric Encryption: Fiestel Cipher, Confusion and Diffusion, DES Algorithm; Asymmetric Encryption: Principles of Public Key Cryptosystems, RSA Algorithm; Message Authentication & Hashing; Digital Signatures: RSA Based, El-Gamal Signatures; Key distribution; User Authentication Protocols; E-Mail Security: PGP, S/MIME; IPsec: AH & ESP; SSL; TLS; Intrusion Detection: Statistical Anomaly Detection, Rule based detection, honeypots; Password Protection.

References:

1. S. Williams, *Cryptography and Network Security: Principles and Practices*, (6e) Pearson Education, 2013.
2. A. Kahate, *Cryptography and Network Security*, (4e) Tata Mc-Graw Hill, 2019
3. K. Charlie, *Network Security: Private Communication in a Public World*, (2e), Pearson Education, 2016.
4. V. Bagad, I. Dhotre, *Cryptography and Network Security*, (2e), Technical Publications, 2008.
5. B.A. Forouzan, *Network Security*, (3e), Tata Mc-Graw Hill, 2011.

CA 6244 CLOUD COMPUTING & CLOUD INFRASTRUCTURE SERVICES [3 0 0 3]

Introduction to Clouds and Cloud Computing: Basic Concepts, Cloud Classifications, and Types of Services, deployment models; Classic Data Center (CDC): DBMS concepts, CDC drawbacks and need of Cloud Resources, CDC Management and case studies; Virtualized Data Center (VDC): Compute and Storage, Compute virtualization overview, Compute virtualization techniques, Virtual Machines, VM Resource management techniques, Physical to virtual conversion, Hypervisor Management Software, Virtual Infrastructure Requirements; Storage: Storage virtualization overview, Virtual Machine Storage, Block level and File level virtualization, Virtual provisioning and automated storage tiering; Networking: VDC networking overview, VDC networking components, VLAN and VSAN technologies, Network traffic management Desktop and Application: Desktop virtualization, Application virtualization, Business Continuity in VDC, Fault tolerance mechanism in VDC, Backup in VDC, Replication and migration in VDC, Cloud Security: Security basics, Cloud security concerns and threats, Cloud security mechanisms, Access control and identity management in Cloud

References:

1. Miller M, *Cloud Computing, (8e)*, Que Publishers 2008.
2. Buyya R K, *Cloud Computing: Principles and Paradigms*, Wiley Press, (1e), 2011.
3. K Saurabh, *Cloud Computing, (2e)*, Wiley India, 2017
4. V Joysula, M Orr, G Page, *Cloud Computing: Automating the Virtualized Data Center*. Cisco Press, (1e), 2012.
5. Mei- Ling Liu, “*Distributed Computing: Principles and Application*”, Pearson Education, Inc. New Delhi, (1e), 2004.

Third Semester

CA 7104 UNIX & SHELL PROGRAMMING [3 1 0 4]

Introduction: UNIX System Overview, Program and Processes, Error Handling, User Identification, Signals, System Calls and Library Functions.: File I/O: File Descriptors, Function for File Modification, I/O Efficiency, File Sharing, Atomic Operations.; Directories: Stat, Fstat, and Lstat Functions, File Types, Set-User-ID and Set-Group-ID, File Access Permissions, Function for modifying file permission and ownership, Symbolic Links, System Data Files and Information: Password File, Shadow Passwords and Other Data Files.; Process Environment: Process Termination, Memory Layout of a C Program, Memory Allocation, setjmp and longjmp Functions.; Process Control: fork Function, vfork Function, exit Functions, wait and waitpid Functions, Race Conditions, Changing User IDs and Group IDs.; Process Relationship: Logins, Process Groups, Sessions, Controlling Terminal, Job Control.; Signals: Signal Concepts, Functions to raise and handle Signals, Program Termination, abort and system functions.; Threads: Thread Concepts, Creation, Termination and Synchronization, Threads Control, Threads and Signals, Threads and fork, Threads and I/O.Shell programming:Basics of Shell Programming,UNIX shell commands, shell scripts variables, loops (for, while), and conditional statements (if else, case), Shell variables, arguments to shell procedure, test command, arithmetic with EXPR command, interactive shell procedures with read.

References:

1. W. R. Steven, S. A. Rago “*Advanced Programming in the Unix environment*”, Addison Wesley, (1e), 2011
2. Y. P. Kanetkar “*Unix Shell Programming*”. BPB Publication, (1e), 2009.

CA 7105 ANDROID APPLICATION DEVELOPMENT [3 1 0 4]

Basic Concept of Mobile Operating Systems Introduction, Design Principal, Structure, platform and features of mobile operating system comparison of mobile OS to traditional OS Application life cycle Micro Kernel Design concept of MOS. Introducing Development Framework, Dalvik Virtual Machine, Android Studio IDE, Android Virtual Device and SDK Manager, Android Architecture and OOPS, Android Architecture and

OOPS, Activity Lifecycle, Activity Classes Introduction to Application Manifest, Android Layouts, Understanding Android Menus , Inter process Communication , Multithreading, JSON Parsing, SQLite Data Types , Cursors and Content Values, SQLite Open Helper, Adding, Updating and Deleting Content. Working with Android Sensor, Camera, Wi-Fi.

References:

1. John Horton, “*Android Programming for Beginner*”,Packt Publishing, (2e), 2018.
2. Dawn Griffiths , David Griffiths, “*Head First Android Development: A Brain-Friendly*”, O'Reilly Media, (2e), 2017
3. Pradeep kothari, “*Android Application Development (With Kitkat Support)*, Black Book”, WILEY, (1e) (May 20, 2014)

CA 7106 SOFTWARE ENGINEERING & PROJECT MANAGEMENT [3 1 0 4]

Introduction to Software Engineering: Software Components, Software Characteristics, Software Crisis, Software Engineering Processes; Software Development Life Cycle (SDLC) Models: Water Fall Model, Prototype Model, Spiral Model, Agile; Requirement Engineering Process: Analysis, Documentation, Review and Management of User Needs, Data Flow Diagrams, Entity Relationship Diagrams, Decision Tables, SRS Document, IEEE Standards for SRS; Basic Concept of Software Design, Architectural Design, Low Level Design Modularization, Design Structure Charts, Pseudo Codes, Flow Charts, Coupling and Cohesion Measures; Design Strategies: Function Oriented Design, Object Oriented Design, Top-Down and Bottom-Up Design; Categories of Maintenance: Preventive, Corrective and Perfective Maintenance, Cost of Maintenance, Software Re-Engineering, Reverse Engineering; The Management spectrum- (The people, the product, the process, the project), Estimation of Various Parameters such as Cost, Efforts, Schedule/Duration, Constructive Cost Models (COCOMO) and its types, SEI capability maturity model, Verification and Validation, SQA Plans, Software Quality Frameworks, ISO 9000 Models. Basics of Project Management: Introduction, Need for Project Management, Project Management Knowledge Areas and Processes, The Project Life Cycle, The Project Manager (PM), Phases of Project Management Life Cycle, Project Management Processes, Impact of Delays in Project Completions, Essentials of Project Management Philosophy, Project Management Principles.

References:

1. R. S. Pressman, *Software Engineering: A Practitioners Approach*, (3e) McGraw Hill, 2009.
2. R. Mall, *Fundamentals of Software Engineering*, (4e) PHI Publication, 2014.
3. K. K. Aggarwal and Y. Singh, *Software Engineering*, (3e) New Age International Publishers, 2008.
4. P. Jalote, *Software Engineering*, Wiley, (1e) 2010.
5. Sommerville, *Software Engineering*, Addison Wesley, (10e) 2013.

CA 7131 MINOR PROJECT [0 0 4 2]

Content of Report Writing:

1. Cover page
2. Declaration
3. Acknowledgement
4. Abstract
5. Table of Content
6. Introduction
7. Survey of Technology
8. Requirement Analysis
 - 8.1. Problem Definition
 - 8.2. Drawback of existing system
 - 8.3. Requirement Specification
 - 8.4. Feasibility Study

9. Planning and Scheduling
10. System Design
 - 10.1. Data Flow Diagram
 - 10.2. ER Diagram
 - 10.3. Data Dictionary and Data Model
 - 10.4. Schema Design
11. Coding Section
12. Screenshots of project
13. Testing
14. Limitation and Future Scope

CA 7132 UNIX & SHELL PROGRAMMING LAB [3 1 0 4]

Testing the use of UNIX commands, UNIX shell commands, Basics of Shell Programming, UNIX System Calls, CPU Scheduling Algorithms, Deadlock Detection Algorithms, Deadlock Avoidance Algorithms, Page Replacement Algorithms, Memory Allocation Algorithms, Disk Scheduling Algorithms, and UNIX Inter Process Communication.

References:

1. 1. W. R. Steven, S. A. Rago "Advanced Programming in the Unix environment", Addison Wesley, 2011
2. 2. Y. P. Kanetkar "Unix Shell Programming". BPB Publication, 2009

CA 7133 ANDROID APPLICATION DEVELOPMENT LAB [0 0 2 1]

Basic Concept of Mobile Operating Systems, setting up development environment, Dalvik Virtual Machine & .apk file extension, AndroidManifest.xml, Resources & R.java, Activities and Activity lifecycle, Launching emulator, Hello World App, switching between activities, Form widgets, Text Fields, Layouts, Option menu, Context menu, Explicit Intents, Implicit intents, Time and Date, Images, Media, ListView, ListActivity, Custom listview, Threads handling, SQLite Programming, SQLiteOpenHelper, SQLiteDatabase, XML Parsing, JSON Parsing, Using Orientation and Accelerometer sensors, Monitoring and managing Internet connectivity, Taking pictures, Media Recorder.

References:

1. John Horton, "*Android Programming for Beginner*", Packt Publishing, (2e), 2018.
2. Dawn Griffiths, David Griffiths, "*Head First Android Development: A Brain-Friendly*", O'Reilly Media, (2e), 2017
3. Pradeep kothari, "*Android Application Development (With Kitkat Support)*", Black Book", WILEY, (1e) (May 20, 2014)

Program Elective-II

CA 7146 DATA MINING AND WAREHOUSING [3 0 0 3]

Introduction: Databases, Data Warehouses, Transactional databases, advanced database system and its applications, Data mining Functionalities: Concept/Class description, Association Analysis classification & Prediction, Cluster Analysis, Outlier Analysis, Evolution Analysis, Classification of Data Mining Systems, Major Issues in Data Mining.

Data Warehouse and OLAP Technology for Data Mining: Differences between Operational Database Systems and Data Warehouses, a multidimensional Data Model, Data Warehouse Architecture, Data Warehouse Architecture, Data Warehouse Implementation, Data Cube Technology.

Data Pre-processing: Data Cleaning, Data Integration and Transformation, Data Reduction, Discretization and Concept Hierarchy Generation. Data Mining Primitives, Languages, and System Architectures, Concept Description: Characterization and Comparison, Analytical Characterization.

Mining Association Rules in Large Databases: Association Rule Mining, Market Basket Analysis, Basic Concepts, Mining Single-Dimensional Boolean Association Rules from Transactional Databases: the Apriori algorithm, Generating Association rules from frequent items, Improving the efficiency of Apriori, Mining Multilevel Association Rules, Multidimensional Association Rules, Constraint-Based Association Mining.

Classification & Prediction and Cluster Analysis: Issues regarding classification & prediction, Different Classification Methods, Prediction, Cluster Analysis, Major Clustering Methods, Applications & Trends in Data Mining: Data Mining Applications, currently available tools.

References:

1. W.H. Inmon "*Building the Datawarehouse*, (3e), Wiley India, 2016.
2. Anahory, "*Data Warehousing in Real World*", (2e), Pearson Education, 2017.

CA 7147 INTERNET OF THINGS

Internet of Things: An overview, System Architecture, Design Principles for Connected Devices, Design Principles for Web connectivity for Connected Devices, Internet Connectivity Principles, Data Acquiring, Organizing and Analytics in IoT, data Collection, Storage & Computing Using Cloud Platform, Sensors and Actuators, Radio Frequency Identification, Wireless Sensor Networks and Participatory Sensing Technology, Prototyping of Embedded Devices for IoT, Gateways, Internet and Web/Cloud Services Software Component, IoT Privacy, Security and governance. IoT based Case studies.

References:

1. Theoleyre, Fabrice, and Ai-Chun Pang, eds," *Internet of Things and M2M Communications*", River Publishers, (1e), 2013.
2. Delsing, Jerker, ed, "*IoT automation: Arrowhead framework*. CRC Press", (1e), 2017.
3. Raj Kamal, "*Internet of Things*", (1e), McGraw-Hill, 2017

CA 7148 ARTIFICIAL INTELLIGENCE [3 0 0 3]

General Issues and Overview of AI: The AI problems, what is an AI technique, Characteristics of AI applications. Introduction to LISP programming: Syntax and numeric functions, Basic list manipulation functions, predicates and conditionals, input output and local variables, iteration and recursion, property lists and arrays.

Problem Solving, Search and Control Strategies: General problem solving, production systems, control strategies forward and backward chaining, exhaustive searches depth first breadth first search. Heuristic Search Techniques Hill climbing, branch and bound technique, best first search & A* algorithm, AND / OR graphs, problem reduction & AO* algorithm, constraint satisfaction problems.

Knowledge Representations: First order predicate calculus, skolemization, resolution principle & unification, interface mechanisms, horn's clauses, semantic networks, frame systems and value inheritance, scripts, conceptual dependency.

References:

1. Munakata, T.: *Fundamentals of the New Artificial Intelligence*, Springer-Verlag New York, Inc., (1e), 1998. ISBN 0-387-98302-3
2. Cerdón, O., Herrera, F., Hoffman, F., Magdalena, L.: *Genetic Fuzzy systems*, World Scientific Publishing Co. Pte. Ltd., (1e), 2001, ISBN 981-02-4016-3
3. Kecman, V.: *Learning and Soft Computing*, The MIT Press, (1e), 2001, ISBN 0-262-11255-8
4. Mehrotra, K., Mohan, C., K., Ranka, S.: *Elements of Artificial Neural Networks*, The MIT Press, (1e), 1997, ISBN 0-262-13328-8

Program Elective-III

CA 7149 FORMAL LANGUAGE & AUTOMATA THEORY [3 0 0 3]

Mathematical Preliminaries and Notation: Three basic concepts, Some Applications, Deterministic Finite Accepters, Nondeterministic Finite Accepters, Equivalence of Deterministic and Nondeterministic Finite Accepters, Reduction of the Number of States in Finite Automata; Regular Expressions, Identifying Non-regular Languages; Context-Free grammars: Parsing and Ambiguity, Context-Free Grammars and Programming Languages, Methods for Transforming Grammars, Two important Normal Forms; Nondeterministic Pushdown Automata, Pushdown Automata and Context-Free Languages, Deterministic Pushdown Automata and Deterministic Context-Free Languages; The Standard Turing Machine: Linear Bounded Automata, Recursive and Recursively Enumerable Languages, Unrestricted Grammars, Context Sensitive grammars and Languages, The Chomsky Hierarchy.

References:

1. P. Linz, *An Introduction To Formal Languages and Automata*, (4e) Narosa Publishing House, 2006.
2. J. Martin, *Introduction to Languages and the Theory of Computation*, (3e) McGraw Hill, 2002.
3. J. Hopcroft, R. Motwani, *Introduction to Automata Theory, Languages and Computation*, (3e) Pearson Education, 2006.

CA 7150 SOFTWARE DEFINED NETWORKS [3 0 0 3]

INTRODUCTION: History of Software Defined Networking (SDN) – Modern Data Center – Traditional Switch Architecture – Why SDN – Evolution of SDN – How SDN Works – Centralized and Distributed Control and Data Planes. OPEN FLOW & SDN CONTROLLERS: Open Flow Specification – Drawbacks of Open SDN, SDN via APIs, SDN via Hypervisor-Based Overlays – SDN via Opening up the Device – SDN Controllers – General Concepts. DATA CENTERS: Multitenant and Virtualized Multitenant Data Center – SDN Solutions for the Data Center Network – VLANs – EVPN – VxLAN – NVGRE. SDN PROGRAMMING: Programming SDNs: Northbound Application Programming Interface, Current Languages and Tools, Composition of SDNs – Network Functions Virtualization (NFV) and Software Defined Networks: Concepts, Implementation and Applications

References:

1. Paul Goransson and Chuck Black, *Software Defined Networks: A Comprehensive Approach*, First Edition, Morgan Kaufmann, (1e), 2014.
2. Thomas D. Nadeau, Ken Gray, *SDN: Software Defined Networks*, O'Reilly Media, (1e), 2013.
3. Siamak Azodolmolky, *Software Defined Networking with Open Flow*, Packet Publishing, (1e), 2013.
4. Vivek Tiwari, *SDN and Open Flow for Beginners*, Amazon Digital Services, Inc., (1e), 2013.
5. Fei Hu, Editor, *Network Innovation through Open Flow and SDN: Principles and Design*, CRC Press, (1e), 2014.

CA 7151 DISTRIBUTED SYSTEMS [3 0 0 3]

Introduction: Distributed System, Goal of Distributed System, System Architecture, Distributed Computing Model, Advantages and Disadvantages, Design Issues. Distributed Shared Memory (DSM): Definition & Architecture, File Model and their Architecture, Access Model, File Applications. Inter Process Communications: Client Server Communication, RPC and their Architecture, Synchronization, Mutual Exclusion, Internet Protocol API. Distributed Scheduling: Issues and their Components, Types, Algorithm. Deadlock Distributed Scheduling: Issues in Deadlock Detection & Resolution, Deadlock Handling Strategy and Algorithm. Multimedia & Database: Multimedia Data, Quality of Service Managements, Types of Distributed Database and their Characteristics.

References:

1. Jean Dollimore, Tim Kindberg, George Coulouris, *Distributed Systems: Concepts and Design*, 4th Edition, Addison Wesley, 2005.
2. A. Taunenbaum, *Distributed Systems: Principles and Paradigms*, 2(e), 2008
3. G. Coulouris, J. Dollimore, and T. Kindberg, *Distributed Systems: Concepts and Design*, Pearson Education, (1e) 2008

Fourth Semester

CA 7270 MAJOR PROJECT [0 0 0 24]

Each student shall carry out a major project in the sixth semester. The project will be carried out under the supervision of a teacher of the department. When the project is carried out in an external organization (academic institution/ industry), a supervisor will also be appointed from the external organization. The project work will be evaluated jointly by the internal supervisor and an examiner to be appointed by the department in consultation with the internal supervisor. The major project shall carry 100 marks distributed as follows: Dissertation: 50% weightage Viva-voce: 50% weightage.

Project Report Formulation:

1. Original copy of the Approved Proforma and Project Proposal
2. Bio-data of the guide with her/his signature and date
3. Certificate of Originality
4. Project documentation
 - a) Cover page
 - b) Declaration
 - c) Acknowledgement
 - d) Abstract
 - e) Table of Content
 - f) Introduction
 - g) Survey of Technology
 - h) Requirement Analysis
 - 8.1. Problem Definition
 - 8.2. Drawback of existing system
 - 8.3. Requirement Specification
 - 8.4. Feasibility Study
 - i) Planning and Scheduling
 - j) System Design
 - 10.1. Data Flow Diagram
 - 10.2. ER Diagram
 - 10.3. Data Dictionary and Data Model
 - 10.4. Schema Design
 - k) Coding Section
 - l) Screenshots of project
 - m) Testing
 - n) Limitation and Future Scope
5. A CD consisting of the executable file(s) of the complete project should be attached on the last page of the project report. In no case, it should be sent separately.