

**SANJEEV AGRAWAL GLOBAL EDUCATIONAL (SAGE)
UNIVERSITY, BHOPAL**

Scheme & Syllabus

for

Master of Computer Application (MCA) - Cloud Computing

With iNurture



School of Computer Application

2021-22 Batch Onwards

Program Educational Objectives (PEOs)

PEO-1: To prepare the graduates as leading professionals in government, academia, corporate, and research organizations along with entrepreneurial pursuits.

PEO-2: To prepare graduates with an ability to articulate and solve problems in the field of Computer Applications specifically in Cloud Computing.

PEO-3: To prepare the graduates with strong learning quotients having adaptability to the constantly changing technological environment.

PEO-4: To prepare the graduates to lead and initiate ethically the professional and organizational goal in the area of specialization and develop innovative and research-oriented methodology to solve the complex problems.

PEO-5: To prepare the graduates towards Application Development and thus has more emphasis on latest programming language and tools to develop better and faster applications.

Program Outcomes (POs):

PO-1: Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2: Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4: Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5: Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6: The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7: Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9: Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10: Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11: Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12: Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Curriculum Components

Components	Credits
Core Courses (14 Courses)	50
Program Elective(02Courses)	8
Skill Enhancement Courses (02 courses)	8
Project Based Learning (02 courses)	4
Project (02 Courses)	20
Total	90

Master of Computer Application (MCA) - Cloud Computing

First Semester																
Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration (Hours)	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
CA21M101	Elements of Computer Networking	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M102	Distributed Operating System	3	-	-	3	3	30	5	5	10	50	100	-	-	-	100
CA21M103	Advanced Data Structures	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M104	Advanced Database Management Systems	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M105	Cloud Computing Tools and Techniques	3	-	-	3	3	30	5	5	10	50	100	-	-	-	100
CA21M106	Linux Administration	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
PB20M101	Project Based Learning-I	-	-	4	2	2	-						50^	50	100	100
		Total			24										900	

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-EndSemester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Master of Computer Application (MCA) - Cloud Computing

Semester Second

Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration (Hours)	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
CA21M201	Advanced Java Programming	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M202	Web Technologies	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M203	Software Engineering Concepts and Methodologies	3		-	3	3	30	5	5	10	50	100	-	-	-	100
CA21M204	Algorithm Design and Analysis	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M205	Fundamentals of Storage and Datacenter Architecture	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M206	Exploring Software as a Service (SaaS)	3	-	-	3	3	30	5	5	10	50	100	-	-	-	100
PB20M201	Project Based Learning-II	-	-	4	2	2							50^	50	100	100
		Total			24											900

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-EndSemester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Master of Computer Application (MCA) - Cloud Computing

Third Semester

Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration (Hours)	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
CA21M301	Windows Administration	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M302	Principles of Virtualization	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M303	Cloud Web Services	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
CA21M304	Infrastructure Solutions of Cloud	3	-	2	4	3	30	5	5	10	50	100	20	30	50	150
Table-I	DSE-I	2	-	2	3	3	30	5	5	10	50	100	20	30	50	150
Table-I	DSE-II	3	-	-	3	3	30	5	5	10	50	100				100
PB20M301	Project	-	-	8	4	2	-						100^	100	200	200
		Total			26											1050

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-EndSemester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Master of Computer Application (MCA) - Cloud Computing

Fourth Semester

Course Code	Course Title	Contact Hours per Week			Credits	ESE Duration (Hours)	Theory						Practical			GT
		L	T	P			MSE	ASG	TA	ATTD	ESE	Tot	CE	ESE	Tot	
PB20M401	Final Project/ Internship	-	-	40	20	3							300^	200	500	500
		Total			20											500

L-Lecture, T-Tutorial, P-Practical, MSE- Mid Semester Exam, ASG- Assignment, TA- Teacher's Assessment, ATTD-Attendance, CE-Continuous Evaluation, ESE-EndSemester Exam, Tot-Total, GT-Grand Total, ^- 02 assessment by panel of Experts

Distribution of credits across all components

SEM No.	Core Courses	Program Elective	Skill Enhancement Courses	Project Based Learning	Project	Total Credit
I.	18	-	4	2	-	24
II.	22	-	-	2	-	24
III.	10	8	-		4	26
IV.	-	-	4		16	20
Total	50	8	8	4	20	94

Table-I
List of Discipline Specific Electives

DSE-I		
S.No	Course Code	Course Name
1.	CA21M305	Automation and Configuration Management
2.	CA21M306	Enterprise Networking
DSE-II		
S.No	Course Code	Course Name
1.	CA21M307	Hybrid Cloud Computing
2.	CA21M308	Cloud Migration

COURSE CODE	ELEMENTS OF COMPUTER NETWORKING	Total Lecture:60 Theory:45 Practical:15
CA21M101	(LTP =3 – 0 – 2 = 4)	
Course Objectives: <ul style="list-style-type: none"> • To understand IP addressing IPv4 and IPv6. • To learn OSI reference Model and TCP/IP Protocol Suite. • To apply and use components of Cisco Router and Catalyst Switches. • To Configure Layer 2 Switching Protocols. • To provide Network Security using Routers. 		
UNITS	CONTENTS	HOURS
I.	Networking Fundamentals The TCP/IP and OSI Networking Models, Compare and contrast TCP and UDP protocols, Describe the impact of infrastructure components in an enterprise network, IPv4 addressing, IPv4 Subnetting, Difference between IPv4 and IPv6 Addressing, IPv6 Address types. Implementing tunneling for IPv6- Case Study.	9
II.	Network Device Management The IOS User Interface, Command-Line Interface (CLI), Router and Switch Administrative Configurations, Router Interfaces, Viewing, Saving, and Erasing Configurations, The Internal Components of a Cisco Router, The Router Boot Sequence, Managing Configuration Register, Backing Up and Restoring the Cisco IOS, Backing Up and Restoring the Cisco Configuration, Using Cisco Discovery Protocol (CDP), Using Telnet, Resolving Hostnames- Case Study	9
II.	IP Routing Routing Basics The IP Routing Process Configuring IP Routing in Our Network Dynamic Routing Distance-Vector Routing Protocols Routing Information Protocol (RIP), EIGRP Features and Operation, EIGRP to Support Large Networks, Configuring EIGRP, Load Balancing with EIGRP, Verifying EIGRP, Open Shortest Path First (OSPF) Basics, Configuring OSPF, Verifying OSPF Configuration, OSPF DR and BDR Elections, OSPF and Loopback Interfaces Troubleshooting OSPF, Configure single area and multi area OSPFv3 for IPv6, Configuring EIGRP and OSPF Summary Routes- Case Study	8
V.	Layer 2 Switching Before Layer 2 Switching, Switching Services, Spanning Tree Protocol (STP), Configuring Catalyst Switches, VLAN Basics VLAN Memberships Identifying VLANs VLAN Trunking Protocol (VTP) Routing between VLANs Configuring VLANs Configuring VTP, Configure, verify, and troubleshoot port security-Case Study.	10
V.	Network Security Perimeter, Firewall and Internal Routers, Introduction to Access Lists, Standard Access Lists, Extended Access Lists, Turning Off and Configuring Network Services, Monitoring Access Lists, Introduction to NAT, Types of Network Address Translation, How NAT Works, Testing and Troubleshooting NAT, Configure and verify PPP and MLPPP on WAN interfaces using local authentication, Configure PPPoE client-side interfaces using local authentication, Configure GRE tunnel connectivity, Describe WAN topology options, Describe WAN access connectivity options- Case Study. Experiments <ol style="list-style-type: none"> 1. Switch Configuration - Basic Commands and Switch Port Security. 2. Router – Configuration and Setting up of Passwords. 	9

	<ol style="list-style-type: none"> 3. Configuration of default, Static and Dynamic Routing. 4. VLAN Configuration. 5. Design and analyze network with router, Switch and Hub to find the number of broadcast domains and collision domain using packet tracer. 6. Configure wireless network for adhoc and infrastructure mode. 7. Configure point to site and site to site VPN. 8. Perform network troubleshooting using ping, traceroute, tracert, ipconfig, arp, nslookup, netstat, nbtstat. 9. Configuration of Access-lists - Standard & Extended ACLs. 10. Configuring Logging to a Remote Syslog Server. 	
Course Outcomes (CO)		
At the end of the course the students will be able to:		
CO1	Analyze⁴ the requirements for a given organizational structure and select the most appropriate networking architecture and technologies.	
CO2	Analyze⁴ the services and features of various protocol layers in data networks.	
CO3	Find¹ the different internet devices and their functions.	
CO4	Identify¹ the basic security threats of a network.	
CO5	Analyze⁴ specify and design the topological and routing strategies for an IP based networking infrastructure.	
Text Books	<ul style="list-style-type: none"> • Lammle, T. (2016). CCNA Routing and Switching Complete Study Guide: Exam 100-105, Exam 200-105, Exam 200-125. John Wiley & Sons. • Johnson, A., & Press, C. (2014). CCNA Routing and Switching Practice and Study Guide. 	

COURSE CODE	DISTRIBUTED OPERATING SYSTEM	Total Lecture:60 Theory:45 Practical:15
CA21M102	(LTP =3 – 0 – 2 = 4)	
Course Objectives: This course introduces the fundamentals of distributed computersystems, assuming the availability of facilities for data transmission. Characterize different implementation paradigms for distributed systems.		
UNITS	CONTENTS	
I	Introduction & Message Passing Introduction of Unit, Definition of Distributed system, Distributed computing System Models, Difference between DOS & NOS, Issues in Designing DOS, Advantages of DOS, Features of Message Passing System, Issues in IPC, Synchronization & Buffering, Process Addressing & Failure Handling, Group Communication, Conclusion of Unit.	
II	Remote Procedure Calls: Introduction of Unit, RPC Models, Transparency of RPC, Stub Generation, RPC Messages & Marshalling Arguments, Call Semantics & Complicated RPC, Client Server Binding, Mutual Exclusion & Deadlock, Election Algorithms, Conclusion of Unit.	
III	Resource Management Introduction of Unit, Features of Global Scheduling Algorithms, Task Assignment, Load Balancing, Load Sharing, Conclusion of Unit	
IV	Process Management Introduction of Unit, Process Migration, Threads, Conclusion of Unit	
V	Distributed File Management Introduction of Unit, Features of DFS, File Models, File Accessing Models, File Sharing Semantics, File Replication, Fault Tolerance, Conclusion of Unit	
Course Outcomes (CO)		
At the end of the course the students will be able to:		
CO1	Analyze⁴ distributed architecture, naming, synchronization, consistency and replication, fault tolerance, security, and distributed file systems	
CO2	Understand² Distributed Computing techniques, Synchronous and Processes.	
CO3	Understand² Process Migration and the concept of Threads	
CO4	Identify¹ Resource management-based Scheduling Algorithms.	
CO5	Analyze⁴ Distributed File Systems and Distributed Shared Memory.	
Text Books	<ul style="list-style-type: none"> Sinha, P. K., & Gahlaut, A. (2011). Distributed operating system: Concepts and design author publisher edition no. of pages price. 	

COURSE CODE	ADVANCED DATA STRUCTURES	Total Lecture: 60 Theory: 45 Practical: 15
CA21M103	(LTP = 3– 0–2 = 4)	
Course Objectives:		
<ul style="list-style-type: none"> • The student should be able to choose appropriate data structures, understand the ADT/libraries, and use it to design algorithms for a specific problem. • Students should be able to understand the necessary mathematical abstraction to solve problems. • To familiarize students with advanced paradigms and data structure used to solve algorithmic problems. • Student should be able to come up with analysis of efficiency and proofs of correctness. 		
UNITS	CONTENTS	HOURS
I.	Dictionaries and Hashing Definition, Dictionary Abstract Data Type, Implementation of Dictionaries. Hashing: Review of Hashing, Hash Function, Collision Resolution Techniques in Hashing, Separate Chaining, Open Addressing, Linear Probing, Quadratic Probing, Double Hashing, Rehashing, Extendible Hashing.	5
I.	Skip Lists Need for Randomizing Data Structures and Algorithms, Search and Update Operations on Skip Lists, Probabilistic Analysis of Skip Lists, Deterministic Skip Lists.	10
I.	Trees: Binary Search Trees, AVL Trees, Red Black Trees, 2-3 Trees, B-Trees, Splay Trees.	10
V.	Text Processing String Operations, Brute-Force Pattern Matching, The Boyer- Moore Algorithm, The Knuth-Morris-Pratt Algorithm, Standard Tries, Compressed Tries, Suffix Tries, The Huffman Coding Algorithm, The Longest Common Subsequence Problem (LCS), Applying Dynamic Programming to the LCS Problem	10
V.	Computational Geometry: One Dimensional Range Searching, Two-Dimensional Range Searching, constructing a Priority Search Tree, Searching a Priority Search Tree, Priority Range Trees, Quad trees, k-D Trees. Recent Trends in Hashing, Trees, and various computational geometry methods for efficiently solving the new evolving problem. List of Experiments: 1. Write Java programs that use both recursive and non-recursive functions for implementing the following searching methods: a) Linear search b) Binary search 2. Write Java programs to implement the following using arrays and linked lists a) List ADT 3. Write Java programs to implement the following using an array. a) Stack ADT b) Queue ADT 4. Write a Java program that reads an infix expression and converts the expression to postfix form. (Use stack ADT). 5. Write Java programs to implement the following using a singly linked list. a) Stack ADT b) Queue ADT 6. Write a Java program to implement priority queue ADT. 7. Write a Java program to perform the following operations: a) Construct a binary search tree of elements. b) Search for a key element in the above binary search tree. c) Delete an element from the above binary search tree. 8. Write a Java program to implement Dijkstra's algorithm for Single source shortest path problem.	10

	<p>9. Write Java programs for implementing the following sorting methods: a) Bubble sort d) Merge sort g) Binary tree sort b) Insertion sort e) Heap sort c) Quick sort f) Radix sort</p> <p>10. Write a Java program to perform the following operations: a) Insertion into a B-tree b) Searching in a B-tree</p> <p>11. Write a Java program that implements Kruskal's algorithm to generate minimum cost spanning tree.</p> <p>12. Write a Java program that implements KMP algorithm for pattern matching.</p>	
Course Outcomes (CO)		
At the end of the course the students will be able to:		
CO 1	Understand² the implementation of symbol table using hashing techniques.	
CO 2	Develop⁶ and analyse algorithms for red-black trees, B-trees and Splay trees.	
CO 3	Develop⁶ algorithms for text processing applications.	
CO 4	Identify³ suitable data structures and develop algorithms for computational geometry problems.	
CO 5	Discuss⁶ various computational geometry like k-D trees.	
Text Books	<ul style="list-style-type: none"> Brass, P. (2008). Advanced data structures (Vol. 193). Cambridge: Cambridge University Press. Drozdek, A. (2012). Data Structures and algorithms in C++. Cengage Learning. 	
Reference Books	<ul style="list-style-type: none"> Weiss, M. A. (1995). Data structures and algorithm analysis. Benjamin-Cummings Publishing Co., Inc.. Goodrich, M. T., & Tamassia, R. (2006). Algorithm design: foundation, analysis and internet examples. John Wiley & Sons. 	

COURSE CODE	ADVANCED DATABASE MANAGEMENT SYSTEMS	Total Lecture:60 Theory:45 Practical:15
CA21M104	(LTP= 3 – 0-2 = 4)	
Course Objectives:		
<ul style="list-style-type: none"> To provide an introduction to the management of database systems. To emphasizes the understanding of the fundamentals of relational systems including data models, database architectures, and database manipulations. To provide an understanding of new developments and trends such as Internet database environment and data warehousing. 		

- To learn database problem-based approach.

UNITS	CONTENTS	HOURS
I.	<p>Comparison between different databases, RDBMS and SQL Significance of Databases, Database System Applications, Advantages and Disadvantages of different Database Management systems, Comparison between DBMS, RDBMS, Distributed and Centralized DB. RDBMS and SQL: Relational Query Languages, The SQL Query Language, Querying Multiple Relations, Creating Relations in SQL, Destroying and Altering Relations, Adding and Deleting Tuples, Integrity Constraints (ICs), Primary and Candidate Keys in SQL, Foreign Keys, Referential Integrity in SQL, Enforcing Referential Integrity, Categories of SQL Commands, Data Definition, Data Manipulation Statements: SELECT - The Basic Form Subqueries, Functions, GROUP BY Feature, Updating the Database, Data Definition Facilities, Views, Embedded SQL *, Declaring Variables and Exceptions, Embedding SQL Statements, Transaction Processing, Consistency and Isolation, Atomicity and Durability, Dynamic SQL.</p>	8
I.	<p>Normalization and Query Optimization: Functional Dependency, Anomalies in a Database, The normalization process: Conversion to first normal form, Conversion to second normal form, Conversion to third normal form, The boyce-code normal form(BCNF), Fourth Normal form and fifth normal form, normalization and database design, Denormalization Query Optimization: Algorithm for Executing Query Operations: External sorting, Select operation, Join operation, PROJECT and set operation, Aggregate operations, Outer join, Heuristics in Query Optimization, Semantic Query Optimization, Converting Query Tree to Query Evaluation Plan, multiquery optimization and application, Efficient and extensible algorithms for multi-query optimization, execution strategies for SQL sub queries, Query Processing for SQL Updates Query Execution: Introduction to Physical-Query-Plan Operators, One-Pass Algorithms for Database, Operations, Nested-Loop Joins, Two-Pass Algorithms Based on Sorting, Two-Pass, Algorithms Based on Hashing, Index-Based Algorithms, Buffer Management, Parallel Algorithms for Relational Operations, Using Heuristics in Query Optimization, Basic Algorithms for Executing Query Operations.</p>	10
I.	<p>Adaptive Query Processing and Query Evaluation: Query processing mechanism: eddy , eddy architecture , how eddy allows for extreme flexibility , properties of query processing algorithms, why adaptive query processing is needed, , where it is most appropriately used, Hardware and Workload Complexity , User Interface Complexity, Data Complexity, Synchronization Barriers in query processing, Robust Query Processing through Progressive Optimization. query evaluation techniques for large databases, Query evaluation plans Concurrency Control Serializability: Enforcing, Serializability by Locks, Locking Systems With Several, Lock Modes, Architecture for a Locking Scheduler Managing Hierarchies of Database Elements, Concurrency Control by Timestamps, Concurrency Control by Validation, Database recovery management. Transaction processing: Introduction of transaction processing, advantages and disadvantages of transaction processing system, online transaction processing system, serializability and recoverability, view serializability, resolving deadlock, distributed locking. Transaction management in multi-database system, long duration transaction, high-performance transaction system.</p>	7
V.	<p>Parallel Database Architectures and Object Oriented DBMS Parallel Database Architectures for parallel databases: Parallel query evaluation, Parallelizing individual operations, I/O Parallelism, Interquery Parallelism, Intraquery Parallelism, Intraoperation Parallelism, Interoperation Parallelism, Design of Parallel Systems. Object Oriented DBMS Overview of object: oriented paradigm, OODBMS architectural approaches, Object identity, procedures and encapsulation, Object oriented data model: relationship, identifiers, Basic OODBMS terminology, Inheritance, Basic interface and class structure, Type hierarchies and inheritance, Type extents and persistent programming languages, OODBMS storage issues.</p>	10

	DDB: Distributed Database Introduction of DDB, DDBMS architectures, Homogeneous and Heterogeneous databases, Distributed data storage, Advantages of Data Distribution, Disadvantages of Data Distribution Distributed transactions, Commit protocols, Availability, Concurrency control & recovery in distributed databases, Directory systems, Data Replication, Data Fragmentation. Distributed database transparency features, distribution transparency.	
V.	<p>Object Relational and Extended Relational Databases, XML</p> <p>Object Relational and Extended Relational Databases: design techniques used in RDBMS, extension techniques in RDBMS, standards for OODBMS</p> <p>products and applications: ODMG-93 standards, ODMG Smalltalk binding, SQL3, Nested relations and collections, Storage and access methods , Implementation issues for extended type , Comparing RDBMS, OODBMS & ORDBMS. XML Query processing and Database application: XML query languages: XML-QL, Lorel, Quilt, XQL, XQuery, and Approaches for XML query processing, Query processing on relational structure and storage schema, XML database management system.</p> <p>Database application: Active database: starburst, oracle, DB2, chimera, Applications of active database, design principles for active rules, Temporal database, special, text and multimedia database. Video database management: storage management for video, video preprocessing for content representation and indexing, image and semantic-based query processing, real time buffer management.</p>	10
	<p>List of Experiments:</p> <ol style="list-style-type: none"> 1. Perform queries for DCL Commands and Locks 2. Implement authorization, authentication, privileges on database. 3. Perform queries to Create synonyms, sequence and index 4. Implement PL/SQL programmes using control structures 5. Advanced SQL <ul style="list-style-type: none"> ▪ Create a table and get alternative odd records from it. ▪ Retrieve common records from two tables. ▪ Convert decimal number to binary number and vice-versa. 6. Implement PL/SQL programmes using exception handling. 7. Write a program to use JDBC API to call stored procedures 8. Implement user defined procedures and functions using PL/SQL blocks 9. Implement various triggers 10. Implement and Practice on functional dependencies 11. Implement and Practice on Normalization –using any database perform various normal forms. 12. Implement and Practice on transaction processing 	
Course Outcomes (CO)		
At the end of the course the students will be able to:		
CO 1	Design³ and build a simple database system and demonstrate competence with the fundamental tasks involved with modelling, designing, and implementing a DBMS	
CO 2	Apply³ various Normalization techniques	
CO 3	Test⁶ PL/SQL programming using concept of Cursor Management, Error Handling, Package and Triggers	
CO 4	Choose⁶ various advance SQL queries related to Transaction Processing and Locking using concept of Concurrency control	
CO 5	Explain⁶ process query and techniques involved in query optimization	
Text Books	Silberschatz, A., Korth, H. F., & Sudarshan, S. (2006). Database system concepts (Vol. 4). New York: McGraw-Hill. Elmasri, R., & Navathe, S. B. (2011). Database systems (Vol. 9). Boston, MA: Pearson Education.	
Reference Books	Ramakrishnan, R., Gehrke, J., & Gehrke, J. (2003). Database management systems (Vol. 3). New York: McGraw-Hill.	

COURSE CODE	CLOUD COMPUTING TOOLS AND TECHNIQUES	Total :45 Lecture: 45
CA21M105	(LTP=3-0-0=3)	
Course Objectives		
<ul style="list-style-type: none"> ● To understand the concept of cloud computing. ● To study the evolution of cloud from the existing technologies. ● To implement the knowledge of computing on the various issues in cloud. ● To assess services provided by lead players in cloud. ● To study the emergence of cloud as the next generation computing paradigm. 		
UNIT	CONTENTS	HOURS
I	Introduction to Cloud Computing Introduction to Cloud Computing, History and Evolution of Cloud Computing, Types of clouds, Private Public and hybrid clouds, Cloud Computing architecture, Cloud computing infrastructure, Merits of Cloud computing, , Cloud computing delivery models and services (IaaS, PaaS, SaaS), obstacles for cloud technology, Cloud vulnerabilities, Cloud challenges, Practical applications of cloud computing.	9
II	Cloud Computing Companies and Migrating to Cloud Web-based business services, Delivering Business Processes from the Cloud: Business process examples, Broad Approaches to Migrating into the Cloud, The Seven-Step Model of Migration into a Cloud, Efficient Steps for migrating to cloud., Risks: Measuring and assessment of risks, Company concerns Risk Mitigation methodology for Cloud computing, Case Studies	9
III	Cloud Cost Management and Selection of Cloud Provider Assessing the Cloud: software Evaluation, System Testing, Seasonal or peak loading, Cost cutting and cost-benefit analysis, Selecting the right scalable application. Considerations for selecting cloud solution. Understanding Best Practices used in selection of Cloud service and providers, Clouding the Standards and Best Practices Issue: Interoperability, Portability, Integration, Security, Standards Organizations and Groups associated with Cloud Computing, Commercial and Business Consideration	9
IV	Governance in the Cloud Industry Standards Organizations and Groups associated with Cloud Computing, Need for IT governance in cloud computing, Cloud Governance Solution: Access Controls, Financial Controls, Key Management and Encryption, Logging and Auditing, API integration. Legal Issues: Data Privacy and Security Issues, Cloud Contracting models, Jurisdictional Issues Raised by Virtualization and Data Location, Legal issues in Commercial and Business Considerations	9
V	Ten Cloud do's and do not's Don't be reactive, do consider the cloud a financial issue, don't go alone, do think about your architecture, don't neglect governance, don't forget about business purpose, do make security the centerpiece of your strategy, don't apply the cloud to everything, don't forget about Service Management, do start with a pilot project.	9
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students should be able to:		
CO1	Analyze³ the Cloud computing setup with its vulnerabilities and applications using different architectures	
CO2	Understand² the concepts, characteristics, delivery models and benefits of cloud computing.	
CO3	Identify² legal and societal issues involved in addressing the security issues of cloud computing.	
CO4	Assess⁴ cloud Storage systems and Cloud security, the risks involved, its impact and develop cloud application.	

CO5	Identify ² the architecture and infrastructure of cloud computing, including SaaS, PaaS, IaaS, public cloud, private cloud, hybrid cloud, etc.
Reference Books	<ul style="list-style-type: none"> • Hausman, K. K., Cook, S. L., & Sampaio, T. (2013). Cloud Essentials: CompTIA Authorized Courseware for Exam CLO-001. John Wiley & Sons. • Hurwitz, J. S., & Kirsch, D. (2020). Cloud computing for dummies. John Wiley & Sons. • Thomas, E., Zaigham, M., & Ricardo, P. (2013). Cloud Computing Concepts, Technology & Architecture. • Srinivasan, A. (2014). Cloud Computing: A practical approach for learning and implementation. Pearson Education India.

COURSE CODE	LINUX ADMINISTRATION	Total Lecture:60 Theory:45 Practical:15
CA21M106	(LTP=3-0-2=3)	
Course Objectives		
<ul style="list-style-type: none"> ● The course explores the security and network access controls in Linux ● To understand how to Organize network system and Mail Services ● Know how to Secure Data and Account Management. 		
UNIT	CONTENTS	HOURS
I	Fundamentals of Linux: Development of Linux, Linux Distributions. Structure of Linux Operating System, Logging In and General Orientation, The X Window System, KDE, GNOME. Navigating the File Systems, Managing Files, File Permission and Access, Shell Basics, Shell Advanced Features, File Name Generation. Common Unix commands.	9
II	Administration of Linux OS Installing Linux, Configuring Disk Devices, Creating and Managing File Systems, File System Backup, Kickstart Installation, Linux Boot Loaders, Linux Kernel Management, Managing User Accounts, Understanding File Listing, Ownership and Permission, Managing Software using RPM, Connecting to Network, Linux Network Services, Setting up a Printer.	9
III	Input and Output Redirection Input Redirection, Output Redirection, Error Redirection, Filter, Pipes. Networking in Linux: Network Connectivity, IP address, Accessing Remote system, Transferring files, and Internet configuration. Process Control: Identifying Process, Managing Process, Background Processing, Putting jobs in Background. Offline File Storage: Storing files to Media Booting process and User.	9
IV	Linux Basic networking and naming service: Introduction to Networking, Networking, Internet Network Services, Dynamic DNS, Electronic Messaging, Apache , NIS and Network File Sharing: NIS, Network File Sharing, SAMBA. Security: Defining System Security Policies, System Authentication Services and Security, Securing Services, Securing Data and Communication	9
V	The Unix File System Inodes - Structure of a regular file – Directories - Conversion of a path name to an inode - Super block - Inode assignment to a new file - Allocation of disk blocks. System calls for the file System: Open – Read - Write - Lseek – Close - File creation - Creation of special files - Changing directory and root - changing owner and mode – stat and fstat - pipes - Dup - Mounting and Un mounting file systems - Link and Un link.	9
	<ol style="list-style-type: none"> 1. Configure the following tasks & verify it. (Hint - use grep/cut/tr/sed) List the lines containing "/sbin/nologin" from the /etc/passwd file. List only lines of output from ps, which lists running processes that contain the string "init". Display the list of GIDs from /etc/passwd file. Alter all the letters that starts from range "a-f" to "A-F" in /etc/passwd file. 2. Create an alias named eth0:0 using below credentials in RHEL 5 and verify it. 3. (a) IP ADDRESS = 172.16.0.1 (b) 255.255.0.0 (c) Default Gateway = 172.16.0.254 (d) DNS 1 = 4.2.2.1 4. Configure password policy for user john with below arguments in RHEL 5. After configuration verify the policy applied. Minimum password age = 4 days Maximum password age = 15 days Inactive days = 2 days Account Expiration date = 6 months from today 5. Configure the following tasks: Add user accounts to your system: Joshua, alex, dax, bryan, zak, ed and manager. Assign each 	

user this password: 123@iMs. Add the groups to your system: sales with GID: 1000, HR with GID: 1100 and web with GID: 1200.

Add Joshua and alex to the sales group, dax and bryan to the HR group, zak and ed to the web group and add manager to all of these groups.

Login with each user & verify using id command that they are in the appropriate groups.

6. Use ACL to accomplish these tasks:

Create groups named Admin and Web. Create users named John and Jimmy.

Create a new directory named /depts/tech/. Change the permission so that root is the owner and Admin is the group owner.

Use ACL to give full permission for /depts/tech/ to the Web group.

Allow John read/execute but not write permission on the /depts/tech/ directory.

Allow Jimmy full permission on the /depts/tech/ directory.

7. You are tasked with finding all SUID & SGID files under the / directories.

8. Configure your system that boots to run level 3 by default. Configure X server using command in run level 3.

9. Devise a ps command that does the following. (Hint: sort/ps/top)

List all processes.

For each process, prints the information which displays the percentage of CPU usage, the process ID & name of the command that created it. The output is sorted by the %cpu value from highest to lowest

10. Explain the suid, sgid& sticky bit permission with example Customize the Bash prompt as per given tasks (Hint - PS1) Display the current value of primary prompt string. Changes prompt to print a static string "ITIMS -". Restore the original prompt. insert the bash history prompt special character "\!" between the hostname and dollar-sign.

11. Configure given tasks for package management: (Hint: use rpm command) Check whether ftp package is installed or not. If it is not installed, install it & verify it. Display the configuration files available through this package. Be sure that ftp service must be enabled at startup.

12. Use rpm queries to answer the following questions.

What files are in the "initscripts" package?

Which installed packages have "gnome" in their names?

Which RPM provides /etc/inittab?

13. Prepare a cron job that take the backup of /home at 5:00pm on every Saturday.

14. Change your system date to 1:00pm March 1990.

15. Copy /etc/fstab file to /tmp directory as newfstab file. The user owner is Jack and group owner is admin. Give full permission to user owner and read, write permission to group owner. No permission to others.

16. Configure your system such that SELinux must be in enforcing mode and firewall is enables and ssh service is not allowed through your firewall.

17. Configure ftp server such that anonymous can download and upload the data to ftp server. Deny users John and Carel to access the ftp server. Note that your ftp server must be accessible in your private network only. It can't be accessible in another network.

18. Create a RAID level 1 on /dev/md0 device by creating two equal partitions of 100MB size and mount it on /data. The RAID device must be mounted at the time of system startup.

19. Configure LVM in volume group named volgrp by creating 2 partitions of 100MB size and mount it on /exam directory. The initial size of LVM is approximately 40MB and after extending the size of LVM is 80MB.

20. Configure the DHCP server such that your DHCP server will able to provide IP configuration to 65 systems in your network.

21. Configure the station as NFS server such that /share directory is shared & only accessible in your network. This NFS share should be automatically mounted on remote client using autofs. On remote client system, NFS share should be mounted on /data/share directory.

22. Configure stationx.example.com for quota such that when user neo type dd if=/dev/zero of=/quota/somefilebs=1024 count=30, he succeed. When he type

	dd if=/dev/zero of=/quota/somefilebs=1024 count=70 he fails	
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students should be able to:		
CO1	Explain² how to manage and administer systems and servers using Linux Operating System	
CO2	Explain² how to attend RED HAT Certification exam in Linux Administration after the completion of this course	
CO3	Understand² what is Red hat Enterprise Linux 6 (RHEL 6) and its use cases.	
CO4	Understand² the various concepts of networking and its important use cases in real time scenario.	
CO5	Understand² the basic concepts of Unix File System and its various concepts like conversion of a path to an inode. The student will learn various concepts pertaining to this file system.	
Text Book	<ul style="list-style-type: none"> Petersen, R. (2007). Linux: The Complete Reference (With Cd). Tata McGraw-Hill Education. 	
Reference Books	<ul style="list-style-type: none"> Van Vugt, S. (2013). Red Hat Enterprise Linux 6 Administration: Real World Skills for Red Hat Administrators. John Wiley & Sons. 	

COURSE CODE	ADVANCED JAVA PROGRAMMING	Total Lecture:60 Theory:45 Practical:15
CA21M201		(LTP= 3-0-2=4)
Course Objectives: This course will meet the following objectives : <ul style="list-style-type: none"> • Introduce the object-oriented programming concepts. • Understand object-oriented programming concepts, and apply them in solving problems. • Analyse the principles of inheritance and polymorphism; and demonstrate how they relate to the design of abstract classes. • Evaluate the implementation of packages and interfaces. • Introduce the concepts of exception handling and multithreading, Collection Framework. • Implement the design of Graphical User Interface using applets and swing controls. 		
UNITS	CONTENTS	HOURS
I.	Java Servlets Introduction to JDBC, Web Applications, Servlets and HTTP Servlets, Filters, Security, Servlet Life Cycle, Servlets for the World Wide Web, Requests, Responses, and Headers, GET and POST, HTTP, Deploying a Servlet , Web Application Deployment Descriptor Structure, Servlet Configuration, HttpServletRequest/Response, ServletContext, Session Management, Case Study.	5
I.	Java Server Pages(JSP) Introduction, JavaBeans, Custom Tags and JSP Fragments, JSP Life Cycle, The Difference Between Servlets and JSP, JSP Syntax and Semantics, Elements and Template Data, JSP Configuration, Standard JSP Actions, Attributes, Comments, Quoting and Escape Characters, Exception Handling, JavaBeans and the JSP Expression Language, JSP Standard Tag Library, Custom Tag Libraries, Database Connectivity, Building a Complete Web Application, Case Study.	10
I.	Java Server Faces Introduction, features, life cycle, manage Beans, UI Components- inputText, outPutText, form, command Button, inputTextArea, inputHidden, inputFile, Bean Validation, facelets, JSF JDBC, JSF with controllers, architectural overview of application developed with JSF and JSP, validator tag, data tables.	10
V.	Hibernate Introduction, advantages, features, Architecture, Environment, Life Cycle, ORM Tool, First program, Sessions, Session factory, Persistent Class, Using the Session, MVC, Hibernate Query language, Criteria Query, Mapping Types, Annotations, Query Language, Native SQL, Case Study.	10
V.	Springs Introduction, Architecture, Environment Setup, Create Sample Program, IOC Containers, Bean Definition, Bean Scopes, Bean Lifecycle, Dependency Injection, IOC injection, Setter Injection, Injecting Inner Beans, Injecting Collection, Event Handling, MVC Framework, Case Study.	10
	List Of Experiments:	
	1. Develop dynamic web application to display current system date and time using servlets. 2. Develop dynamic web application to display login page with proper HTML UI elements using servlets. 3. Implement a servlet to authenticate login details, which is created previously (user name and password should be accepted using HTML and displayed using a Servlet) 4. Develop dynamic web application to manage product (prodId, name, category, price) details using servlets. This app must have following pages a. Home page	

	<p>b. Product adding page</p> <p>c. Product editing page</p> <p>d. Product displaying page</p> <p>5. Develop dynamic web application to manage user (userId, name, dob, address) details using JSP. This app must have following pages</p> <p>a. Home page</p> <p>b. User adding page</p> <p>c. User editing page</p> <p>d. User displaying page</p> <p>6. Write JSP program to implement custom tag with name <product>, which display product (prodId, name, category, price) details</p> <p>7. Enhance previous JSP program to fetch data from database</p> <p>8. Develop Rich Internet Applications to manage product and user details using struts and database</p> <p>9. Develop Hibernate application to manage product details like insert, update, delete and display from database using HQL</p> <p>Develop Spring based dynamic web application to manage courses, students in a college environment using Web MVC framework and JDBC</p>	
Course Outcomes (CO)		
At the end of the course the students will be able to:		
CO 1	Identify ² classes, objects, members of a class and relationships among them needed for a specific problem	
CO 2	Develop ⁶ Java application programs using OOP principles and proper program structuring	
CO 3	Demonstrate ³ the concepts of polymorphism and inheritance	
CO 4	Design ⁴ error handling techniques using exception handling.	
CO 5	Understand ² the use of Packages and Interface in java	
Reference Books	<ul style="list-style-type: none"> • Falkner, J., & Jones, K. (2004). Servlets and JavaServer Pages: The J2EE Technology Web Tier. Addison-Wesley. • Ottinger, J. B., Linwood, J., & Minter, D. (2016). Beginning Hibernate: For Hibernate 5. Apress. • Johnson, R., Hoeller, J., Arendsen, A., & Thomas, R. (2009). Professional Java development with the Spring framework. John Wiley & Sons. • Geary, D. M. (2010). Core JavaServer Faces, 3/e. Pearson Education India. 	

COURSE CODE	WEB TECHNOLOGIES	Total Lecture:60 Theory:45 Practical:15
CA21M202	(LTP= 3-0-2=4)	
Course Objectives: This course will meet the following objectives: <ul style="list-style-type: none"> • Introduce students to web technologies such as HTML, CSS, XML, PHP • Teach them to create static and simple dynamic web pages or applications using these technologies • Understand web application deployment and software architectures • Students will learn basic web application design, development and testing skills. 		
UNITS	CONTENTS	HOURS
1	Introduction to HTML5 Introduction to HTML, What is HTML and Where did it come from?, HTML Syntax, Semantic Markup, Structure of HTML Documents, Quick Tour of HTML Elements, HTML5 Semantic Structure Elements, Introduction to CSS, What is CSS, CSS Syntax, Location of Styles, Selectors, The Cascade: How Styles Interact, The Box Model, CSS Text Styling.	5
2	HTML Tables and Forms HTML Tables and Forms, Introducing Tables, Styling Tables, Introducing Forms, Form Control Elements, Table and Form Accessibility, Microformats, Advanced CSS: Layout, Normal Flow, Positioning Elements, Floating Elements, Constructing Multicolumn Layouts, Approaches to CSS Layout, Responsive Design, CSS Frameworks	10
3	JavaScript JavaScript: Client-Side Scripting, What is JavaScript and What can it do?, JavaScript Design Principles, Where does JavaScript Go?, Syntax, JavaScript Objects, The Document Object Model (DOM), JavaScript Events, Forms, Introduction to Server-Side Development with PHP, What is Server-Side Development, A Web Server's Responsibilities, Quick Tour of PHP, Program Control, Functions	10
4	PHP Arrays and Superglobals PHP Arrays and Superglobals, Arrays, \$_GET and \$_POST SuperglobalArrays, \$_SERVER Array, \$_FILES Array, Reading/Writing Files, PHP Classes and Objects, Object-Oriented Overview, Classes and Objects in PHP, Object Oriented Design, Error Handling and Validation, What are Errors and Exceptions?, PHP Error Reporting, PHP Error and Exception Handling	10
5	Managing State Managing State, The Problem of State in Web Applications, Passing Information via Query Strings, Passing Information via the URL Path, Cookies, Serialization, Session State, HTML5 Web Storage, Caching, Advanced JavaScript and jQuery, JavaScript Pseudo-Classes, jQuery Foundations, AJAX, Asynchronous File Transmission, Animation, Backbone MVC Frameworks, XML Processing and Web Services, XML Processing, JSON, Overview of Web Services.	10
	List Of Experiments:	
	1. HTML5 Semantic elements Students will learn to: <ul style="list-style-type: none"> • Use basic new HTML5 semantic elements 2. CSS Positioning Students will learn how to <ul style="list-style-type: none"> • Use CSS3 to position HTML elements on a page as • Use the float attribute 3. Restaurant site with online menu Students will learn to: <ul style="list-style-type: none"> • Use CSS3 effectively to do things like format and distinguish the Page title, header, 	

	<p>background and various types of menu items to create a visually pleasing design & layout</p> <p>4. Children's story website Students will learn to:</p> <ul style="list-style-type: none"> • Create a custom website from scratch (Take a plain text version of the Jataka tales and design a visually appealing 5 page website). <p>5. Online Cookbook with Home page, recipe pages and glossary Students will learn to:</p> <ul style="list-style-type: none"> • Implement Menus <p>6. Print CSS Students will learn to:</p> <ul style="list-style-type: none"> • Create a CSS file which will be applied to the web page when being printed <p>7. Library Website designed for accessibility Students will learn to:</p> <ul style="list-style-type: none"> • Use HTML Tables & Forms <p>8. Responsive Web Design Students will learn how to :</p> <ul style="list-style-type: none"> • Design a web page that adapts to devices with various screen sizes <p>9. INU IT Assignments Page with Navigation Students will learn to :</p> <ul style="list-style-type: none"> • Login to a server and create a directory to upload assignments • Use HTML Lists • Implement hover text <p>10. Mock web site Page for updating student attendance, transferring attendance data to the server using JSON and querying any student's attendance. Students will learn how to</p> <ul style="list-style-type: none"> • Create a web page using what they learned 	
Course Outcomes (CO)		
At the end of the course the students will be able to:		
CO 1	Discuss⁶ differences between URIs, URNs, and URLs, and demonstrate a detailed understanding of http-scheme URLs, both relative and absolute	
CO 2	Describe² the actions, including those related to the cache, performed by a browser in the process of visiting a Web address	
CO 3	Install³ a web server and experiment with basic administrative procedures, such as tuning communication parameters, denying access to certain domains, and interpreting an access log	
CO 4	Use² CSS to implement a variety of presentation effects in HTML and XML documents, including explicit positioning of elements	
CO 5	Demonstrate² techniques for improving the accessibility of an HTML document.	
Text Books	<ul style="list-style-type: none"> • Pilgrim, M. (2010). HTML5: up and running: dive into the future of web development. "O'Reilly Media, Inc." 	
Reference Books	<ul style="list-style-type: none"> • Lubbers, P., Albers, B., & Salim, F. (2010). Pro HTML5 programming: Powerful APIs for richer internet application development. New York, NY: Apress. 	

COURSE CODE	SOFTWARE ENGINEERING CONCEPTS AND METHODOLOGIES	Total Lecture:45 Theory:45
CA21M203		(LTP= 3-0-0=4)
<p>Course Objectives: This course will meet the following objectives: Incorporates various accepted methodologies to design software. This course gives a detailed description of the entire process of developing a software project and also the issues associated after development. This course covers the introductory concepts of software engineering and its design, development and maintenance.</p>		
UNITS	CONTENTS	HOURS
1	Principles and Motivations History; definitions; Engineered approach to software development; Software development process models from the points of view of technical development and project management: waterfall, rapid prototyping, incremental development, spiral models, Aspect Software Development, Agile Software Development, Emphasis on computer-assisted environments. Selection of appropriate development process.	5
2	Software Development Methods Formal, semi-formal and informal methods; Requirements elicitation, requirements specification; Data, function, and event-based modeling; Popular methodologies such as Yourdon's SAD, SSADM; Managing the Software Projects	10
3	Software Engineering Tools and Environments Upper- and lower-CASE tools, evolution of CASE tools-classification, features, strengths and weaknesses; ICASE; CASE standards. Role of the repository for supporting incremental development, software reuse Software Quality Assurance: SQA Tasks, Goals and Metrics, Software Review Techniques: Informal reviews-Formal Technical Reviews, Software Reliability, Software risk management, Case Studies. Real Time Systems	10
4	Configuration Management Need, Configuration management functions and activities; Configuration management techniques; Case studies.	10
5	Software Testing Fundamentals Basic Terminology, Testing Techniques and strategies. Brief introduction to various standards related to Software Engineering.	10
Course Outcomes (CO)		
At the end of the course the students will be able to:		
CO 1	Apply ³ the software engineering lifecycle by demonstrating competence in communication, planning, analysis, design, construction, and deployment	
CO 2	Apply ³ one or more significant application domains	
CO 3	Understand ² role of an individual and as part of a multidisciplinary team to develop and deliver quality software	
CO 4	Demonstrate ³ an understanding of and apply current theories, models, and techniques that provide a basis for the software lifecycle	
CO 5	Apply ² software engineering principles and techniques	
Reference Books	1. Pressman, R. S. (2005). Software engineering: a practitioner's approach . Palgrave macmillan. 2. Jawdekar, W. S. (2004). Software Engineering Principles and Practices . 3. Đorđević-Kajan, S. (2001). Sommerville Ian: Software engineering , Addison-Wesley, Reading, Massachusetts, USA, 2000. Factauniversitatis-series: Electronics and Energetics , 14(1), 133-137.	

COURSE CODE	ALGORITHM DESIGN AND ANALYSIS	Total Lecture:60 Theory:45 Practical:15
CA21M204	(LTP=3-0-2=4)	

Course Objectives

- To teach paradigms and approaches used to analyze and design algorithms and to appreciate the impact of algorithm design in practice.
- To make students understand how the worst-case time complexity of an algorithm is defined, how asymptotic notation is used to provide a rough classification of algorithms.
- To explain different computational models (e.g., divide-and-conquer), order notation and various complexity measures (e.g., running time, disk space) to analyse the Complexity/performance of different algorithms.
- To teach various Advanced design and analysis techniques such as greedy algorithms, Dynamic programming & Know the concepts of tractable and intractable problems and the classes P, NP and NP-complete problems.

UNIT	CONTENTS	HOURS
I	Introduction What is an Algorithm? Algorithm Specification, Analysis Framework, Performance Analysis: Space complexity, Time complexity. Asymptotic Notations: Big-Oh notation (O), Omega notation (Ω), Theta notation (Θ), and Little-oh notation (o). Important Problem Types: Sorting, Searching, String processing, Graph Problems.	9
II	Brute Force, Divide and Conquer Approaches Selection Sort and Bubble Sort, Sequential Search. Sorting, Sets and Selection: Merge sort, Quick sort, Bucket sort, Radix sort, Advantages and Disadvantages of divide and conquer	9
III	Method General method, Coin Change Problem, Knapsack Problem, Job sequencing with deadlines. Optimal Tree problem: Huffman Trees and Codes. Transform and Conquer Approach: Heaps and Heap Sort.	9
IV	Dynamic Programming General method with Examples, Multistage Graphs. Transitive Closure: Warshall's Algorithm, Single source shortest paths: Dijkstra's Algorithm, All Pairs Shortest Paths: Floyd's Algorithm, Optimal Binary Search Trees, Knapsack problem, Bellman-Ford Algorithm, Travelling Sales Person problem, Reliability design.	9
V	Backtracking General method, N-Queens problem, Sum of subsets problem, Graph coloring, Hamiltonian cycles. Branch and Bound: Assignment Problem, Travelling Sales Person problem, 0/1 Knapsack problem: LC Branch and Bound solution, FIFO Branch and Bound solution. NP-Complete and NP-Hard problems: Basic concepts, non-deterministic algorithms, P, NP, NP-Complete, and NP-Hard classes.	9

List of Experiments

1. Implement Selection Sort on given numbers
2. Implement Sequential Search to find an element
3. Implement Quick Sort on given numbers
4. Implement Merge Sort on given numbers
5. Implement Heap Sort
6. Implement Optimal Binary Search Tree
7. Implement Graph to find shortest path
8. Implement code to find out a given graph is opened or closed
9. Implement 0/1 Knapsack problem using Dynamic Programming.

10. Implement All-Pairs Shortest Paths Problem using Floyd's algorithm on a given graph.	
Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students should be able to:	
CO1	Discuss ³ rigorous correctness proofs for algorithms.
CO2	Apply ³ important algorithmic design paradigms and methods of analysis.
CO3	Analyze ⁴ the asymptotic performance of algorithms.
CO4	Examine ⁴ a familiarity with major algorithms and data structures
CO5	Evaluate ⁵ efficient algorithms in common engineering design situations.
Text Book	<ul style="list-style-type: none"> • Lee, R. C. T., Chang, R. C., Tsai, Y. T., & Tseng, S. S. (2005). Introduction to the Design and Analysis of Algorithms. Tata McGraw-Hill. • Horowitz, E., Sahni, S., & Rajasekaran, S. (1997). Computer algorithms C++: C++ and pseudocode versions. Macmillan.
Reference Books	<ul style="list-style-type: none"> • Leiserson, C. E., Rivest, R. L., Cormen, T. H., & Stein, C. (1994). Introduction to algorithms (Vol. 3). MIT press. • Sridhar, S. (2015). Design and Analysis of Algorithms. Oxford University Press.

COURSE CODE	FUNDAMENTALS OF STORAGE AND DATACENTER ARCHITECTURE	Total Lecture:60 Theory:45 Practical:15
CA21M205	(LTP =3 – 0 – 2 = 4)	
Course Objectives :		
<ul style="list-style-type: none"> ● To illustrate the explosion in demand from businesses for data to be highly available and access it in a secure manner. ● To study Data Center Architecture and its requirements. ● To contrast the storage systems and infrastructure architectures. ● To understand planning and designing of Data center. ● To introduce about Server Farms, its types and features. ● To understand complexities and challenges in managing storage infrastructures. 		
UNIT	CONTENTS	HOURS
I	Introduction to Storage and Data Centres: Information Storage Data – Types of Data –Information, Storage, Evolution of Storage Technology and Architecture, Managing Storage Infrastructure, Information Lifecycle Management, ILM Implementation and Benefits. Data Centres Overview, Data Centre Goals and Facilities, Roles of Data Centres in the Enterprise and Service Provider Environment, Data Centre Architecture – Data Centre Requirements.	9
II	Storage System Environment Components of a Storage System Environment – Host –Connectivity – Storage, Disk Drive Components –Platter – Spindle, Read/Write Head, Actuator Arm Assembly, Controller, Physical Disk Structure, Zoned Bit Recording, Logical Block Addressing, Disk Drive Performance, I Disk Service Time, Fundamental Laws Governing Disk Performance, Logical Components of the Host RAID and Storage Networking Technologies : Implementation of RAID, Software RAID, Hardware RAID, RAID Array Component, RAID Levels , Striping, Mirroring , RAID Impact on Disk, Performance, Introduction to Direct Attached Storage – Types of DAS – Introduction to SAN – Components of SAN – FC connectivity – FC topologies – Introduction to NAS – NAS components – NAS Implementation – NAS File sharing	9
III	Data Centre Design Characteristics of an Outstanding Design, Guidelines for Planning a Data Centre, Data Centre Structures, No, Raised or Raised Floor, Aisles, Ramp, Compulsory Local Building Codes, Raised Floor Design and Deployment, Plenum, Floor Tiles, Equipment Weight and Tile Strength, Electrical Wire ways, Cable Trays, Design and Plan against Vandalism, Data Centre Design Case Studies, Modular Cabling Design, Points of Distribution, ISP Network Infrastructure, ISP WAN Links, Data Centre Maintenance.	9
IV	Introduction to Server Farms Types of server farms and data centre, internet server farm, intranet server farm, extranet server farm, internet data centre, corporate data centre, software defined data centre, data centre topologies, Aggregation Layer, Access Layer, Front, End Segment, Application Segment, Back, End Segment, Storage Layer, Data Centre Transport Layer, Data Centre Services, IP Infrastructure Services, Application Services, Security Services, Storage Services.	10
V	Business Continuity and Disaster Recovery fundamentals Business continuance infrastructure services, the need for redundancy, Information availability, Data Center Tiers classification, BC terminology, BC planning life cycle, BC technology solutions, backup and recovery considerations, backup technologies, uses of local replicas, Local replication technologies, Restore and restart considerations, Modes of remote replications, remote replication technologies.	8
List of Experiments		

1. Configuring the Directly Attached Disks for Basic and Dynamic Disks
2. Creating and configuring the disk partitions and volumes for the disk in Windows/Linux System
3. Creating and Configuring the RAID 0, 1 and RAID5 in windows server 2012 R2
4. Configuring the Network Share using Windows Server 2012 R2
5. Configuring the File Server in Windows Server 2012 R2
6. Configuring NFS in Linux Server
7. Configuring the iSCSI in Windows Server 2012 R2
8. Configuring FCOE in Windows Server 2012 R2
9. Creating a System Backup and Restoring in Windows Server and Linux System
10. Creating and Restoring the Snapshot for Virtual Machines in Hyper-V

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students should be able to:

CO1	Explain² the storage devices ,data centre architecture and its requirements.
CO2	Illustrate² the storage at network level.
CO3	Compare⁴ and contrast SAN, NAS and DAS.
CO4	List⁴ and explain types of storage in infrastructure.
CO5	Evaluate⁵ Server Farms and Services associated with it.
Text Books	<ul style="list-style-type: none"> ● Somasundaram, G., & Shrivastava, A. (2009). EMC Education Services,“Information Storage and Management”. ● Arregoces, M., &Portolani, M. (2003). Data center fundamentals. Cisco Press. ● Spalding, R. (2003). Storage networks: the complete reference. Tata McGraw-Hill Education. ● Jayaswal, K. (2005). Administering data centers: servers, storage, and voice over IP. John Wiley & Sons.

COURSE CODE	EXPLORING SOFTWARE AS A SERVICES	Total Lecture : 45 Theory :45
CA21M206	(LTP =3 – 0 – 0 = 3)	
Course Objectives :		
<ul style="list-style-type: none"> • Understand the concepts, characteristics, delivery models and benefits of cloud computing • Understand the key security and compliance challenges of cloud computing • Understand the key technical and organisational challenges • Reduce the investment in server hardware by sharing end user licenses • Reduce hiring costs of software 		
UNIT	CONTENTS	HOURS
I	Introduction to SaaS Origin of SaaS – Defining SaaS, SaaS Paradigms and Eco System – SaaS Business Model – SaaS Software Stack – Multitenancy – SaaS Vendor Competence, Advantages of adapting SaaS	10
II	Characterizing SaaS Streamlining administration with centralized installation, Optimizing cost and performance with scale on demand — SaaS Business Metrics – The Business Problem of SaaS – Technical Challenges of SaaS	9
III	Comparing service scenarios Improving collaboration with business productivity tools, Simplifying business process creation by integrating existing components – Using Online Software and Services, SaaS platform services (application development, application migration, SaaS implementation, business intelligence, Cloud based/big data/real time analytics)	9
IV	SaaS Solutions SaaS vendor horizontal solutions: ADP, Cisco, Salesforce.com, Microsoft Online Services, SAP, Oracle OnDemand, Tibco, Cordys, Google, Zoho, Taleo, NetSuite, SuccessFactors, Eloqua, Workday. SaaS vendor vertical solutions: SmartStream, Callidus Software, TriZetto, Fineos, Misys, Merced System, Inc.	8
V	SaaS mainstream offerings SaaS Enablement (ISV and product based), vendor-based SaaS offerings (SFDC, Cordys, Oracle), SaaS solution development, SaaS migration, Cloud application usage optimization. Inspecting SaaS technologies – Web Services, Web 2.0 – Web OS, deploying web applications, implementing web services on Amazon Cloud: SOAP, REST, Choosing a development platform – Future of SaaS Applications.	9
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students should be able to:		
CO 1	Define ¹ Analyse and appreciate the advantages of using SaaS.	
CO 2	Compose ⁶ and integrate various SaaS services.	
CO 3	Explain ² the various SaaS solutions with the help of products provided by various vendors	
CO 4	Discover ⁴ various horizontal solution of SaaS	
CO 5	Discuss ² the web technologies under SaaS	
Text Books	<ul style="list-style-type: none"> • Bouzid, A., &Rennyson, D. (2015). The art of SaaS: a primer on the fundamentals of building and running a successful SaaS business. • Sahil P. (2011), “The SaaS EDGE”, Tata McGraw Hill, • Michon, R. (2017). The Complete Guide to Software as a Service: Everything you need to know about SaaS. CreateSpace Independent, 52. 	

COURSE CODE	WINDOWS ADMINISTRATION	Total Lecture:60 Theory:45 Practical:15
CA21M301	(LTP =3 – 0 – 2 = 4)	
Course Objectives :		
<ul style="list-style-type: none"> The objective of this course is to make students feel too provides a network foundation from which you can centrally manage settings on your computers that are based on the Windows® operating system, and upon which you can run the most popular business applications. Students will learn various aspects of managerial writing including report writing. 		
UNIT	CONTENTS	HOURS
I	Installing and Configuring Windows Server 2012 Introduction, Selecting a Windows Server 2012 Edition, Supporting Server Roles and Features, Server Licensing, Installing Windows Server 2012: System Requirement, Performing a Clean Installation, Working with Installation Partitions, Server Core Defaults, Server Core Capabilities, Completing Post-Installation Tasks, Converting Between GUI and Server Core, Upgrade paths, Installing Windows Server Migration Tools, Configuring NIC Teaming, Configuring local storage, Configuring WDS to install OS through networking.	9
II	Securing Files and Disks. How to Securing Files, Encryption files with EFS, Configuring EFS, Using the Cipher Command, Sharing Files Protected with EFS with others, Configuring EFS with Group Policies, Configuring EFS Recovery Agent, Managing EFS Certificates, Encrypting Files with BitLocker, Configuring BitLocker Encryption, configuring BitLocker to Go, Configuring BitLocker Policies, Managing BitLocker Certificates.	9
III	Configuring File and Share Access Permissions Designing a File-Sharing Strategy, Arranging Shares, Controlling Access, Mapping Drives, Creating Folder Shares, Assigning Permissions, Understanding the windows Permission Architecture and Basic, Advanced Permissions, Allowing and Denying Permissions, Inheriting Permissions, Understanding Effective Access, Setting Share Permissions, Understanding NTFS Authorization, Assigning Basic NTFS Permissions, Understanding Resource Ownership, Combining Share and NTFS Permissions, Installing File Server Resource Manager, Using, creating, changing Quotas, Managing Files with File Screening, Creating File Groups, Creating a File Screen, Creating a File Screen Exception, Creating a File screen Template. Storage Reports Management.	9
IV	Configuring DNS Zones and Records Understanding DNS, Understanding DNS Names and Zones, Understanding the Address Resolution Mechanism, configuring and Managing DNS Zones, Installing DNS, Configuring Primary and Secondary Zones, Configuring Active Directory-Integrated Zones, configuring Zone Delegation, configuring Stub Zones, configuring Caching-Only Servers, Configuring Forwarding and Conditional Forwarding, Configuring DNS Record types, creating and Configuring DNS Resource Records, Start of Authority(SOA) Records, Name Server(NS) Records, Host(A and AAAA) Records, Canonical Name(CNAME) Records, Pointer(PTR) Records..	9
V	Implementing Patch Management and Monitoring Server Performance Understanding windows Updates and Automatic Updates, Deploying Windows Server Update Services(WSUS), How to Install and Configure WSUS, Configuring WSUS Synchronization, Configuring WSUS Computer Groups, Configuring Group Policies for Updates, Configuring Client-Side Targeting, Approving Updates, Viewing Reports, Administrating WSUS with Commands, Troubleshooting Problems with Installing Updates. Introducing the Microsoft Management Console (MMC), Server Manager, Event Viewer, Understanding Logs and Events, Adding and Filtering Events, Managing Performance, Task Manager, Resource Monitor, Configuring Data Collector Sets (DCS), Monitoring the Network using Netstat and protocol analyzers.	9

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students should be able to:

CO1	Apply ³ knowledge and skills needed to install and configure windows server 2012 and configure local storage and other services like file sharing and print sharing.
CO2	Plan ⁶ a File-Sharing Strategy
CO3	Define ⁵ Configuring DNS Zones and Manage all type of Records
CO4	Plan ⁶ Patch management and monitor Server performance
CO5	Apply ³ knowledge to take up the certification exams in windows server 2012.
Text Books	1. Windows Server 2012: A Handbook for Professionals by Aditya Raj (Author) 2. Administering Windows Server 2012 (Certification Guide) by Orin Thomas Reference Book: 1. Administering Windows Server 2012 by Patrick Regan 2. Mastering Windows Server 2012 R2 by Mark Minasi, Kevin Greene, Christian Booth, and Robert Butler.

Lab - List of Programs

1. Installing and Configuring Windows Server 2012 Core Version and Converting from Core version to GUI.
2. Configuring Local storage using Disk management and Diskpart commands.
3. Installing and Configuring FSRM for Quota management and File Screening.
4. Configuring EFS and creating recovery agent.
5. Securing Disk and Drive using Bit Locker Drive Encryption
6. Installing and Configuring Primary DNS Server.
7. Installing and Configuring Secondary and Stub Zone for DNS Server
8. Installing and Configuring Windows Server Update Services [WSUS].
9. Configuring Group Policies for Updates so that clients can target WSUS Server.
10. Creating and Configuring Data Collector Set.

COURSE CODE	Principles of Virtualization	Total Lecture:60 Theory:45 Practical:15
CA21M302	(LTP =3 – 0 – 2 = 4)	

Course Objectives :

- Learning the principles of virtualization technologies and cloud computing;
- Introduce the concepts how virtual machines, hypervisors, virtual networks and virtualstorage work together;
- Emphasizes on how to apply and build cloud infrastructure in practice;
- Introduce actual approaches in virtual machine management and troubleshooting.
- Provides students with hands-on practice experience on how to build secured cloud infrastructure;

UNIT	CONTENTS	HOURS
I	Introduction to Virtualization Understanding Virtualization: Describing Virtualization, Understanding the Importance of virtualization, Understanding virtualization software operation. Understanding Hypervisors: Describing a Hypervisors, Understanding the Role of a Hypervisor, Comparing today’s Hypervisors. Introducing VMware vSphere 6: Exploring VMware vSphere 6.0, Planning a VMware vSphere Deployment, Deploying VMware ESXi, Performing post installation configuration.	9
II	VMware vCenter Server Installing and Configuring vCenter Server: Introducing vCenter Server, Choosing the version of vCenter server, planning and designing a vCenter server deployment, Installing vCenter server and its components, Installing vCenter server in a linked mode group, Deploying the vCenter server virtual appliance, exploring vCenter Server, creating and managing a vCenter Server Inventory, Exploring vCenter servers management features, Managing vCenter Server settings, vSphere web client administration.	9
III	Creating and Configuring Virtual Networks Introduction to Virtual Network, Working with vSphere Standard Switches, Working with vSphere Distributed switches, Examining Third-Party distributed virtual switches, configuring virtual switch security. Implementing vSphere Storage Fundamentals: vSphere storage concepts, understanding virtual volumes, SCs vs. LUNs, storage policies, Virtual volumes, working with VMFS Datastores, Raw device mappings, NFS Datastores, VM-level storage configuration.	9
IV	Working with Virtual Machines Creating and Managing Virtual Machines: Understanding Virtual Machines, Creating a Virtual Machine, Installing a guest Operating System, Installing VMware tools, Managing Virtual Machines, Modifying Virtual Machines, Cloning VMs, Creating templates and deploying Virtual Machines, Using OVF templates, Using content libraries, Working with vApps, Importing machines from other environments. Configure and maintain a vCloud Air Connection: Create a VPN connection between vCloud Air and On-premise site, Deploy a Virtual Machine using vCloud Air, Migrate a virtual machine to vCloud Air, Verify VPN connection configuration to vCloud Air, Configure vCenter Server Connection to vCloud Air.	9
V	Securing and Monitoring VMware vSphere Securing VMware vSphere: Overview of vSphere security, Securing ESXi Hosts, Securing vCenter Server, Securing virtual machines. Monitoring VMware vSphere Performance: Overview of performance monitoring, Alarms, Working with performance charts, Monitoring CPU, Memory, Network and Disk usage. Automating VMware vSphere: Advantages of Automation, vSphere automation options, Automation with Power CLI, Using vCLI from vSphere management assistant, Using vSphere management assistant for automation with vCenter , ESXCLI and PowerCLI.	9

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students should be able to:

CO1	Creation² , manage and troubleshoot virtual machines;
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CO2	Plan ⁶ and Configure a vCloud Air Connection
CO3	Apply ³ vSphere Storage Fundamentals
CO4	Define ⁵ Managing vCenter Server
CO5	Plan ⁶ troubleshooting methodology to fix issues in virtualized environment
Text Books	<p>Text Books:</p> <ol style="list-style-type: none"> 1. Virtualization Essentials Paperback – 26 Apr 2012 by Matthew Portnoy - wiley publications 2. VMware Cookbook Paperback – 17 Jul 2012 by Troy - Shroff/O'Reilly; Second edition (17 July 2012) <p>Reference Book:</p> <ol style="list-style-type: none"> 1. Mastering VMware vSphere 5.5 (SYBEX) Paperback – 2014 by Scott Lowe, Nick Marshall, Forbes Guthrie, Matt Liebowitz, and Josh Atwell - Wiley (2014) edition.

Lab - List of Programs

1. Install and configure VMware ESXi Server 6.0, a type-I hypervisor on a host machine to deploy a virtual machine.
 - a) Launch DCUI Console.
 - b) Configure Management Network
 - c) Set IPV4 & DNS Configuration.
2. Restart .
3. .Installation and deployment of VMware vSphere Client in a Physical Machine. Connect ESXi Host with all required configurations. – Use ESXi 5.X version for this Lab.
4. Installation and deployment of VMware vCenter in a virtual machine that runs on an ESXi host-Mount VMware vCenter 6.0 on Windows Server operating system 2012, 64 bits along with the necessary drivers.
 - a) Configure the settings(RAM-8GB,Processor-2)
 - b) Mount iso image of vCenter on CD/DVD drive
 - c) Select Embedded deployment
 - d) Create New vCenter Single-Sign-On domain
 - e) Allow Common ports, Platform service controller ports & vCenter Server ports.
 - f) Launch vSphere Web Client.
5. Creation of virtual machine using vCenter Server on a machine that has access to ESXi host by installing vSphere client - Launch vSphere client and communicate with the ESXi host by performing the following operations.
 - a) Create a virtual machine
 - b) Configure and run the machine
 - c) Select Guest OS Ubuntu
 - d) Select a location & datacentre
 - e) Create a Cluster & Add a host
6. Modify virtual machine settings by adjusting configuration like hardware, adding new virtual hard disk, number of virtual processor and memory settings. Clone a virtual machine including all its settings.
7. Installing Windows Virtual PC on various platforms (32-bit, 64-bit).
8. Creating and managing virtual hard disks.
9. Create a Snapshot & then create a virtual machine using that snapshot.
10. Create a Template & then create a virtual machine from Template.

COURSE CODE	Cloud Web Services	Total Lecture:60 Theory:45 Practical:15
CA21M303	(LTP =3 – 0 – 2 = 4)	
Course Objectives : <ul style="list-style-type: none"> ● Describe the AWS Cloud and the AWS global infrastructure ● Recognize and explain basic AWS Cloud architectural principles ● Describe key services on the AWS platform and their common use cases ● Describe the basic security and compliance aspects of the AWS platform and the shared security model ● Define the billing, account management, and pricing models ● Describe basic/core characteristics of deploying and operating in the AWS Cloud 		
UNIT	CONTENTS	HOURS
I	Introduction to Cloud Computing And Amazon Web Services Introduction to Cloud Computing, Cloud Service Delivery Models (IAAS, PAAS, SAAS), Cloud Deployment Models (Private, Public, Hybrid and Community), Cloud Computing Security, Case Study Introduction to Amazon Web Services, Why Amazon? Use Cases, AWS Storage Options, AWS Compute Options, AWS Database Options, AWS Workflow Automation and Orchestration Options, AWS Systems Management And Monitoring Options, AWS Virtual Private Cloud Introduction, Pricing Concepts.	9
II	Introduction to Ec2 Introduction To EC2, Instance Types And Uses, Auto scaling Instances, Amazon Machine Images (AMIS), Modifying Existing Images, Creating New Images of Running Instances, Converting An Instance Store AMI To An EBS AMI, Instances Backed By Storage Types, Elastic IPS, Elastic Load Balancing.	9
III	Web Applications and Security Introduction to Elastic Beanstalk, Deploying Scalable Application On AWS, Selecting And Launching An Application Environment, Provisioning Application Resources with Cloud formation, Introduction to Cloud Watch, Describe Amazon Cloud Watch metrics and alarms, AWS Messaging Services (SNS, SQS, SES). Introduction to AWS Security, Describe Amazon Identity and Access Management (IAM), AWS Directory Service, AWS Key Management Service, Securing Data at Rest and In Motion.	9
IV	AWS Storage Amazon Storage, S3 Storage Basics, Buckets and Objects, Creating A Web Server Using S3 Endpoints, Managing Voluminous Information with EBS, Glacier Storage Service , Describe Amazon Dynamo, Understand key aspects of Amazon RDS, Launch an Amazon RDS instance	9
V	AWS Networking Introduction to AWS Networking , Access Control Lists (ACLs), Setting Up a Security Group, Setting Up VPC And Internet Gateway, Setting Up A VPN, Setting Up A Customer Gateway For VPN, Setting Up Dedicated Hardware For VPC, Scenario 1:VPC With A Public Subnet Only (Standalone Web), Scenario 2: VPC with Public And Private Subnets (3 Tier App), Scenario 3:VPC With Public And Private Subnets And Hardware VPN Access (Web On The Cloud, Database and App On Prem) Scenario 4: VPC With A Private Subnet Only And Hardware VPN Access. (Extension Of Your Corporate Network), Route53 for	9

	DNS System, Cloud front, Case Study
Course Outcomes as per Bloom's Taxonomy	
At the end of the course the students should be able to:	
CO1	Apply ³ IAAS, PAAS, SAAS on Aws Cloud platform
CO2	Creation ³ of EC2 instances from of AMI's
CO3	Plan ⁶ and Managing Voluminous Information with EBS, Glacier Storage Service
CO4	Understand ² Amazon Identity and Access Management
CO5	Plan ⁶ Up VPC And Internet Gatewayin Cloud Plarform
Text Books	<p>Text Book:</p> <ol style="list-style-type: none"> 1. Joe Baron, Hisham Baz , Tim Bixler , Biff Gaut , Kevin E. Kelly , Sean Senior , John Stamper , “AWS Certified Solutions Architect Official Study Guide: Associate Exam, John Wiley and Sons Publications, 2017. <p>Reference Books:</p> <ol style="list-style-type: none"> 1. Yohan Wadia , “AWS Certified Solutions Architect Official Study Guide: Associate Exam, John Packt Publishing, 2016. 2. Bernald Golden, “Amazon Web Services for Dummies”, John Wiley & Sons, 2013.

Lab - List of Programs

- 1.AWS root user account creation using AWS management console.
2. Understanding AWS Billing Dashboard and Setting up billing alerts using CloudWatch.
3. Launching an EC2 instance and accessing it through SSH using putty.
4. Creating web server on EC2, with and without bash script.
5. (i) Creating Amazon machine Image(AMI) from an existing instance (ii) Creating and customizing a new AMI.
6. Demonstrating Elastic Load Balancer with the help of 3 EC2 instances.
7. (i) Creating roles and attaching policies for EC2 service(automating START and STOP of instance) using Identity and Access Management(IAM)
(ii) Demonstrating the use of Amazon Lambda and suitable code for automating START and STOP of EC2 instance by integrating Lambda service with the respective roles created for the same.
8. Demonstrating S3-bucket creation, object upload, setting access permissions and S3 versioning.
9. Demonstrating version control in S3. Notice the difference with and without versioning after uploading object with same name but different size.
- 10 Creating and hosting static web site using S3 bucket.
- 11 Demonstrating Amazon SNS service.
- 12 Configuration of Database engine using Amazon RDS.
- 13 Creating DNS using Route 53.
- 14 Creating your own VPC, subnets, route tables and security groups.

COURSE CODE	Infrastructure Solutions of Cloud	Total Lecture:60 Theory:45 Practical:15
CA21M304	(LTP =3 – 0 – 2 = 4)	
Course Objectives :		
<ol style="list-style-type: none"> To understand the azure virtual machines Recognize the services offered by Azure Understand the azure storage Configure the Azure active directory services 		
UNIT	CONTENTS	HOURS
I	Introduction to Microsoft Azure Virtual machines Introduction to Azure VM - Resource planning with Basic and standard vm - VM pricing - Difference between basic and standard vm - Creating virtual machines - Choosing the type of vm - Configuring DNS address - Configuring endpoints - Connecting to virtual machine - Implementing the lifecycle of a virtual machine - Uploading and downloading virtual hard disks - Attaching an empty hard disk to vm - Creating VM from a custom image - Deleting images and disks	9
II	Azure Networking Creating and configuring a virtual network - Deploying a virtual machine in a virtual network - Deploying a web service in a virtual network - Modifying a network configuration - Configuring access control list - Configuring reserved IP addresses - Configuring public IP addresses - Implementing a point-to-site VPN - Implementing a site-to-site VPN - Implementing a virtual network to virtual network vpn - Configuring internal load balancing.	9
III	Azure Storage Storage account in azure - Implement blobs and azure files - Types of storage in azure - Blob - Table - Queue - Drives - Managing storage account keys - Implementing SQL databases - Choosing a service tier - Implementing point-in-time recovery - Implementing geo-replication - Scalability strategies - Importing and exporting data	9
IV	Azure Active Directory and Azure Services Implementing directory synchronization - Configuring a custom domain - Monitoring azure active directory - Adding a web application with azure AD - Adding a native application with azure AD - Configuring a graph API permission for an application - Configuring role instance count - Configuring role operating system settings - Configuring ssl - Configuring network traffic rules - Configuring remote desktop - Monitoring a cloud service - Configuring endpoint monitoring.	9
V	Implementing Websites In Azure Creating an azure websites - Configuring site settings - Configuring custom domain for a website - Configuring SSL certificates for an azure website - Configuring azure traffic manager - Creating a new web hosting plan - Creating a website within existing web hosting plan - Migrating websites between hosting plans	9
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students should be able to:		
CO1	Creation³ of Windows Azure Account	
CO2	Plan⁶ of Virtual Machine on ServerApplicationa	
CO3	Understand² of Virtual Machine to cluster and deployment of load balances	
CO4	Define⁵ of webpages in Azure	
CO5	Apply³ Monitoring Azure Services	

Text Books	<p>Ref 70-533: Implementing Microsoft Azure Infrastructure Solutions Paperback Washam Michael Exam Ref 70-533: Implementing Microsoft Azure Infrastructure Solutions Paperback.</p> <p>Reference Book Microsoft Azure Essentials: Fundamentals of Azure (ISBN 9780735697225), Michael S. Collier and Robin E. Shahan Microsoft Azure Essentials: Fundamentals of Azure (ISBN 9780735697225),</p>
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Lab - List of Programs	
<ol style="list-style-type: none"> 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11. 12. 	<ol style="list-style-type: none"> 1. Create and document the process of creating a windows azure account 2. Create a virtual machine from available releases of windows server images 3. Create a virtual machine using the option “quick Create” 4. Create a custom VM and Capture the image 5. Create a vm from a captured image 6. Add a VMs to a cluster and deploy load balancer on the same 7. Create and publish / host a webpage in windows azure 8. Create a website using Visual studio 9. Create a SQL server DB , Create tables and add data to the table 10. Test basic sql commands on the table created in the previous step. 11. Migrate an on premise DB to Azure 12. Create a storage account in Azure

COURSE CODE	DSE-I	Total Lecture:60 Theory:45 Practical:15
CA21M305	AUTOMATION AND CONFIGURATION MANAGEMENT (LTP =3 – 0 – 2 = 4)	
Course Objectives : <ul style="list-style-type: none"> ● It will introduce you to Windows PowerShell and provide an overview of the product's functionality. ● Basic understanding of the cmdlets available for system administration ● Understanding pipeline feature in Windows PowerShell ● Learning PS Providers, PS Drives adapters, Windows Management Instrumentation (WMI) and Common Information Model (CIM) ● Introduces you to the Windows PowerShell remoting technology that enables you to connect to one or more remote computers and instruct them to run commands on your behalf 		
UNIT	CONTENTS	HOURS
I	Introduction to Windows PowerShell Overview and background of Windows PowerShell, Understanding command syntax, Finding commands, Active Directory administration cmdlets, Network configuration cmdlets, Other server administration cmdlets. Understanding the pipeline, Selecting, sorting, and measuring objects, Filtering objects out of the pipeline, Enumerating objects in the pipeline, Sending pipeline data as output, Passing the pipeline data, Advanced considerations for pipeline data	9
II	PowerShell Adapters and Management Tools Using PS Providers, Using PS Drives, Creating files and folders on a remote computer, Creating a registry key for your future scripts, Create a new Active Directory group. Understanding WMI and CIM, Querying data by using WMI and CIM, Making changes with WMI/CIM, Querying information by using WMI, Querying information by using CIM, Invoking methods. Using variables, Manipulating variables, Manipulating arrays and hash tables, working with variable types, using arrays, Using hash tables	9
III	PowerShell scripting Introduction to scripting, Scripting constructs, Importing data from files, Setting a script, Processing an array with a ForEach loop, Processing items by using If statements, Creating a random password, Creating users based on a CSV file. Accepting user input, Overview of script documentation, Troubleshooting and error handling, Functions and modules, Querying disk information from remote computers, Updating the script to use alternate credentials, Documenting a script, Creating a logging function, Adding error handling to a script, Converting a function to a module	9
IV	Administering Remote Computers Using basic Windows PowerShell remoting, Using advanced Windows PowerShell, remoting techniques, Enabling remoting on the local computer, Performing one-to-one remoting, Performing one-to-many remoting, Using PSSessions, Using implicit remoting, managing Multiple computers.	9
V	Advanced Windows PowerShell techniques Using background jobs, Starting and managing jobs, Using scheduled jobs, creating a scheduled job. Creating profile scripts, Using advanced techniques, Practicing advanced techniques: Creating a profile script, Verifying the validity of an IP address, Reporting disk information, Configuring NTFS permissions, Creating user accounts with passwords from a CSV file, Practicing script development.	9
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students should be able to:		
CO1	Apply³ Network configuration cmdlets and server administration using cmdlets	
CO2	Plan⁶ Active Directory Group Using PowerShell Adapters and Management Tools	

CO3	Plan ⁶ Troubleshooting and error handling, Functions and modules
CO4	Apply ³ a logging function, Adding error handling to a script, Converting a function to a module
CO5	Apply ³ profile scripts, Using advanced PowerShell techniques
Text Books	Text Book: 1. Windows PowerShell Cookbook by leeholmes& dean Tsaltas, published by Shroff Publishers & distribution.

Lab - List of Programs

1	Configuring Windows PowerShell and working with basic commands.
2	Windows Administration and working with Objects
3	Working with file and pipeline parameter binding
4	Using PSproviders and PSdrives
5	Working with WMI and CIM
6	Perform basic network implementation, database management & detecting Attacks
7	Write the power shell script for following problem statement's
8	Create a PowerShell quiz script
9	Sample scripts for system administration on Azure Platform
10	PowerShell commands for active directory and Azure Active Directory

COURSE CODE	Enterprise Networking	Total Lecture: 60 Theory: 4 Practical: 15
CA21M306	(LTP =3 – 0 – 2 = 4)	

Course Objectives:

- Analyze state-of-the-art real-world enterprise-wide networks.
- Design build, and implement advanced enterprise-wide computer networks;
- Configure, troubleshoot, and maintain typical enterprise-wide computer networks
- Introduce both theoretical, practical, and technical issues in enterprise-wide computer networks

UNIT	CONTENTS	HOURS
I	Basic Network Principles, Explain IP operations, Explain TCP operations, Explain UDP operations, Layer 3 Technologies: IPv4 addressing, IPv6 addressing, Static Routing, Default Routing, Routing Protocol Types	9
II	Routing, Administrative Distance, Filtering with Any Protocol, Routing Information Protocol version2, Routing Information Protocol next generation	9
III	Routing Protocols, Enhanced Interior Gateway Routing Protocol, Open Shortest Path First, Redistribution, Manual and Auto Summarization, ROUTE maps.	9
IV	Advanced Routing, Manual and Auto Summarization, ROUTE maps, Loop prevention mechanisms, Border Gateway Protocol, VPN Routing and Forwarding instances lite, VPN Technologies.	9
V	WAN Technologies, Identify different Wide Area Network Technologies, Wide Area Network serial connection, Point-to-Point Protocol (PPP) connection, Explain Frame Relay	9

Course Outcomes as per Bloom's Taxonomy

At the end of the course the students should be able to:

CO1	Define ⁵ Static Routing, Default Routing.
CO2	Apply ³ Filtering the route with Any Protocol
CO3	Apply ³ Manual and Auto Summarization using ROUTE maps
CO4	Plan ⁶ VPN Routing and Forwarding instance using VPN Technologies
CO5	Apply ³ Point-to-Point Protocol (PPP) connection Using Cisco packet Tracer
Text Books	1. Network Warrior, SECOND EDITION, by Gary A. Donahue 2. CCNA Routing and Switching 200-120 Official Cert Guide Library by Wendell Odom

Lab - List of Programs

1. Executing of Switch Configuration - Basic Commands
2. Recognize Switch Configuration - Switch Port Security
3. Schematize Router - Configuration
4. Demonstrate Configuration of IP Address for a Router
5. Classify Setting up of Passwords
6. Compare PPP Encapsulation, PPP PAP Authentication, PPP CHAP Authentication
7. Differentiate Configuration of Static and Dynamic Routing
8. Analyse Configuration of Default Route
9. Execute Implementation of EIGRP
10. Execute Implementation of OSPF
11. Interpret VLAN Configuration
12. Show Switch Troubleshooting
13. Justify Configuration of Access-lists - Standard & Extended ACLs
14. Analyse Cisco Discovery Protocol
15. Illustrate DHCP, DHCP Relay & DHCP Exclusions
16. Demonstrate Configuring Logging to a Remote Syslog Server

COURSE CODE	Hybrid Cloud Computing	Total Lecture:45 Theory:45 Practical:00
CA21M307	(LTP =3 – 0 – 0 = 3)	
Course Objectives:		
<ul style="list-style-type: none"> ● Introducing Hybrid Cloud and its Management ● Managing Data, Workloads, Virtualization and deployment in Hybrid cloud. ● Planning Hybrid cloud resources and best practices that can be followed on Hybrid cloud computing. ● Using Azure cloud for implementing Hybrid Cloud environment. 		
UNIT	CONTENTS	HOURS
I	The Hybrid Cloud Explaining Hybrid Cloud, Services for Hybrid Cloud environment, Requirements for cloud Integration, Hybrid Cloud Management – Cloud Service management, Impact of Virtualization in Hybrid Cloud, Hybrid Cloud service Management Plan.	9
II	Managing Hybrid Cloud Environment Managing and Integrating Data, Managing Hybrid Workloads, Architectural Considerations, Development and Deployment in a Hybrid Cloud, Virtualization and the Hybrid Cloud.	9
III	Hybrid Cloud Strategy Planning Hybrid Cloud Strategy – Identifying Starting points, Plan for providing resources, supporting dynamic lifecycle, Complexity in cloud, Balancing costs and benefits, managing data storage in cloud – Hybrid cloud storage considerations, Support for storage growth and changes, Hybrid Cloud Resources, Hybrid Cloud Best Practices, Do’s and Don’ts of Hybrid Cloud.	9
IV	Azure as a Platform for Hybrid Cloud Execution Models – Websites, cloud services, Virtual machines, Data Management – SQL database, Storage Tables, Blobs, CDN, Bigdata, Messaging and Integration Components – Service Bus, Virtual Network, Traffic Manager, BizTalk services, Media and Mobile services, Supporting services – Caching, Identity Management, Private Cloud Components and services to build Hybrid Cloud.	9
V	Hybrid Options in Windows Azure On-Premises Service Integrated with cloud service – Using Windows azure services bus and virtual networks, Cloud services integrated with On-Premise service – Application on premise integration with Azure storage, Cloud Bursting and test cloud infrastructure, Disaster Recovery (DR) Site, Service bus as an Integration Hub, Enabling Modern applications, and Virtual desktops in Windows Azure.	9
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students should be able to:		
CO1	Understand ² Hybrid cloud and its management.	
CO2	Define ⁵ Manage and Integrate Data, Workloads and deployment of application on Cloud.	
CO3	Plan ⁶ Virtualization on Hybrid cloud environment.	
CO4	Plan ⁶ for Hybrid cloud strategy and manage resources following the best practices.	
CO5	Apply ³ Microsoft Azure platform for implementing Hybrid cloud environment.	
Text Books	1. Judith Hurwitz , Marcia Kaufman , Fern Halper , Daniel Kirsch, “ Hybrid Cloud for Dummies“, John Wiley & Sons Inc., 2nd Edition, 2012.	
	Reference Books: 1. Danny Garber, “Windows Azure Hybrid Cloud”, “, John Wiley & Sons Inc., 2013.	

COURSE CODE	CLOUD MIGRATION	Total Lecture:45 Theory:45 Practical:0
CA21M308	(LTP =3 – 0 – 0 = 3)	
Course Objectives :		
<ul style="list-style-type: none"> ● To get introduced to cloud migration and its strategies and To Analyze enterprise cloud adaption techniques. ● To explain migration of large scale services to the cloud with benefits of cloud adoption. ● To learn migrating services to AWS cloud using cloud adoption framework. ● Determine and Analyze cloud adaption framework and risk migration methodology for cloud migration ● To Apply the concepts of migrating web application to cloud 		
UNIT	CONTENTS	HOURS
I	Getting started with moving to cloud Introduction to Cloud Migration – Migrating Business Applications to Public Cloud Services, Benefits of Migrating data and workloads to the Cloud, Types of Cloud Migration Strategies, Migration Tools, Cloud Transformation Maturity Model, Ensuring Successful Cloud Adoption– Cloud Storage, Application performance, Data Integration, Security, Interoperability, Moving Organization to Cloud – Delivering Business Processes from the Cloud, Cloud Migration Strategy and Plan, Efficient Steps for cloud migration.	9
II	Cloud Migration Plan Introduction to Migration Plan – Key elements of a Cloud Migration Plan, Migration plan considerations – Time Management, Workloads being migrated, Migration priorities, Definition of process and roles, Security, Vendor Selection, Selecting the deployment model, Validating the services to be moved to cloud, Performance metrics, Effectiveness of cloud migration, Migration and deployment options, Optimization and Cost Management in an effective cloud migration, Business continuity after Migration, Case Study on Cloud Migration.	9
III	Migrating Services to Cloud: Challenges Migrating Services to AWS, Cloud Adoption Framework, Successful Migration, Understanding On-premises cost, Migration cost considerations, Broad Aspects of Migration into Cloud, Migration of virtual Machines and techniques, Fault Tolerance Mechanisms, Migration Risks – Architectural complexity, Poor Application selection, Application dependencies, Unwanted Latency, Privacy and Security Considerations, Fault tolerance and Availability, Organizational concerns – Measuring and assessment of risks, Risk Mitigation methodology for Cloud Migration.	9
IV	Migrating Large scale services to the cloud Steps for ensuring successful large scale cloud migration, Handling Failures, Risks involved in working at a big scale migration, Pre-release and deployment considerations, Monitoring and Alerting, Mitigation.	9
V	Migration Case Studies Migrating an on-premise application to cloud, migrating web applications to AWS cloud and Google cloud, Migrating Batch Processes to the cloud, Migrating Backend Processing pipeline to the cloud, migrating from an End-of-Life Data Center to AWS.	9
Course Outcomes as per Bloom's Taxonomy		
At the end of the course the students should be able to:		
CO1	Understand² the Cloud Migration Strategy for Different cloud providers	
CO2	Plan⁶ a cloud migration based on a client requirement and ensuring business continuity even after migration.	
CO3	Define⁵ and identify various migrating strategies that can be used for a given scenario.	
CO4	Define⁵ various risks involved in a big scale migration.	
CO5	Apply³ Migrating an on-premise application to Cloud	

Text Books	Text Book 1. "Migrating Large-Scale Services to the Cloud" Eric Passmore 1st Edition, 2016. Reference Books 1. "A Practical Guide to Cloud Migration - Migrating Services to AWS (AWS Whitepaper)" Amazon Web Services, AWS White Paper December 2015, Kindle Edition.
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COURSE CODE	FINAL PROJECT/ INTERNSHIP	Practical:40
PB20M401	(LTP =0 – 0 – 40 = 20)	
<p>Course Objectives:</p> <ul style="list-style-type: none"> • Final Project represents the culmination of study towards the Master of Computer Application (Cloud Computing) Degree. Projects offer the opportunity to apply and extend material learned throughout the program. Assessment is by means of a seminar presentation, submission of a report, and a public demonstration of work undertaken. • In contrast to the majority of courses studied elsewhere in the program, projects are undertaken individually or in small groups. This necessarily introduces the dimension of workload management into the program to enable completion of a large, relatively unstructured "assignment" over the course of the semester. • The projects undertaken span a diverse range of topics, including theoretical, simulation and experimental studies, and vary from year to year. The emphasis is necessarily on facilitating student learning in technical, project management and presentation spheres. 		
<p>Guidelines for Submission of MCA Project All the students of MCA (Cloud Computing) final year are required to submit a project report based on the work done by him/her during the project period.</p>		
<p>THE GUIDE Each of the student/group will be assigned a faculty member as project guide.</p>		
<p>PROJECT TIME / MAN-HOURS</p> <ul style="list-style-type: none"> • The Final Projects would be 40 man-hours per week carries a total of 500 marks. • The Project topics should be based on syllabus or as per the requirement of specific industry in sync with the course. • Every student has to prepare and submit the project work separately. • Plagiarism would not be accepted under any circumstances. • Project Report should compulsorily include the software development; soft copy should also be submitted in CD along with Hard Bound Project report. 		
<p>Project Evaluation Guidelines. The project is evaluated on the basis of following aspects: Presentation - 25% of total marks. Project Report - 30% of total marks. Demonstration - 10% of total marks. Methodology - 15% of total marks. Viva - 20% of total marks. Passing criteria is 50% of overall marks allotted to the project</p>		
<p>COURSE OUTCOMES AS PER BLOOM'S TAXONOMY</p>		
<p>At the end of the course the students should be able to:</p>		
<p>Understand²an engineering project.</p>		
<p>Design⁶ engineering solutions to complex problems utilising a systems approach.</p>		
<p>Define² and identify various migrating strategies that can be used for a given scenario.</p>		
<p>Apply³ and undertake problem identification, formulation and solution.</p>		
<p>Demonstrate³ a sound technical knowledge of their selected project topic.</p>		