DR. D. Y. PATIL SCHOOL OF SCIENCE & TECHNOLOGY

DR. D. Y. PATIL VIDYAPEETH, PUNE

(Deemed to be University)

(Accredited (3rd cycle) by NAAC with a CGPA of 3.64 on four-point scale at 'A++' Grade)

(Declared as Category - I University by UGC Under Graded Autonomy Regulations, 2018)

(An ISO 9001: 2015 and 14001:2015 Certified University and Green Education Campus)

MCA detailed syllabus for Semester III & IV

SEMESTER III							
Course Code	**Course Type as per NEP**	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
MCA-CA-301	MAJOR	Introduction to Data Science	4	0	0	4	4
MCA-CA-302	MAJOR	Advanced Data Structure	3	0	4	7	5
MCA-CA-303	MAJOR	Data Communication and Networks	3	0	2	5	4
PEC-CA-301	DSE	Discipline Specific Elective	3	0	4	7	5
PCC-CA-301	VA	Value Added	1	0	2	3	2
HSMC-CA-301	AEC	Ability Enhancement Course	2	0	0	2	2
		Total	16	0	12	28	**22**

VA: Computer Assembly & Repair
DSE: DevOps/Cloud (AWS/AZURE)/Salesforce/ open elective III
AEC:Physical Education/ NSS/NCC/Internship/Apprenticeship

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Dr. D. Y. Patil School of Science & Technology

Second Year (3rd SEM) MCA (2024-25 Course)

MCA-CA-301 : Introduction to Data Science

Teaching Scheme:	Credit	Examination Scheme:
TH: _4_ Hours/Week	**_3_**	**Internal (TH): _40_ Marks** **External (TH): _60_ Marks**

Prerequisite Courses, if any:

- Fundamentals of Data Science
- Basic of mathematics, Calculus and Statistics

Companion Course, if any: NO

Course Objectives:

- To focus on the analysis of data to extract knowledge and insight.
- Identify and describe the methods and techniques commonly used in data science.
- Demonstrate proficiency with the methods and techniques for obtaining, organizing, exploring, and analyzing data.
- Recognize how data analysis, inferential statistics, modeling, machine learning, and statistical computing can be utilized in an integrated capacity.
- Create and modify customizable tools for data analysis and visualization per the evaluation of characteristics of the data and the nature of the analysis.
- Demonstrate the ability to clean and prepare data for analysis and assemble data from a variety of sources. To introduce the data science

Course Outcomes:

On completion of the course, learner will be able to–

1. Recognize various disciplines that contribute to a successful data science effort.
2. Understand the processes of data science - identifying the problem to be solved, data collection, preparation, modeling, evaluation and visualization.
3. Able to use basic data structures in loading, cleaning the data and preprocessing the data.
4. Develop and appreciate various techniques for data modeling and mining.
5. Able to cognizant of ethical issues in many data science tasks and its associated libraries for data analytics and visualization.
6. Able to do the exploratory data analysis on real time datasets to understand and implement lists, vectors, matrices, data frames, linear regression.

Course Contents

Unit I	Introduction	(04 Hours)

Introduction to Data Science – Evolution of Data Science – Data Science Roles – Stages in a Data Science Project – Applications of Data Science in various fields – Data Security Issues.

Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Understanding data science**	**(06 Hours)**
Introduction – Types of Data: Numeric – Categorical – Graphical – High Dimensional Data – Classification of digital Data: Structured, Semi-structured and Un-structured - Example Applications. Sources of Data: Time Series – Transactional Data – Biological Data – Spatial Data – Social Network Data – Data Evolution.		
Mapping of Course Outcomes for Unit II	CO1, CO2	
Unit III	**Data Collection and Data Pre-Processing**	**(04 Hours)**
Data Collection Strategies – Data Pre-Processing Overview – Data Cleaning – Data Integration and Transformation – Data Reduction – Data Discretization.		
Mapping of Course Outcomes for Unit III	CO2,CO3	
Unit IV	**Exploratory Data Analytics**	**(04 Hours)**
Descriptive Statistics – Mean, Standard Deviation, Skewness and Kurtosis – Box Plots – Pivot Table – Heat Map – Correlation Statistics – ANOVA.		
Mapping of Course Outcomes for Unit IV	CO3, CO4	
Unit V	**Model Development**	**(06 Hours)**
Simple and Multiple Regression – Model Evaluation using Visualization – Residual Plot – Distribution Plot – Polynomial Regression and Pipelines – Measures for In-sample Evaluation – Prediction and Decision Making.		
Mapping of Course Outcomes for Unit V	CO4, CO5	
Unit VI	**Model Evaluation**	**(06 Hours)**
Generalization Error – Out-of-Sample Evaluation Metrics – Cross Validation – Over fitting – Under Fitting and Model Selection – Prediction by using Ridge Regression – Testing Multiple Parameters by using Grid Search		
Mapping of Course Outcomes for Unit VI	CO6	
Learning Resources		

Text Books:

1. An introduction to Data Science by Jeffrey Stanton
2. The Elements of Data Analytic Style by Jeff Leek
3. Exploratory Data Analysis with R, by Roger Peng
4. OpenIntro Statistics, by Diez, Barr, and Centinkaya-Rundel

Reference Books:

1. Jojo Moolayil, “Smarter Decisions : The Intersection of IoT and Data Science”, PACKT, 2016.
2. Cathy O’Neil and Rachel Schutt , “Doing Data Science”, O'Reilly, 2015.
3. David Dietrich, Barry Heller, Beibei Yang, “Data Science and Big data Analytics”, EMC 2013
4. Raj, Pethuru, “Handbook of Research on Cloud Infrastructures for Big Data Analytics”, IGI Global.

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

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Dr. D. Y. Patil School of Science & Technology

Second Year of MCA (2024-25 Course)

302 : Advanced Data Structures

Teaching Scheme:	Credit	Examination Scheme:
TH: 3 Hours/Week	**5**	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

- Data Structures & Algorithms

Course Objectives:

- To develop a logic for graphical modelling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, learner will be able to–

1. Identify and implement the complexity goals and benefits of a good hashing scheme for real world applications.
2. To apply appropriate advanced data structure and efficient algorithms to approach the problems of various domain.
3. Design and specify the operations of a non-linear based abstract data type and implement them in high level programming language.
4. To use effective and efficient data structures in solving various Computer Engineering domain problems.
5. To analyze the algorithmic solutions for resource requirements and optimization
6. To use appropriate modern tools to understand and analyze the functionalities confined to the data structure usage.

Course Contents

Unit I	Hashing	(07 Hours)

Hash Table- Concepts-hash table, hash function, bucket, collision, probe, synonym, overflow, open hashing, closed hashing, perfect hash function, load density, full table, load factor, rehashing, issues in hashing, hash functions- properties of good hash function, division, multiplication, extraction, mid-square, folding and universal, Collision resolution strategies- open addressing and chaining, Hash table overflow- open addressing and chaining, extendible hashing.

Skip List- representation, searching and operations- insertion, removal.

#Exemplar/Case Studies	Implement Dictionary as an ADT
Mapping of Course Outcomes for Unit I	CO1, CO4

Unit II	Search Trees	(07 Hours)

Weight balanced tree, Optimal Binary Search Tree (OBST), Examples of OBST, Multiway search tree- Overview, Implementation, B-Tree- Overview, Operations on B-Tree, B+Tree- Overview, Operations on B+ Tree, Height Balanced Tree- AVL tree- Properties, Rotations, Insertion, Deletion, Red Black Tree- Properties, Rotations, Insertion, Deletion.		
#Exemplar/Case Studies	Study and analyze OBST implementation by using Dynamic Programming.	
Mapping of Course Outcomes for Unit II	CO2, CO3, CO4	
Unit III	**Indexing Trees**	**(07 Hours)**
Indexing and Multiway Trees- Indexing, indexing techniques, Trie Tree, Splay Tree, K-dimensional tree. Heap-Basic concepts, realization of heap and operations, Heap as a priority queue, heap sort, Binary Heap: Structure Property, Heap Order Property, Basic Heap Operations: insert, delete, Percolate down, Other Heap Operations.		
#Exemplar/Case Studies	Study and analyze use of Indexing tree in DNS.	
Mapping of Course Outcomes for Unit III	CO2,CO3, CO5	
Unit IV	**Graphs**	**(07 Hours)**
Overview of Elementary Graph Algorithms, Topological sort, Single Source Shortest Path Algorithms: Dijkstra's, Bellman-Ford, A*, All-Pairs Shortest Paths: Floyd-Warshall's Algorithm.		
#Exemplar/Case Studies	Compare single pair shortest path algorithms with respect to complexity.	
Mapping of Course Outcomes for Unit IV	CO2, CO3, CO4	
Unit V	**SET Theory**	**(06 Hours)**
Disjoint Sets – Equivalence relation, Basic Data Structure, Simple Union and Find algorithms, Smart Union and Path compression algorithm. String Matching – The naive string-matching algorithm, The Rabin-Karp algorithm, The Knuth-Morris-Pratt algorithm.		
#Exemplar/Case Studies	Implement real time applications of SET theory	
Mapping of Course Outcomes for Unit V	CO2, CO5	
Unit VI	**File Organization**	**(06 Hours)**
Sequential file organization- concept and primitive operations, Direct Access File- Concepts and Primitive operations, Indexed sequential file organization-concept, types of indices, structure of index sequential file, Linked Organization- multi list files, coral rings, inverted files and cellular partitions. External Sort- Consequential processing and merging two lists.		
#Exemplar/Case Studies	Study and implement k way merge algorithm.	
Mapping of Course Outcomes for Unit VI	CO4, CO6	
Learning Resources		
Text Books:		

1. Horowitz, Sahani, Dinesh Mehata, ―Fundamentals of Data Structures in C++‖, Galgotia Publisher, ISBN: 8175152788, 9788175152786.
2. Y. Langsam, M. Augenstin, A. Tannenbaum, "Data Structures using C and C++", 2nd Edition, Prentice Hall of India, 2002, ISBN-81-203-1177-9.

Reference Books:

1. Classic Data Structures-D. Samanta, Prentice Hall India Pvt. Ltd.
2. Data Structures using C and C++- Yedidyah Langsam, Moshe J. Augenstein, Aaron M. Tenenbaum, Pearson Education
3. Data Structures: A Pseudo code approach with C, Richard Gilberg ,Behrouz A. Forouzan, Cengage Learning.
4. Introduction to Data Structures in C- Ashok Kamthane, Pearson Education
5. Algorithms and Data Structures, Niklaus Wirth, Pearson Education

@The CO-PO mapping table

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

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Dr. D. Y. Patil School of Science & Technology

Second Year MCA(2024-25 Course)

Advanced Data Structures Lab

Teaching Scheme	**Credit Scheme**	**Examination Scheme and Marks**
Practical: 04 Hours/Week	**05**	**Internal: 40 Marks** **External: 60 Marks**

Companion Course: Advanced Data Structures

Course Objectives:

- To develop a logic for graphical modelling of the real life problems.
- To suggest appropriate data structure and algorithm for graphical solutions of the problems.
- To understand advanced data structures to solve complex problems in various domains.
- To operate on the various structured data
- To build the logic to use appropriate data structure in logical and computational solutions.
- To understand various algorithmic strategies to approach the problem solution.

Course Outcomes:

On completion of the course, learner will be able to–

1. Apply appropriate advanced data structure and efficient algorithms to approach the problems of various domain.
2. Design and demonstrate the operations of a non-linear based abstract data type and implement them in high level programming language.
3. Apply and analyze effective and efficient data structures in solving various Computer Engineering domain problems.
4. Apply appropriate modern tools to understand and analyze the functionalities confined to the data structure usage.

Guidelines for Instructor's Manual

The instructor's manual should be created as a comprehensive guide and practical tool. It should encompass an introduction (detailing information about the University, program, institute, department, foreword, and preface), the course curriculum, guidelines for conducting classes and assessments, topics covered, concepts, objectives, outcomes, a selection of typical applications/assignments/guidelines, and reference materials..

Guidelines for Student's Laboratory Journal

Students are required to submit their laboratory assignments in the form of a journal. This journal should include a certificate, a table of contents, and a handwritten write-up for each assignment. The write-up should cover the assignment title, completion date, objectives, problem statement, software and hardware requirements, assessment grades/marks with the assessor's signature, a brief overview of the theory/concepts, algorithm, flowchart, test cases, test data set (if applicable), mathematical models (if applicable), and conclusion/analysis. Additionally, softcopies of program codes along with sample outputs for all assignments must be submitted. In an effort to promote environmental consciousness and contribute to Green IT, please refrain from attaching printed papers to the journal. Instead, it is encouraged to utilize a DVD containing students' programs, which will be maintained by the Laboratory In-charge. For reference purposes, one or two journals with program prints may be retained in the Laboratory.

Guidelines for Laboratory /Internal Assessment

The Continuous Assessment of laboratory work should consider a student's overall performance on laboratory assignments. Each assessment of laboratory assignments will allocate

grades/marks based on various criteria, including adherence to deadlines, performance, creativity, effective coding, and punctuality.

Guidelines for Practical Examination

The formulation of problem statements should be a collaborative effort between the internal and external examiners. In practical assessments, utmost importance should be placed on successfully executing the problem statement. Evaluation may include relevant questions to gauge students' grasp of fundamental concepts and their ability to implement solutions effectively and efficiently. This approach promotes transparent evaluation and fairness, thereby alleviating any uncertainty or doubt among students. Adhering to these principles will solidify our collective efforts for a promising beginning to students' academic journey.

Guidelines for Laboratory Conduction

The instructor should craft assignments by considering the topic's prerequisites, technological dimensions, practical applications, and current trends. The assignment policy should cater to the needs of average students while also incorporating elements to engage and challenge the more advanced learners. Utilization of open-source software is encouraged, aligning with the learned concepts. Additionally, the instructor must include an assignment or mini-project tailored to the specific branch, extending beyond the syllabus scope.

Operating System recommended :- Windows / Linux

Programming tools recommended: - Turbo C++, Open Source C++ Programming tool like G++/GCC

Virtual Laboratory:

- https://ds1-iiith.vlabs.ac.in/Introduction.html
- https://ds2-iiith.vlabs.ac.in/List%20of%20experiments.html

Part I : Name of the Lab

Suggested List of Laboratory Experiments/Assignments
(6 assignments are compulsory)

Sr. No.	Group A(Two Assignments are compulsory)
1.	Consider telephone book database of N clients. Make use of a hash table implementation to quickly look up client‘s telephone number.
2.	Given sequence k = k1 <k2 < … < kn of n sorted keys, with a search probability pi for each key ki . Build the Binary search tree that has the least search cost given the access probability for each key.
3.	Write C++ program to implement AVL tree with rotations.
4.	Write C++ program to implement Heap sort.
5.	Write C++ program to implement Dijkstras shortest path algorithm with suitable example.
6.	Write C++ program to implement Floyd Warshall algorithm with suitable example.
7.	Write C++ program to perform the following operations on SET: a) Union b) Intersection c) Set Difference
8.	Write C++ programs to implement: a) Sequential File. b) Indexed Sequential File
	Group B (Mini Project) **Select any one problem statement**
1.	Implement Optimal treaps with priority-changing parameters.

2.	Implement BSTs following the memoization algorithm.
3.	Build Obscure binary search trees.
4.	Implement K-d Trees for spatial data.
5.	Build Knight’s travails.
6.	Implement Search engine for data structures
7.	Build Stack-based text editor
8.	

@The CO-PO Mapping Matrix

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

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Second Year of MASTER OF COMPUTER APPLICATION (2024-25 Course)

MCA-CA-303 : Data Communication and Networks

Teaching Scheme:	Credit	Examination Scheme:
TH: 03 Hours/Week **PR: 02 Hours/Week**	04	**Internal (TH): 40 Marks** **External (TH): 60 Marks**

Prerequisite Courses, if any:

- Fundamentals of Digital Electronics
- Basic of Computer Networking, data communication

Companion Course, if any: Computer Networks

Course Objectives:

- To Understand the Architectural Overview of Internet.
- To Understand the use of network components.
- To Understand the various Error detection and correction methods.
- Understand the architecture and its components and working of OSI and TCP/IP models and its performance.
- To Explore and learn about IP v4 and IPv6 addresses.

Course Outcomes:

On completion of the course, learner will be able to–

CO1: To understand process of data communication along with analog and digital signals, various network architectures.

CO2: To understand various types of guided and unguided media for transmission of data.

CO3: To use different types of error detection and correction methods in wireless communication.

CO4: To study and design different types of topologies using network components.

CO5: To analyze use of OSI reference model for networking.

CO6: To use appropriate IP addressing as per network condition, its architecture and use(IPv4 and IPv6).

Course Contents

Unit I	**Fundamentals of Data Communication and Computer Networks**	**(06 Hours)**
Process of data communication and its components: transmitter, receiver, medium, message, protocol. Protocol Standards, Standard of analog and digital signals organizations. Bandwidth, Data Transmission Rate, Baud Rate and Bits per second. Modes of Communication (Simplex, Hall duplex, Full Duplex). Analog Signal and Digital Signal, Analog and Digital transmission: Analog to Digital, Digital to Analog Conversion. Fundamental Of Computer Network: Definition and Need of Computer Network, Applications, Network Benefits. Classification of networks: LAN, MAN, WAN. Network architecture: Peer to Peer, Client-Server Network.		
#Exemplar/Case Studies	Demonstration of LAN, peer to peer and client server network.	
Mapping of Course Outcomes for Unit I	CO1	
Unit II	**Transmission Media and Switching**	**(06 Hours)**

Communication Media: Guided Transmission Media, Twisted Pair Cable, Coaxial Cable, Fiber Optic Cable. Unguided Transmission Media, Radio Waves, Microwaves, Infrared, Satellite. Line-of-Sight Transmission Point to Point, Broadcast. Multiplexing: Frequency-Division multiplexing and Time-Division Multiplexing. Switching: Circuit-switched networks and Packet-switched networks.		
#Exemplar/Case Studies	Demonstration of various cables.	
Mapping of Course Outcomes for Unit II	CO2	
Unit III	**Error Detection, Correction and Wireless Communication**	**(06 Hours)**
Types of Errors: Single Bit Error and Burst Error, Redundancy. Error Detection: Longitudinal Redundancy Check (LRC), Vertical Redundancy Check (VRC), Cyclic Redundancy Check (CRC), Forward error Correction. IEEE standards: 802.1, 802.2, 802.3, 802.4, 802.5. Wireless LANs: 802.11 Architecture, MAC Sublayer, Addressing Mechanism. Bluetooth Architecture: Piconet, Scatternet. Mobile Generations: 1G, 2G, 3G, 4G and 5G.		
#Exemplar/Case Studies	Use of error detection and correction mechanism, Bluetooth mechanism.	
Mapping of Course Outcomes for Unit III	CO3	
Unit IV	**Network Topologies and Network Devices**	**(06 Hours)**
Network Topologies: Introduction, Definition, Selection Criteria, Types of Topology- i) Bus ii) Ring iii) Star iv) Mesh v) Tree vi) Hybrid. Network Connecting Devices: Hub, Switch, Router, Repeater, Bridge, Gateway, Modern, Wireless infrastructure Components.		
#Exemplar/Case Studies	Demonstration of various topologies and network devices.	
Mapping of Course Outcomes for Unit IV	CO4	
Unit V	**Reference Models**	**(06 Hours)**
OSI Reference Model: Layered Architecture, Peer-to- Peer Process, Interfaces between Layer, Protocols, Organization of the Layers, Encapsulation Layers of the OSI Reference Model (Functions and features of each Layer) - Physical Layer, Data Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, Application Layer. TCP/IP model: Layered Architecture, Data link layer: nodes and links, services, categories of links, sublayers, Link layer addressing: three types of addresses, address resolution protocol (ARP). Network Layer Addresses: address space, classful and classless addressing, dynamic host configuration protocol (DHCP), network address resolution (NAT). Transport layer protocol: transport layer services, connectionless and connection-oriented protocol.		
#Exemplar/Case Studies	Uses of OSI model	
Mapping of Course Outcomes for Unit V	CO5	
Unit VI	**Introduction to IPv4 and IPv6**	**(06 Hours)**
Introduction: Addressing mechanism in the Internet IP Addressing — IP Address classes, classless IP addressing, Subnetting, supernetting, Masking. IPv4 and IPv6 with all format details.		

#Exemplar/Case Studies	Demonstration of IPv4 and IPv6 addresses.
Mapping of Course Outcomes for Unit VI	CO6

Learning Resources

Text Books:

1. Forouzan Behrouz A. - Data communications and networking|| Tata McGraw Hill, New Delhi , 2006, ISBN : 0070472971.
2. Tanenbaum Andrew S. - Computer Networks || PHI Learning Pvt Ltd, Delhi , ISBN-13: 978-0-13-2126953.

Reference Books:

1. Godbole Achyut - Data communications and networks|| Tata McGraw Hill, New Delhi, ' 2006, ISBN : 0070472971.
2. Comer Douglas E - Internetworking with TCP/IP Principles, Protocols and Architectures|| PHI Learning Pvt Ltd, Delhi, ISBN: 81-203-2065-4.

Practical List:

1. Prepare specification table for guided and unguided media
2. Classify network connecting devices with their specifications.
3. Create a small Network. Install, configure various devices and perform at least one peer -to-peer service and client/server service over it.
4. Design layout of a Network for department, Deciding upon type of network, number/length of components with their specifications.
5. Interconnect two PCs using RS232 cable. Write step by step procedure to transfer a file from one computer to another through RS232 and implement.
6. Prepare hardware specification to develop a wireless LAN for a cyber café for 20 users.
7. Create a Bluetooth network of 5 devices namely laptop, mobile phone, speaker, printer, keyboard and transfer file from one device to other. Configure your laptop/mobile as a hotspot for internet access.
8. Prepare a proposal to develop a network system that links two branch offices of an organization. Two branches are separated by a distance of 10KM. Make appropriate assumption while making proposal.

@The CO-PO mapping table

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

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Dr. D. Y. Patil School of Science & Technology
Second Year of MASTER OF COMPUTER APPLICATION (MCA)
(2024-25 Course)
PEC-CA-301: Discipline Specific Elective -5 (Cloud(AWS/Azure)

Teaching Scheme:	Credit	Examination Scheme:
TH: 2 Hours/Week	4	**Internal (TH): 20 Marks** **External (TH): 30 Marks**

Prerequisite Courses, if any:

- Fundamentals of Embedded Systems, IoT
- Basic of Computer Networking, data communication ,

Companion Course, if any: Embedded Systems and IoT

Course Objectives:

1. Describe the AWS Cloud and the AWS global infrastructure
2. Recognize and explain basic AWS Cloud architectural principles
3. Describe key services on the AWS platform and their common use cases
4. Describe the basic security and compliance aspects of the AWS platform and the shared security model
5. Define the billing, account management, and pricing models
6. Describe basic/core characteristics of deploying and operating in the AWS Cloud
7. To understand the azure virtual machines
8. Recognize the services offered by Azure
9. Understand the azure storage
10. Configure the Azure active directory services To understand the azure virtual machines
11. Recognize the services offered by Azure
12. Understand the azure storage
13. Configure the Azure active directory services

Course Outcomes:

On completion of the course, learner will be able to–

CO1:Windows Azure Account and IAAS, PAAS, SAAS on Aws Cloud platform (Creation & Apply)

CO2 :Virtual Machine on Server Application (Plan)

CO3: Virtual Machine to cluster and deployment of load balances and Managing Voluminous Information with EBS, Glacier Storage Service (Understand)

CO4: Interpret Architecture and Pharrell Programing of Cloud Computing. (Apply)

CO5: Demonstrate practical implementation of Cloud computing and to understand the azure virtual machines . and Amazon Identity and Access Management ,Internet Gateway in Cloud Platform (Understand)

Course Contents

Unit I	**Introduction to Microsoft Azure Virtual machines**	**(09 Hours)**

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		
#Exemplar/Case Studies	Food Service	
Mapping of Course Outcomes for Unit I	CO1,CO2	
Unit II	**Azure Networking**	**(09 Hours)**
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		
#Exemplar/Case Studies	Payment Gateway	
Mapping of Course Outcomes for Unit II	CO2, CO3	
Unit III	**Azure Storage**	**(09 Hours)**
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 georeplication - Scalability strategies - Importing and exporting data.		
#Exemplar/Case Studies	Media BroadCasting Service	
Mapping of Course Outcomes for Unit III	CO2,CO3	
Unit IV	**Introduction to Cloud Computing And Amazon Web Services**	**(09 Hours)**
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.		
#Exemplar/Case Studies	Pricing Model: Usage Reporting, billing andmetering (AWS), Cloud Statistics	
Mapping of Course Outcomes for Unit IV	CO3, CO5	
Unit V	**AWS Storage**	**(09 Hours)**

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		
#Exemplar/Case Studies	Cryon	
Mapping of Course Outcomes for Unit V	CO3, CO5	
Unit VI	**AWS Networking**	**(09 Hours)**
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 SUB DNS System, Cloud front, Case Study		
#Exemplar/Case Studies	Xebia	
Mapping of Course Outcomes for Unit VI	CO4,CO5	

Learning Resources

Text Books:

3. Microsoft Azure Essentials: Fundamentals of Azure, 2nd Edition, Michael Collier, Robin Shahan ISBN: 978-1-5093-0296-3.
1. AWS Certified Solutions Architect Official Study Guide: Associate Exam (Aws Certified Solutions Architect Official: Associate Exam) by Joe Baron,Hisham Baz , Tim Bixler , Biff Gaut, Kevin E. Kelly

ISBN: 978-1119138556

Reference Books:

1. Cloud Computing Bible by Barrie Sosinsky, Wiley India Pvt. Ltd,
2. Microsoft Azure Essentials: Fundamentals of Azure (ISBN 9780735697225), Michael S. Collier and Robin E. Shahan
3. Microsoft Azure Essentials: Fundamentals of Azure (ISBN 9780735697225),
4. Yohan Wadia , "AWS Certified Solutions Architect Official Study Guide: Associate Exam, John Packt Publishing
5. Bernald Golden, "Amazon Web Services for Dummies", John Wiley & Sons.

@The CO-PO mapping table												
PO	**PO1**	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**
CO1	3	1	2	1	2	3	-	-	1	-	-	1
CO2	3	1	3	1	3	3	-	-	1	-	-	-
CO3	3	2	3	2	3	2	2	-	1	-	-	-
CO4	3	2	3	2	1	2	-	-	1	-	-	-
CO5	3	2	3	1	1	1	1	-	1	-	-	1

Dr. D. Y. Patil Vidyapeeth, Pimpiri, Pune
Dr. D. Y. Patil School of Science & Technology
Second Year of MASTER OF COMPUTER APPLICATION (MCA)
(2024-25 Course)
PEC-CA-301: Discipline Specific Elective -5 (Cloud(AWS/Azure))

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	**04**	**Internal: 40 Marks** **External: 60 Marks**

Companion Course: ESC-CS 601: Cloud Computing

Course Objectives:

- 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
- To understand the azure virtual machines
- Recognize the services offered by Azure
- Understand the azure storage
- Configure the Azure active directory services

Course Outcomes:

On completion of the course, learner will be able to–

CO1 : : IAAS, PAAS, SAAS on Aws Cloud platform and Monitoring Azure Services (Apply)
CO2 : EC2 instances from of AMI's and Windows Azure Account (Creation)
CO3 : Managing Voluminous Information with EBS, Glacier Storage Service and Virtual Machine on ServerApplication (Plan)
CO4 : Amazon Identity and Access Management(Understand)
CO5 : VPC And Internet Gatewayin Cloud Plarform and Monitoring Azure Services (Plan)

Guidelines for Instructor's Manual

The instructor's manual should be created as a comprehensive guide and practical tool. It should encompass an introduction (detailing information about the University, program, institute, department, foreword, and preface), the course curriculum, guidelines for conducting classes and assessments, topics covered, concepts, objectives, outcomes, a selection of typical applications/assignments/guidelines, and reference materials..

Guidelines for Student's Laboratory Journal

Students are required to submit their laboratory assignments in the form of a journal. This journal should include a certificate, a table of contents, and a handwritten write-up for each assignment. The write-up should cover the assignment title, completion date, objectives, problem statement, software and hardware requirements, assessment grades/marks with the assessor's signature, a brief overview of the theory/concepts, algorithm, flowchart, test cases, test data set (if applicable), mathematical models (if applicable), and conclusion/analysis. Additionally, softcopies of program codes along with sample outputs for all assignments must be submitted. In an effort to promote environmental consciousness and contribute to Green IT, please refrain from attaching printed papers to the journal. Instead, it is encouraged to utilize a DVD containing students' programs, which will be maintained by the Laboratory In-charge. For reference purposes, one or two journals with program prints may be retained in the Laboratory.

Guidelines for Laboratory /Internal Assessment

The Continuous Assessment of laboratory work should consider a student's overall performance on

laboratory assignments. Each assessment of laboratory assignments will allocate grades/marks based on various criteria, including adherence to deadlines, performance, creativity, effective coding, and punctuality.

Guidelines for Practical Examination

The formulation of problem statements should be a collaborative effort between the internal and external examiners. In practical assessments, utmost importance should be placed on successfully executing the problem statement. Evaluation may include relevant questions to gauge students' grasp of fundamental concepts and their ability to implement solutions effectively and efficiently. This approach promotes transparent evaluation and fairness, thereby alleviating any uncertainty or doubt among students. Adhering to these principles will solidify our collective efforts for a promising beginning to students' academic journey.

Guidelines for Laboratory Conduction

The instructor should craft assignments by considering the topic's prerequisites, technological dimensions, practical applications, and current trends. The assignment policy should cater to the needs of average students while also incorporating elements to engage and challenge the more advanced learners. Utilization of open-source software is encouraged, aligning with the learned concepts. Additionally, the instructor must include an assignment or mini-project tailored to the specific branch, extending beyond the syllabus scope.

Operating System recommended :- Ghost OS,CloudMe

Programming tools recommended: - CloudZero,Amazon Web Services,Google App Engine

Virtual Laboratory:

- https://vlab.noaa.gov/web/osti-modeling/cloud-computing1
- https://www.codio.com/solutions/virtual-labs

Part I : Cloud Computing

Suggested List of Laboratory Experiments/Assignments
(6 assignments are compulsory)

Sr. No.	Group A(Two Assignments are compulsory)
1.	AWS root user account creation using AWS management console
2.	Understanding AWS Billing Dashboard and Setting up billing alerts using Cloud Watch
3.	Launching an EC2 instance and accessing it through SSH using putty.
4.	Creating web server on EC2, with and without bash script
5.	Create and document the process of creating a windows azure account
6.	Create a virtual machine from available releases of windows server images
7.	Create a virtual machine using the option “quick Create”
8.	Create a custom VM and Capture the image
	Group B (Mini Project) **Select any one problem statement**
1.	Creating and hosting static web site using S3 bucket.
2.	Demonstrating Amazon SNS service.

3.	Configuration of Database engine using Amazon RDS.
4.	Creating DNS using Route 53
5.	Create a SQL server DB , Create tables and add data to the table
6.	Test basic sql commands on the table created in the previous step.
7.	Migrate an on premise DB to Azure
8.	Create a storage account in Azure

@The CO-PO Mapping Matrix

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

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune
Dr. D. Y. Patil School of Science & Technology
Second Year MASTER OF COMPUTER APPLICATION
MCA Sem III (2024-25 Course)
Discipline Specific Elective -6 Lab

Teaching Scheme	Credit Scheme	Examination Scheme and Marks
Practical: 02 Hours/Week	**04**	**Internal: 40 Marks** **External: 60 Marks**

Companion Course: PEC-CA-301 Discipline Specific Elective -6 (DevOps)

Course Objectives:

- To understand DevOps practices which aims to simplify Software Development Life Cycle
- To be aware of different Version Control tools like GIT, CVS or Mercurial
- To Integrate and deploy tools like Jenkins and Maven, which is used to build, test and deploy applications in DevOps environment
- To be familiarized with selenium tool, which is used for continuous testing of applications deployed.
- To use Docker to Build, ship and manage applications using containerization
- To understand the concept of Infrastructure as a code and install and configure Ansible tool

Course Outcomes:

On completion of the course, learner will be able to–

CO1: To understand the fundamentals of DevOps engineering and be fully proficient with DevOps terminologies, concepts, benefits, and deployment options to meet your business requirements **CO2:** To obtain complete knowledge of the "version control system" to effectively track changes augmented with Git and GitHub.

CO3: To understand the importance of Jenkins to Build and deploy Software Applications on server environment.

CO4: Understand the importance of Selenium and Jenkins to test Software Applications.

CO5 : To understand concept of containerization and Analyze the Containerization of OS images and deployment of applications over Docker and To understand concept of containerization and Analyze the Containerization of OS images and deployment of applications over Docker

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Operating System recommended: - Windows

Programming tools recommended: - Android

Virtual Laboratory:

Part I: Applied Cryptography & Network Security Lab

Suggested List of Laboratory Experiments/Assignments
(8 assignments are compulsory)

Sr. No.	Group A
9.	To understand DevOps: Principles, Practices, and DevOps Engineer Role and Responsibilities.
10.	To understand Version Control System / Source Code Management, install git and create a GitHub account.
11.	To Perform various GIT operations on local and Remote repositories using GIT Cheat-Sheet

12.	To Setup and Run Selenium Tests in Jenkins Using Maven.
13.	To understand Continuous Integration, install and configure Jenkins with Maven/Ant/Gradle to setup a build Job.
14.	To understand Docker Architecture and Container Life Cycle, install Docker and execute docker commands to manage images and interact with containers.
15.	To Build the pipeline of jobs using Maven / Gradle / Ant in Jenkins, create a pipeline script to Test and deploy an application over the tomcat server.
16.	To understand Jenkins Master-Slave Architecture and scale your Jenkins standalone implementation by implementing slave nodes.
	Group B
9.	To install and Configure Pull based Software Configuration Management and provisioning tools using Puppet.
10	To provision a LAMP/MEAN Stack using Puppet Manifest.
11	To learn Software Configuration Management and provisioning using Puppet Blocks(Manifest, Modules, Classes, Function) (Mini Project)

@The CO-PO Mapping Matrix

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

SEMESTER IV							
Course Code	**Course Type as per NEP**	**Course Name**	**L**	**T**	**P**	**Hr**	**Cr**
PCC-CA-401	MAJOR	Research Project / CAPSTONE Project/Internship	0	0	32	32	16
		Total			32	32	16

Dr. D. Y. Patil Vidyapeeth, Pimpri, Pune

Dr. D. Y. Patil School of Science & Technology

Final Year of Master of Computer Application (2024-25 Course)

PCC-CA 401 : Research Project/Internship

Teaching Scheme:	**Credit**	**Examination Scheme:**
TH: 32 Hours	**16**	**Internal (TH): 100 Marks** **External (TH): 400 Marks**

Prerequisite Courses, if any:

- In depth knowledge about societal/research/innovation/ entrepreneurial problems and appropriate applicable solutions

Companion Course, if any: Embedded Systems and IoT

Course Objectives:

- To gain the experience in preparing and writing Technical
- Documentation/ reports for product/projects.
- To Identify and analyze the societal/research/entrepreneurial
- Problem in detail to define its scope with problem specific data.
- To develop clarity of presentation based on communication,
- Teamwork and leadership skills.

Course Outcomes:

After completion of the course students will be able to use different experimental techniques.
CO1: Students will be able to use different software/ computational/analytical tools.
CO2: Students will be able to design and develop an experimental set up/ equipment/test rig.
CO3: Students will be able to conduct tests on existing set ups/equipment and draw logical conclusions from the results after analyzing them.
CO4: Students will be able to either work in a research environment or in an industrial environment.
CO5: Students will be conversant with technical report writing.
CO6: Students will be able to present and convince their topic of study to the engineering community.

Research Project/Internship	**Supporting Activities to be completed under Research Project/Internship**	32 hours/ Week

Selection of Technology, Installations, UML implementations, testing, Results, and performance discussions using data tables per parameter considered for the improvement with existing known algorithms and comparative graphs to support the conclusions drawn. Student should publish one International Journal Paper (having ISSN Number and preferably with Citation Index II); or paper can be published in reputed International Journal recommended by the guide of the project and in addition to above the term work shall include the paper published, reviewers comments and certificate of presenting the paper in the conference. To maintain the quality of the project work it is mandatory on the project guides to maintain a progressive record of the project which shall include the project discussion agenda, weekly outcomes achieved during practical sessions, corrective actions and comments on the progress report as per the plan submitted by the students including dates and timing,

along with the signature of the student as per the class and teacher time table; such record of progressive work shall be referred by the project examiners during evaluation.

Criteria:

- Regularity in maintenance of the diary/log.
- Adequacy & quality of information recorded.
- Drawings, sketches and data recorded.
- Thought process and recording techniques used.
- Organization of the information.

After completion of Internship, the student should prepare a comprehensive report to indicate what he has observed and learnt in the training period.

@The CO-PO mapping table

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