



Gyanmanjari
Innovative University

Syllabus
Gyanmanjari College of Computer Application
Semester-I (MCA)

Subject: Cloud Computing and Virtualization - MCA2CC11505

Type of course: Minor Stream

Prerequisite: Knowledge of virtualization concepts, basic networking protocols, cloud service models and familiarity with any Linux/Unix operating system environment.

Rationale:

This course provides a structured and in-depth understanding of Cloud Computing and Virtualization through both theoretical concepts and practical implementation. It covers cloud architecture, virtualization types and platforms, virtual machine management, cloud service and deployment models, VM scheduling, cloud storage, network virtualization, cloud security, synchronization, deadlocks, and container management. Students also work with cloud utilities, filters, communication commands, disk scheduling, security principles, and cloud file management techniques. Practical exercises and simulations using tools reinforce learning and enable students to apply core cloud computing and virtualization mechanisms effectively.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks		Total Marks
CI	T	P	C	SEE	CCE	
4	0	2	5	100	50	150

Legends: CI-Classroom Instructions; T-Tutorial; P-Practical; C-Credit; ESE-End Semester Examination; MSE-Mid Semester Examination; V-Viva; CA-Continuous Assessment; ALA-Active Learning Activities.

Course Content:

Sr. No.	Course Content	Hrs.	% Weightage
	Introduction to Cloud Computing and AWS Basics Theory Topics: Cloud computing means using the internet to store data, run applications, and access resources instead of a local computer. The main service models are IaaS (virtual machines and storage), PaaS (development platforms), and SaaS (ready-to-use apps like Gmail).		



1	Deployment types are Public Cloud (available to everyone), Private Cloud (for one organization), and Hybrid Cloud (a mix of both). AWS(Amazon Web Services) is the most popular cloud platform. Key AWS services: EC2 (virtual servers), S3 (file storage), IAM (user access control), and the AWS Management Console for easy point-and-click setup. Practical: 1. Create a free AWS account and explore the AWS Management Console dashboard. 2. Launch a basic EC2 instance (virtual server) using the default settings and connect to it. 3. Create an S3 bucket, upload a file to it, and make it publicly accessible. 4. Create an IAM user with limited permissions and log in using that user. 5. Stop and terminate an EC2 instance and observe billing changes in the console. 6. Write a simple shell script that prints 'Hello from AWS EC2' and run it on the instance. 7. Use AWS CLI to list all S3 buckets and EC2 instances from the terminal. 8. Upload a static website (HTML file) to S3 and enable static website hosting. 9. Set up a basic Cloud Watch alert to notify when EC2 CPU usage goes above 80%. Evaluation Method: <table border="1"> <thead> <tr> <th>Sr. No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr> </thead> <tbody> <tr> <td>1</td><td>AWS Console Lab Task: Students will create an EC2 instance, attach an S3 bucket, and write a basic shell script demonstrating cloud resource setup and basic commands.</td><td>20</td><td></td></tr> <tr> <td>2</td><td>Cloud Explorer Lab Report: Students will explore AWS free tier services, take screenshots of key dashboards, and submit a PDF report on the GMIU Portal.</td><td></td><td>10</td></tr> <tr> <td></td><td>Total</td><td>20</td><td>10</td></tr> </tbody> </table> AWS Console Lab Task (20 Marks) Students will receive a task from faculty to launch an EC2 instance, create an S3 bucket, and write a basic shell script that interacts with cloud resources. The script should use simple commands (echo, ls, pwd, read) and demonstrate basic cloud setup. Students must show working output in the console.	Sr. No.	Evaluation Methods	SEE	CCE	1	AWS Console Lab Task: Students will create an EC2 instance, attach an S3 bucket, and write a basic shell script demonstrating cloud resource setup and basic commands.	20		2	Cloud Explorer Lab Report: Students will explore AWS free tier services, take screenshots of key dashboards, and submit a PDF report on the GMIU Portal.		10		Total	20	10	18	20%
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	Cloud Explorer Lab Report (10 Marks) Students will explore AWS free tier services (EC2, S3, IAM) using the AWS Management Console. take screenshots of key steps, write a short note on what each service does, and compile everything into a PDF report submitted on the GMIU Portal.																		
2	Microsoft Azure — Core Services and Virtual Machines Theory Topics: Microsoft Azure is Microsoft's cloud platform. It offers similar services to AWS: Virtual Machines (compute), Blob Storage (file storage), Azure Active Directory (user management), and the Azure Portal for managing everything through a browser. Azure Resource Groups help organize related services together. Azure regions are physical data centers around the world. Azure pricing is pay-as-you-go — you only pay for what you use. Students will learn to create and manage VMs, storage accounts, and basic networking on Azure. Practical: 10. Create a free Azure account and explore the Azure Portal dashboard. 11. Create a Resource Group and understand how it organizes cloud resources. 12. Launch a Windows or Linux Virtual Machine on Azure using default settings. 13. Connect to the Azure VM using Remote Desktop (Windows) or SSH (Linux). 14. Create an Azure Blob Storage account and upload/download a file. 15. Set up a basic Azure Virtual Network (VNet) and understand subnets. 16. Create an Azure Active Directory user and assign a basic role. 17. Monitor VM performance using Azure Monitor and view basic metrics. 18. Stop and deallocate a VM to save cost and observe the billing difference. Evaluation Method: <table border="1"> <thead> <tr> <th>Sr. No.</th><th>Evaluation Methods</th><th>SEE</th><th>CCE</th></tr> </thead> <tbody> <tr> <td>1</td><td>Azure VM Setup Lab: Students will create a Resource Group, launch a VM, connect to it, and demonstrate basic file operations through the Azure Portal.</td><td>20</td><td></td></tr> <tr> <td>2</td><td>Azure Service Discovery Report: Students will explore Azure Portal, test key services, and submit a PDF with screenshots and observations on the GMIU Portal.</td><td></td><td>10</td></tr> <tr> <td></td><td>Total</td><td>20</td><td>10</td></tr> </tbody> </table>	Sr. No.	Evaluation Methods	SEE	CCE	1	Azure VM Setup Lab: Students will create a Resource Group, launch a VM, connect to it, and demonstrate basic file operations through the Azure Portal.	20		2	Azure Service Discovery Report: Students will explore Azure Portal, test key services, and submit a PDF with screenshots and observations on the GMIU Portal.		10		Total	20	10	18	20%
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	Azure VM Setup Lab (20 Marks) Students will create a Resource Group, launch a VM (Linux or Windows), and connect using SSH or RDP, and run basic commands on it. They must show clear output screenshots and explain each step performed in the Azure Portal. Azure Service Discovery Report (10 Marks) Students will explore Azure free tier services (VM, Blob Storage, Active Directory), take screenshots of key dashboards and operations, write short descriptions of each service, and submit a compiled PDF report on the GMIU Portal.		
3	Google Cloud Platform (GCP) — Storage and Compute Theory Topics: Google Cloud Platform (GCP) is Google's cloud offering. Key services: Compute Engine (virtual machines), Cloud Storage (object storage for files), BigQuery (easy data analysis), and the GCP Console for management. GCP is well known for its data and analytics tools. GCP projects organize all resources. Cloud Storage buckets hold files and can be made public or private. Compute Engine allows you to create VMs in minutes. GCP's free tier offers useful services at no cost for students to practice with. Practical: 19. Create a free GCP account and explore the Google Cloud Console. 20. Create a new GCP Project and understand how projects organize resources. 21. Launch a Compute Engine VM instance and connect to it using SSH from the browser. 22. Create a Cloud Storage bucket, upload a file, and set its access permissions. 23. Use Cloud Shell (built-in terminal) to run basic Linux commands and gcloud commands. 24. Write a simple shell script in Cloud Shell to list storage buckets and VM instances. 25. Load a sample dataset into BigQuery and run a simple SQL query on it. 26. Enable and explore Cloud Monitoring to view basic VM metrics. 27. Delete all created resources and verify the project is clean to avoid charges.	18	20%



Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	GCP Cloud Shell Lab: Students will use GCP Cloud Shell to create a VM, manage a storage bucket, and run basic gcloud and shell commands demonstrating GCP fundamentals.	20	
2	GCP Exploration Report: Students will explore GCP Console, test Compute Engine and Cloud Storage, and submit a PDF report with screenshots on the GMIU Portal.		5
3	In House SDP: Building soft skills, aptitude, employability alongside the technical cloud computing curriculum. It closes connecting class room learning to the university's broader placement-readiness initiative.		5
	Total	20	10

GCP Cloud Shell Lab (20 Marks)

Students will use GCP Cloud Shell to launch a Compute Engine VM, create a Cloud Storage bucket, upload a file using gsutil, and run basic gcloud commands. A simple shell script should demonstrate listing resources and checking project details. Clear output must be shown.

GCP Exploration Report (05 Marks)

Students will explore GCP free tier services (Compute Engine, Cloud Storage, BigQuery), take screenshots of key operations, write brief explanations of what each service does, and compile everything into a PDF submitted on the GMIU Portal.

In House SDP (05 Marks)

Students will attend SDP and learn Building soft skills, aptitude, employability alongside the technical cloud computing curriculum. It closes connecting class room learning to the university's broader placement-readiness initiative. Student have to submit SDP Certificate in PDF format on GMIU Portal.

Cloud Security, Networking, and Cost Management

Theory Topics:

Cloud security protects your data and services in the cloud. Basic security practices: strong passwords, multi-factor authentication (MFA), and least-privilege access (give users only the permissions they need). Each cloud platform (AWS, Azure, GCP) has identity and access management tools for this. Cloud networking basics: Virtual Private Cloud (VPC) creates a private section of the cloud for your resources. Security Groups act as firewalls, controlling which traffic is allowed in or out. Load Balancers distribute traffic across multiple servers so no single server gets overloaded. Cloud cost management: use budget alerts and the free tier wisely to avoid unexpected bills.

Practical:

28. Enable Multi-Factor Authentication (MFA) on your AWS/Azure/GCP account.
29. Create a Security Group on AWS that allows only SSH (port 22) and HTTP (port 80) traffic.
30. Set up a basic VPC with a public subnet on AWS and launch an EC2 instance inside it.
31. Create a budget alert on AWS/Azure to get notified when spending exceeds a set limit.
32. Write a shell script to check open network ports on a cloud VM using netstat or ss.
33. Use IAM on AWS to create a policy that allows read-only access to S3 and test it.
34. Simulate a basic load balancer setup on AWS by registering two EC2 instances.
35. Review the cloud pricing calculator (AWS/Azure/GCP) and estimate cost for a simple web app.
36. Set up a simple firewall rule on GCP to block all traffic except HTTP and SSH.
37. Write a script to automate stopping all running EC2 instances using AWS CLI to save cost.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	Network & Security Lab Task: Students will configure a Security Group, set up MFA, create a basic VPC, and demonstrate network access control on any cloud platform.	20	

18

20%



2	Cloud Cost & Security Case Study: Students will analyse a given cloud scenario, identify security risks, estimate costs, and submit a short individual report on the GMIU Portal.		5
3	Student Chapter Association: Student will join Cloud Computing and Virtualization course work with hands-on clubs, hackathons, and guest sessions.		5
Total		20	10

Network & Security Lab Task (20 Marks)

Students will configure a Security Group on AWS (or equivalent on Azure/GCP), enable MFA on their account, and create a basic VPC with a public subnet. They must demonstrate that their VM is accessible only through allowed ports and show all configurations through console screenshots.

Cloud Cost & Security Case Study (05 Marks)

Students will be given a simple cloud deployment scenario and must identify at least three security risks, suggest fixes, and use the cloud pricing calculator to estimate monthly cost. Findings must be submitted as an individual PDF on the GMIU Portal.

Student Chapter Association (05 Marks)

Student will join Cloud Computing and Virtualization course work with hands-on clubs, hackathons, and guest sessions. After attending student have to submit certificate in PDF format on GMIU Portal.

Containers, DevOps, and Multi-Cloud Concepts

Theory Topics:

Containers are lightweight packages that hold an application and everything it needs to run (code, libraries, settings). Docker is the most popular tool for creating and running containers. Unlike virtual machines, containers start faster and use fewer resources. Kubernetes helps manage many containers automatically. DevOps means developers and operations teams working together to deliver software faster. Key idea: automate everything — building, testing, and deploying code. CI/CD (Continuous Integration/Continuous Deployment) pipelines do this automatically. Multi-Cloud means using more than one cloud provider (e.g., AWS + Azure) to avoid depending on a single vendor.



Practical:

38. Install Docker on a cloud VM (or use an online Docker playground) and run a simple hello-world container.
39. Write a basic Dockerfile to create a custom image that runs a simple Python or shell script.
40. Build and run your custom Docker image; list running containers using docker ps.
41. Push your Docker image to Docker Hub (a free public container registry).
42. Write a shell script to display all running containers, their names, and their sizes.
43. Write a shell script to accept a container name from the user and check its status.
44. Simulate basic FCFS disk scheduling with a shell script for a list of I/O requests.
45. Simulate SSTF disk scheduling with a shell script and show total seek distance.
46. Use gzip, zip, and tar to compress and decompress files on a cloud VM and compare file sizes.
47. Write a shell script using arrays to store container names, print all elements, and search for a specific one.
48. Write a shell script that accepts command-line arguments and prints the count and values.

Evaluation Method:

Sr. No.	Evaluation Methods	SEE	CCE
1	Container & Docker Lab: Students will write shell scripts to build and run a Docker container, display container details, and simulate a basic disk scheduling algorithm.	20	
2	Cloud DevOps Case Study: Students will document a simple CI/CD workflow for a given app, identify multi-cloud benefits, and submit a short individual report on the GMIU Portal.		10
	Total	20	10

Container & Docker Lab (20 Marks)

Students will install Docker (or use an online environment), write a Dockerfile, build a custom image, and run a container. They must also write a shell script to list running containers and simulate either FCFS or SSTF disk scheduling. All outputs must be clearly shown.



	Cloud DevOps Case Study (10 Marks) Students will describe a simple CI/CD pipeline for a given web application scenario, explain how multi-cloud strategy helps avoid vendor lock-in, and identify two cost-saving techniques. Findings must be compiled into a PDF submitted on the GMIU Portal.		
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Suggested Specification:

Distribution of Theory Marks (Revised Bloom's Taxonomy)						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage %	15%	15%	20%	15%	15%	20%

Course Outcome:

After learning the course, the students should be able to:

CO1	Understand cloud computing basics, service models, and AWS core services, and explore the AWS Console to manage virtual servers and storage.
CO2	Use Microsoft Azure to create and manage virtual machines, blob storage, and resource groups through the Azure Portal.
CO3	Apply Google Cloud Platform services such as Compute Engine and Cloud Storage, and use Cloud Shell and gcloud commands for basic automation.
CO4	Evaluate cloud security practices, configure basic networking (VPC, Security Groups), and manage cloud costs using budget alerts and pricing calculators.
CO5	Demonstrate container management using Docker, understand DevOps and CI/CD concepts, and apply multi-cloud strategies with shell scripting for automation.

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students.

A minimum of 20-30% of the course content shall be suggested to deliver through Flipped Learning, where students study digital learning resources before the classroom session. Classroom time shall be utilized for discussion, problem-solving, practical applications, and higher-order learning activities.

Students shall be encouraged to use AI-powered learning platforms, simulation software, virtual laboratories, digital libraries, research databases, online certification courses, NPTEL, SWAYAM, MOOCs, and other technology-enabled learning resources to strengthen conceptual understanding and practical competence.



Continuous assessment shall be conducted through Active Learning Assignments (ALAs), quizzes, skill demonstrations, presentations, practical exercises, projects, case studies, innovation activities, peer assessment, reflective learning, and industry-oriented tasks instead of relying primarily on conventional written assignments.

Reference Books:

- [1] Cloud Computing: Concepts, Technology & Architecture - Thomas Erl, Wiley
- [2] AWS Certified Cloud Practitioner Study Guide - Ben Piper & David Clinton, Sybex.
- [3] Microsoft Azure Fundamentals Exam Guide AZ-900 - Jack Lee, Packt Publishing.
- [4] Google Cloud Platform in Action - JJ Geewax, Manning Publications.
- [5] Docker Deep Dive by Nigel Poulton, Independently Published.



Suggested Assessment Guidelines:

Module-1: Introduction to Cloud Computing and AWS Basics — AWS Console Lab Task

Program Implementation Task (20 Marks)		
Criteria	Description	Marks
Understanding	Clear understanding of cloud service models and AWS console navigation.	5
EC2 & S3 Setup	Correct launch of EC2 instance and S3 bucket with proper configuration.	5
Shell Script	Working script with basic commands (echo, ls, read) running on the instance.	5
Output & Accuracy	All tasks executed without errors; outputs clearly shown.	5
Total		20

Module-2: Microsoft Azure — Core Services and Virtual Machines — Azure VM Setup Lab

Program Implementation Task (20 Marks)		
Criteria	Description	Marks
Azure Portal Navigation	Ability to navigate Azure Portal and locate key services easily.	5
VM Creation & Connection	Correct setup of VM with proper OS, size, and successful SSH/RDP connection.	5
Storage Operations	Successful creation of Blob Storage and file upload/download.	5
Output & Accuracy	All tasks completed without errors; clear screenshots provided.	5
Total		20

Module-3: Google Cloud Platform (GCP) — Storage and Compute — GCP Cloud Shell Lab

Program Implementation Task (20 Marks)		
Criteria	Description	Marks
GCP Console Navigation	Ability to navigate GCP Console and locate Compute Engine, Cloud Storage, BigQuery.	5
VM & Cloud Shell Usage	Correct VM creation and use of Cloud Shell with gcloud commands.	5



Storage Operations	Successful bucket creation and file operations using gsutil	5
Output & Accuracy	All tasks completed without errors; correct sample outputs shown.	5
Total		20

Module-4: Cloud Security, Networking, and Cost Management — Network & Security Lab Task

Program Implementation Task (20 Marks)		
Criteria	Description	Marks
Security Configuration	Correct setup of MFA, IAM policies, and Security Group rules.	5
VPC & Networking	Proper creation of VPC, subnet, and verified network connectivity.	5
Cost Awareness	Correct use of pricing calculator and budget alert setup.	5
Output & Accuracy	All configurations working correctly; clear screenshots shown.	5
Total		20

Module-5: Containers, DevOps, and Multi-Cloud Concepts — Container & Docker Lab

Program Implementation Task (20 Marks)		
Criteria	Description	Marks
Docker Understanding	Correct usage of Docker commands: build, run, ps, push, and Dockerfile creation.	5
Shell Script — Containers	Working script to display container details and check status.	5
Disk Scheduling Script	Correct simulation of FCFS or SSTF with accurate seek order and distance.	5
Output & Accuracy	All scripts run without errors; correct sample outputs shown.	5
Total		20

