KBTCOE

Maratha Vidya Prasarak Samaj's

Karmaveer Adv. Baburao Ganpatrao Thakare College of Engineering

An Autonomous Institute affiliated to Savitribai Phule Pune University, Pune

Udoji Maratha Boarding Campus, Gangapur Road, Nashik - 422 013,

Maharashtra, India

Syllabus of Under-Graduate Program

Third Year B.Tech. Computer Engineering – Honors in Cloud Computing (2024 Pattern)

(As per NEP 2020)

Academic Year 2026-27

(Copy for Student Circulation Only)

25.03.2026

Third Year B.Tech. Computer Engineering – Honors in Cloud Computing
Curriculum Structure (2024 Pattern) Semester – V

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
102507	HON-1	Cloud Architecture	3	2	-	40	60	25	25	150	3	1	-	4
Total			3	2	0	40	60	25	25	150	3	1	0	4

Third Year B.Tech. Computer Engineering – Honors in Cloud Computing
Curriculum Structure (2024 Pattern) Semester – VI

Course Code	Course Type	Course Name	Teaching Scheme (Hrs/Week)			Evaluation Scheme and Marks					Credits			
			TH	PR	TU	CCE	ESE	TW	PR + OR	TOT	TH	PR	TU	TOT
102607	HON-2	Cloud Virtualization Technology	3	2	-	40	60	25	25	150	3	1	-	4
Total			3	2	0	40	60	25	25	150	3	1	0	4

Semester - V

Course Code: 102507	Course Name: Cloud Architecture	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Operating Systems, Computer Networks, Distributed Systems.

Course Objectives:

- To introduce the fundamental concepts of distributed computing and cloud computing, including architecture, characteristics, and benefits.
- To understand different cloud service models (IaaS, PaaS, SaaS) and deployment models.
- To explore cloud infrastructure services such as virtual machines, containers, elastic computing resources, and accelerated computing using GPU-enabled cloud infrastructure.
- To study cloud storage technologies, including object storage, block storage, file storage, and cloud data management techniques.
- To understand cloud networking concepts, including virtual networks, virtual private cloud (VPC), load balancing, DNS services, and resource provisioning mechanisms.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the fundamental concepts of distributed computing and cloud computing.

CO2: Select suitable cloud service models and deployment models.

CO3: Use cloud infrastructure services, including compute resources, containers, and accelerated infrastructure.

CO4: Analyze cloud storage solutions and data management techniques.

CO5: Illustrate cloud networking solutions, including virtual networks, VPC, load balancing, DNS, and resource provisioning mechanisms.

Course Contents:

Unit-I: Fundamentals of Cloud Computing **08 Hours**

Overview of Distributed Computing: Introduction, Characteristics, Architecture, Advantages and Challenges. **Introduction to cloud computing:** Definition, characteristics,

Architecture, Comparison of cloud computing with traditional IT infrastructure, Economics of Cloud, Migrating into the cloud, Role of data centres in cloud computing. Cloud migration strategies. **Role of data centres in cloud computing:** Tier classifications, PUE, cooling, and green data centres..

Unit-II: Cloud Service and Deployment Models 08 Hours

Service Models: IaaS, PaaS, SaaS, Emerging models: FaaS (Function-as-a-Service), AIaaS (AI-as-a-Service), GPUaaS (GPU-as-a-Service). **Deployment Models:** public, private, hybrid, community. **Cloud benefits & challenges:** scalability, elasticity, vendor lock-in, latency, compliance, Cloud Providers and Platforms.

Unit-III: Cloud Infrastructure Services and GPU Compute Services 08 Hours

Cloud Infrastructure: Introduction, Components, Cloud Compute Services: Virtual Machines, Containers, Elastic Computing Resources. **GPUaaS:** NVIDIA GPU cloud instances, Google Tensor Processing Units for AI workloads. **Resource Management:** CPU, Memory, Storage, I/O, and GPU resource allocation. **Accelerated Computing Concepts:** CUDA overview, GPU vs CPU for parallel workloads.

Unit-IV: Cloud Storage Services 08 Hours

Cloud Storage: Introduction, characteristics, Types, Data management, Advantages, Challenges, Applications, Data lifecycle management.

Storage for AI/ML workloads: high-throughput storage (FSx for Lustre, Filestore), dataset versioning. Advantages, challenges, and real-world applications of cloud storage.

Unit-V: Cloud Networking Services 08 Hours

Virtual networks, virtual private cloud (VPC), load balancing, domain name services (DNS), network connectivity in cloud environments, Resource provisioning and scheduling in cloud infrastructure, resource monitoring, and management, Cloud infrastructure services: Applications, advantages, and benefits. **Case Study:** Social Media Platform.

Learning Resources:

Text Books:

1. R. Buyya, C. Vecchiola, and S. T. Selvi, Mastering Cloud Computing: Foundations and Applications Programming, Morgan Kaufmann, 2013.
2. G. Coulouris, J. Dollimore, T. Kindberg and G. Blair, Distributed Systems: Concepts and Design, 5th ed. Boston, MA, USA: Pearson Education, 2012.

Reference Books:

1. T. Erl, Cloud Computing: Concepts, Technology and Architecture. Boston, MA, USA: Pearson Education, 2014.

2. K. Hwang, G. C. Fox, and J. J. Dongarra, Distributed and Cloud Computing: From Parallel Processing to the Internet of Things, Morgan Kaufmann, 2011

Web link for MOOC / NPTEL Links:

1. Cloud Computing by Prof. Soumya Kanti Ghosh, IIT Kharagpur. https://nptel.ac.in/courses/106105167

List of Practicals:

1. Demonstrate distributed system communication.
2. Deploy compute infrastructure in the cloud.
3. Implement container-based cloud applications.
4. Implement cloud storage and file management.
5. Implement cloud networking.
6. Implement scalable application deployment.
7. Implement accelerated computing.
8. Implement ML training using cloud services.
9. Monitor infrastructure resources.

Semester - VI

Course Code: 102607	Course Name: Cloud Virtualization Technology	
Teaching Scheme	**Credit**	**Evaluation Scheme**
Theory : 3 Hours/Week **Practical :** 2 Hours/Week	**3** **1**	**CCE : 40 Marks** **ESE : 60 Marks** **TW : 25 Marks** **PR + OR : 25 Marks**

Expected Prerequisite Courses:

- Cloud Architecture.

Course Objectives:

- To understand the fundamental concepts of virtualization, virtualization architectures, and hypervisor technologies used in modern computing environments.
- To understand virtualization technologies from hypervisors to GPU virtualization, software-defined data centres, scalability, performance monitoring, and security in virtualized environments.
- To explore scalability techniques in virtualized environments, including network scalability, storage scalability, and GPU virtualization technologies.
- To analyze performance monitoring techniques and troubleshooting methods for CPU, memory, storage, and networking in virtual machines.
- To study security mechanisms and management techniques in virtualized environments, including VM security, container deployment, and automation using cloud infrastructure tools.

Course Outcomes:

After successful completion of the course, learner will be able to:

CO1: Explain the concepts of virtualization, hypervisor technologies, and resource virtualization in computing environments.

CO2: Illustrate virtualized infrastructures, including compute, storage, and networking resources in software-defined data centers.

CO3: Apply scalability techniques in virtual environments, including network, storage, and GPU resource management.

CO4: Analyze system performance and troubleshoot issues related to CPU, memory, networking, and storage in virtual machines.

CO5: Examine security mechanisms and automation tools for managing secure virtualized environments and container-based deployments.

Course Contents:

Unit-I: Introduction to Virtualization 08 Hours

Virtualization: Definition, Benefits, Implementation levels, Architecture, **Hypervisor Technologies:** Concept, Functions, and Types, Resource Virtualization, Virtual machines versus containers: architectural comparison, use cases. Virtual networking concepts. **Configuration of storage in a virtualised environment:** datastores, IP storage, fibre channel, Virtual Storage Area Network (vSAN), object-based storage, virtual volumes, GPU Virtualization, Resource Virtualization. **GPU Virtualization:** GPU Passthrough (PCIe passthrough), NVIDIA vGPU (GRID technology), NVIDIA MIG (Multi-Instance GPU) for shared GPU infrastructure, Storage in virtualised environments.

Case Study: GCP Console, VirtualBox.

Unit-II: Design and Configuration of Virtualised Environments 08 Hours

Configuration and management of compute, networking, and storage resources in a software-defined data centre (SDDC). Creating and configuring High Availability (HA), Distributed Resource Scheduler (DRS), and datastore clusters. Enabling Fault Tolerance for critical virtual machines (VMs). Creating resource pools to manage the resource allocations to virtual machines. Datastore clusters and Storage DRS. Fault Tolerance (FT) for mission-critical VMs. **Resource pools:** creation, shares, reservations, and limits for CPU and memory allocation. **Case Study:** VM Cluster.

Unit-III: Scalability in a Virtualised Environment 08 Hours

Network scalability: load-based Network Interface Card (NIC) teaming, traffic filtering, bandwidth aggregation for network resource pools, and distributed virtual switches. **Storage scalability:** datastores, storage APIs, vSphere Array Integration, storage policies, Virtual Storage Area Network (vSAN), Virtual Volumes (vVols). **Host and management scalability:** content libraries, host profiles, vSphere Auto Deploy, GPU scalability**,** Scaling GPU resources**,** Cluster scaling patterns. **Case Study:** Large Data Analytics Platform.

Unit-IV: Performance Monitoring in Virtual Environment 08 Hours

Key performance metrics for CPU, memory, networking, and storage, Optimising the number of cores per socket for VMs. Memory considerations with Virtual Non-uniform memory Access (vNUMA), Resolving host/guest CPU saturation, Monitoring memory activity, Resolving host-level swapping, Dedicating memory to critical VMs, Monitoring disk latency, memory reclamation techniques, memory over-commitment monitoring. GPU performance monitoring, Storage performance, Network performance, Troubleshooting methodology.

Case Study: VMware VCenter Server.

Unit-V: Securing a Virtualised Environment 08 Hours

Configuring host access, authentication, and hypervisor firewall. Securing VMs, Deploying and Managing Containers within a Virtualised Environment. Install and manage a Kubernetes cluster on VMware vSphere. Container security, **Container orchestration security:** Kubernetes RBAC, Pod Security Standards, Network Policies, Deploying containers in virtualised environments. **Case Study:** Trivy, Snyk.

Learning Resources:

Text Books:

1. HC. Wolf and E. M. Halter, Virtualization: From the Desktop to the Enterprise. Berkeley, CA, USA: Apress, 2005.
2. M. Portnoy, Virtualization Essentials, 3rd ed., Wiley, 2023.

Reference Books:

1. J. E. Smith and R. Nair, Virtual Machines: Versatile Platforms for Systems and Processes. San Francisco, CA, USA: Morgan Kaufmann, 2005.
2. R. Buyya, C. Vecchiola, and S. T. Selvi, Mastering Cloud Computing: Foundations and Applications Programming. Burlington, MA, USA: Morgan Kaufmann / Elsevier, 2013.
3. NVIDIA vGPU Documentation: https://docs.nvidia.com/grid/
4. VMware vSphere Documentation: https://docs.vmware.com/en/VMware-vSphere/

Web link for MOOC / NPTEL Links:

1. Cloud Computing by Prof. Soumya Kanti Ghosh, IIT Kharagpur https://nptel.ac.in/courses/106105167
2. Cloud Infrastructure and Services by Prof. Dr. Nilesh K. Modi. https://onlinecourses.swayam2.ac.in/e-learning/preview/nou25_cs33

List of Practicals:

1. Implement virtualization using a hypervisor.
2. Implement virtual networking in a virtualized environment.
3. Implement storage management in a virtualized environment.
4. Implement resource management features.
5. Implement fault tolerance for critical virtual machines.
6. Implement scalable network infrastructure.
7. Implement scalable storage infrastructure.
8. Implement GPU virtualization.
9. Monitor VM performance.
10. Deploy containers inside virtual machines.
11. Implement container orchestration.