

Cloud Computing

Devi Ahilya University, Indore, India Institute of Engineering & Technology			BE IV Year Computer Engineering (Semester – A)				
Subject Code : 7CERC2	Instructions Hours per Week			Credits			
Subject Name: Cloud Computing	L	T	P	L	T	P	TOTAL
Duration of Theory Paper: 3 Hours	3	1	1				

Course Objective: To study the latest Computing Technologies of Computer Engineering.

UNIT – I: Introduction to Cloud Computing

Introduction & Overview: Definition, evolution of cloud computing, history of distributed and grid computing leading to cloud. **Characteristics of Cloud, Service Models:** Infrastructure as a Service (IaaS), Platform as a Service (PaaS), Software as a Service (SaaS), features, use cases & providers (AWS, Azure, Google Cloud). **Deployment Models:** Public, Private, Hybrid & Community clouds – comparison and applicability. **Role of Virtualization:** How virtualization enables resource sharing and forms the foundation of cloud. **Applications of Cloud Computing:** Industry domains – healthcare, finance, education, entertainment, etc. **Cloud Challenges, Advantages & Disadvantages:** **Issues in Cloud, SOA (Service-Oriented Architecture) Model:** Principles, services, and integration with cloud. **Cloud-based Operating Systems & Tools:** CloudOS concepts, deployment tools (Docker, Kubernetes, OpenStack). **Cloud as Green Computing Model.**

UNIT – II: Virtualization

Virtualization Concepts & Characteristics: Definition, benefits, **Types of Virtualization:** Infrastructure-level (hardware), OS-level, application-level. **CPU Virtualization, Storage Virtualization, Network Virtualization, Hypervisors:** Type-1 (bare-metal) and Type-2 (hosted) with examples, **SAN (Storage Area Network):** Definition and need in cloud Components, **VLAN (Virtual Local Area Network):** Concept, IEEE 802.1Q tagging, VLAN configuration basics Role in traffic segmentation and cloud security, **Server Virtualization:** VMware, VirtualBox, Hyper-V – use in cloud setups. **Data Center Challenges & Solutions:** Energy usage, scalability, redundancy. **Scaling a Cloud Infrastructure:** Vertical & horizontal scaling using virtualization.

UNIT – III: Service Management in Cloud

Service Monitoring: Tools & techniques, **Load Balancing:** Approaches & tools, **Database Recovery & Backup:** Cloud backup strategies, snapshot management. **Virtual Machine Management:** VM lifecycle, cloning, templates, snapshots. **Service Level Agreements (SLA):** Importance, structure, enforcement in cloud services. **Migration of Virtual Machines:** Cold migration vs live migration, tools, **Cloud Management Issues:** Resource contention, orchestration, automation challenges.

UNIT – IV: Issues and Challenges in Cloud

General Cloud Issues: Latency, multi-tenancy, data portability, vendor lock-in. **Cloud Security Services:** IAM (Identity and Access Management), encryption, compliance frameworks. **Secure Cloud Software Requirements:** Best practices for secure development in cloud. **Cloud Security Challenges:** Data breaches, insider threats, DDoS attacks. **Network Security in Cloud:** Segmentation, firewalling, VLAN use. **Virtual Machine Security:** Isolation, sandboxing, patching. **Threats & Mitigation:** Emerging threats & best practices for prevention.

UNIT – V: Using Mobile Cloud & Emerging Trends

Mobile Devices & Cloud: Role of smartphones in cloud access, synchronization. **Cloud Services on Smartphones:** APIs, mobile app integration. **Mobile Web Services:** Accessing SaaS & PaaS from mobile devices. **Performance Synchronization:** Offline vs online sync, challenges in mobile-cloud interaction. **Protocols:** WAP, REST, and other mobile-cloud protocols. **Fog Computing:** Concept, difference from cloud, use cases in IoT. **Case Studies: Google App Engine:** Platform & services **Amazon AWS:** EC2, S3, Lambda **OpenStack:** Open-source IaaS platform **Aneka:** .NET-based PaaS framework **Microsoft Azure:** Hybrid cloud services

Course Outcomes (COs)

- **CO1:** Explain fundamentals of cloud computing & service models.
 - **CO2:** Demonstrate virtualization concepts (SAN, VLAN, hypervisors).
 - **CO3:** Apply service management (VM migration, SLA, load balancing).
 - **CO4:** Analyze cloud security issues & solutions.
 - **CO5:** Explore mobile cloud, fog computing & case studies.
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CO–PO Mapping (Highlights)

- **CO1** → PO1, PO5, PO12

- **CO2** → PO1, PO2, PO3, PO5, PO7
- **CO3** → PO1, PO3, PO4, PO5, PO9, PO12
- **CO4** → PO1, PO4, PO6, PO8
- **CO5** → PO1, PO3, PO5, PO9, PO10, PO11, PO12

(Strong links to **Engineering Knowledge (PO1)**, **Modern Tool Usage (PO5)** & **Life-long Learning (PO12)**.)

Lab Components (Key Assignments)

1. Cloud platform exploration (AWS/Azure/GCP)
 2. VM setup (VMware/VirtualBox)
 3. Hypervisor comparison
 4. **VLAN configuration** (Cisco Packet Tracer)
 5. **SAN setup** (iSCSI in VMware)
 6. Storage Virtualization (LVM)
 7. Load balancer (NGINX/HAProxy)
 8. VM Migration (cold/live)
 9. Docker app deployment
 10. Cloud security practices (IAM, MFA)
 11. Mobile cloud sync
 12. Mini-project (3-tier app on AWS/OpenStack)
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Recommended Books:

- 1) Rajkumar Buyya; Cloud Computing Principles and Paradigms; John Wiley & Sons 2011.
- 2) Rajkumar Buyya; Mastering Cloud Computing; Elsevier Inc 2013.
- 3) Cloud Computing Bible, Barrie Sosinsky, Wiley-India, 2010
- 4) Toby Velte, Anthony Velte, Robert Elsenpeter, “Cloud Computing, A Practical Approach” McGraw-Hill Osborne Media; 1 edition [ISBN: 0071626948], 2009.

IIT NPTEL links:

- https://www.youtube.com/watch?v=ZHCtVZ6cjdg&list=PLmmuEIIzy1cbwIMvGF1EsV4ZtAe8vA_7I (Prof S K Ghosh)
- <https://www.youtube.com/watch?v=NzZXz3fJf6o&list=PLShJJCRzJWxhz7SfG4hpaBD5bKOloWx9J>