



Kot Bhalwal, Jammu



Model Institute of Engineering
& Technology (Autonomous)
Dr. Arun K. Gupta Teaching-Learning Centre

Department of Computer Science and Engineering

Details of Lesson Plan

S.No.	Particulars	Details
1.	Course Name	Cloud Computing
2.	Course Code	COM-601
3.	Academic Year	2024-25
4.	Semester	6th
5.	Number of Lesson plans	47
6.	Faculty Assigned	Ms. Vishalika

Vishalika

Faculty Signature



Lesson Plan No. 1	Course Name: Cloud Computing Introduction to Course	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand the basic concepts of cloud computing. b. Recognize the importance of cloud computing in modern technology. c. Identify various real-world applications of cloud computing.
Teaching Aids (if any)	a. Presentation slides. b. Projector c. You Tube video
Teaching Development	<ol style="list-style-type: none">Introduction (10 minutes)<ul style="list-style-type: none">Ask questions:<ol style="list-style-type: none">Have you ever used Google Drive, Dropbox, or iCloud?What happens when you stream a movie on Netflix or listen to songs on Spotify?Where do social media platforms like Instagram or Facebook store your photos?What if your laptop crashes? How do you access your documents?These platforms work seamlessly because of Cloud Computing, which allows storage and computing power over the internet instead of on personal devices.Cloud Computing is transforming industries, from startups to tech giants like Google, Amazon, and Microsoft.Discuss course outcomes.Development (30 minutes) Why Cloud Computing?<ul style="list-style-type: none">Discuss the shift from traditional computing (storing files locally) to cloud-based storage.Benefits:<ul style="list-style-type: none">Scalability: Handle growing amounts of work easily.Cost Efficiency: No need to invest in expensive hardware.Accessibility: Data can be accessed from anywhere.Security & Backup: Reduces the risk of data loss.Real-World Examples<ol style="list-style-type: none">Netflix: Uses AWS Cloud to stream movies without buffering.Google Docs: Allows multiple users to collaborate in real time.Online Gaming: Games like Fortnite use cloud servers for multiplayer experience.Career & Job Perspective<ul style="list-style-type: none">Cloud Engineer, Cloud Security Specialist and DevOps EngineerDiscussion on certifications:<ul style="list-style-type: none">AWS Certified Solutions ArchitectGoogle Cloud Professional Engineer



	<ul style="list-style-type: none">• Microsoft Azure Fundamentals- Introduction to Cloud Computing courses available on platforms like Coursera and LinkedIn Learning <p>Future Trends in Cloud Computing (10 minutes)</p> <ul style="list-style-type: none">- Edge Computing - Bringing computation closer to users.- Serverless Computing - Developers focus on coding without managing infrastructure.- AI & Cloud Integration - AI-powered cloud applications improving automation.
Closure	<ol style="list-style-type: none">1. Summarize key concepts: Cloud models, benefits, real-world applications.2. Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p> <ul style="list-style-type: none">• "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, Chapter 1, pp. 1-30.• "Mastering Cloud Computing" by Rajkumar Buyya, Chapter 2, pp. 15-40.
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What cloud-based applications do you use in your daily life?"2. "How does cloud computing improve businesses and services?"3. "Can you think of a new application that could benefit from cloud computing?" <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 1.1	Course Name: Cloud Computing Understanding Cloud Computing	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the fundamental concepts of cloud computing. Identify real-world applications of cloud computing. Recognize the benefits and challenges of cloud computing. Explore career opportunities in cloud computing.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Ask questions: <ol style="list-style-type: none"> Have you ever used Google Drive, Dropbox, or iCloud? How does Netflix stream movies smoothly without downloading them? Where does Instagram store millions of photos uploaded every second? If your laptop crashes, how do you access your documents? These platforms function efficiently because of Cloud Computing—which enables storage, processing, and services over the internet instead of personal devices. Cloud Computing is transforming industries, powering tech giants like Amazon, Google, and Microsoft. Development (30 minutes) <ol style="list-style-type: none"> What is Cloud Computing? (10 Minutes) <ul style="list-style-type: none"> Traditional vs. Cloud Computing Basic Terminologies Key Benefits: <ul style="list-style-type: none"> Scalability Cost Efficiency Accessibility Security & Backup Real-World Examples: <ul style="list-style-type: none"> Netflix (AWS) Google Docs (Real-time collaboration) Challenges of Cloud Computing (10 Minutes) <ul style="list-style-type: none"> Security Risks Internet Dependency Downtime Issues Vendor Lock-in Future Trends in Cloud Computing (10 Minutes) <ul style="list-style-type: none"> Emerging Technologies: <ul style="list-style-type: none"> Edge Computing Serverless Computing AI & Cloud Integration



	<p>YouTube Video Link: https://www.youtube.com/watch?v=mxT233EdY5c</p>
Closure	<ol style="list-style-type: none">1. Summarize key concepts: Cloud Computing, benefits, challenges and future trends.2. Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p> <ul style="list-style-type: none">• "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl (Chapter 1, pp. 1-30)• "Mastering Cloud Computing" by Rajkumar Buyya (Chapter 2, pp. 15-40)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. How has cloud computing impacted the way businesses and individuals use technology?2. In what ways can cloud computing improve collaboration and productivity?3. What are the biggest risks associated with cloud computing, and how can they be mitigated? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 1.2	Course Name: Cloud Computing Fundamental Concepts and Models	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the fundamental concepts of cloud computing. Identify different roles in cloud computing. Describe key characteristics of cloud computing. Explain Cloud Service Delivery Models (IaaS, PaaS, SaaS). Discuss Cloud Deployment Models (Public, Private, Hybrid, Community).
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Ask questions: <ol style="list-style-type: none"> "Have you ever used Google Drive, OneDrive, or Dropbox? How do they work?" Brief discussion on how cloud computing is used in daily life. Show a slide with an image of cloud computing applications. Cloud computing is the delivery of computing services over the internet—storage, servers, databases, networking, and software—without direct management by the user. Development (30 minutes) <ol style="list-style-type: none"> Roles in Cloud Computing (5 minutes) <ul style="list-style-type: none"> Cloud Service Provider (CSP) – Companies like AWS, Azure, Google Cloud. Cloud Consumer – End users or organizations using cloud services. Cloud Broker – Acts as an intermediary between CSPs and consumers. Cloud Auditor – Ensures compliance and security. Cloud Carrier – Provides network connectivity. Real-life Example: <ul style="list-style-type: none"> <i>Netflix uses AWS for video streaming instead of managing its own servers.</i> Characteristics of Cloud Computing (5 minutes) <ul style="list-style-type: none"> On-demand self-service – Access resources anytime (e.g., creating an AWS instance). Broad network access – Available from any device, anywhere. Resource pooling – Shared infrastructure for multiple users. Rapid elasticity – Scale up/down based on demand. Measured service – Pay only for what you use. Real-life Example: <ul style="list-style-type: none"> <i>Amazon.com scales its cloud servers during Black Friday sales and reduces them afterward.</i>



	<p>C. Cloud Service Delivery Models (IaaS, PaaS, SaaS) (10 minutes)</p> <ul style="list-style-type: none">• Infrastructure as a Service (IaaS) – Virtual servers, storage (AWS EC2, Google Compute Engine).• Platform as a Service (PaaS) – Development platforms (Google App Engine, Heroku).• Software as a Service (SaaS) – Web-based applications (Google Drive, Gmail, Zoom). <p>D. Cloud Deployment Models (10 minutes)</p> <ul style="list-style-type: none">• Public Cloud – Services available to the public (AWS, Azure, GCP).• Private Cloud – Dedicated for a single organization (Banking sector, government agencies).• Hybrid Cloud – Combination of Public and Private clouds (NASA uses AWS & Private Cloud).• Community Cloud – Shared by multiple organizations (Universities, Healthcare). <p>3. Exercise (10 minutes)</p> <p>Group Discussion:</p> <ul style="list-style-type: none">• <i>"Which cloud model would be best for a startup? A bank? A university?"</i> <p>Ask students to differentiate between IaaS, PaaS, and SaaS with examples.</p> <p>YouTube Video Link: https://www.youtube.com/watch?v=1BMO7YkwR6Y</p>
Closure	<ul style="list-style-type: none">• Summarize key concepts• Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p> <ul style="list-style-type: none">• <i>Cloud Computing: Principles and Paradigms</i> – Rajkumar Buyya (Chapter 1, Pages 1-20).• <i>Mastering Cloud Computing</i> – Rajkumar Buyya (Chapter 2, Pages 25-45).
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. Which characteristic of cloud computing do you think is most important?2. Which cloud model would you recommend for a multinational company? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>

Lesson Plan No. 1.3	Course Name: Cloud Computing Cloud-Enabling Technology: Broadband Networks and Internet Architecture	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the role of broadband networks in cloud computing. Explain the structure of internet architecture. Identify different types of broadband technologies. Discuss how broadband networks enable cloud services.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board Case Studies (Netflix, AWS, Google Cloud, 5G Applications)
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Ask questions: <ol style="list-style-type: none"> "How do we stream movies on Netflix without buffering?" Brief Discussion: <ul style="list-style-type: none"> Link it to broadband networks & internet architecture. Show an infographic of global internet traffic growth. "Broadband networks provide high-speed internet, which forms the backbone of cloud computing by ensuring seamless data transfer." Development (30 minutes) <ol style="list-style-type: none"> Broadband Networks and Cloud Computing (10 minutes) <ul style="list-style-type: none"> Types of Broadband Technologies: <ul style="list-style-type: none"> Fiber Optic (Google Fiber, Verizon Fios) DSL (BSNL Broadband, AT&T DSL) Cable Internet (Xfinity, Spectrum) Satellite Internet (Starlink, HughesNet) 5G & Wireless Networks (Jio 5G, T-Mobile 5G) Real-life Example: <ul style="list-style-type: none"> <i>Netflix & YouTube relies on broadband for smooth video streaming.</i> Internet Architecture (10 minutes) <ul style="list-style-type: none"> Layers of Internet Architecture: <ul style="list-style-type: none"> Physical Layer – Fiber optics, cables, satellites. Network Layer – ISPs, routing, IP addressing. Transport Layer – TCP/UDP for reliable communication. Application Layer – Websites, cloud services (AWS, Google Drive). Real-life Example: <ul style="list-style-type: none"> <i>How Google Search works in milliseconds using internet layers.</i> Role of Broadband in Cloud Computing (10 minutes) <ul style="list-style-type: none"> Why is Broadband Essential for Cloud Services? <ul style="list-style-type: none"> Enables real-time data access. Reduces latency (Edge Computing, CDN).



	<ul style="list-style-type: none">○ Supports SaaS (Google Docs, Zoom, Microsoft Teams).● Real-life Example:<ul style="list-style-type: none">○ <i>AWS Data Centers use high-speed broadband to handle millions of cloud requests per second.</i> <p>3. Exercise (10 minutes) Group Discussion: <i>"Which broadband technology is best for cloud applications?"</i> Ask students to map real-world cloud applications to broadband technologies.</p> <p>YouTube Video Link: https://www.youtube.com/watch?v=YtxLexm-9pI</p>
Closure	<ul style="list-style-type: none">● Summarize key concepts● Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p> <ul style="list-style-type: none">● Cloud Computing: Principles and Paradigms – Rajkumar Buyya (Chapter 3, Pages 55-70).● Mastering Cloud Computing – Rajkumar Buyya (Chapter 4, Pages 85-100).
Evaluation	Reflective Questions (What Why Who?). Allow students to answer and discuss. 1. How will 5G impact cloud computing? Spend 5 minutes to wrap up and consolidate the learnings



Kot Bhalwal, Jammu



Lesson Plan No. 1.4	Course Name: Cloud Computing Cloud-Enabling Technology: Data Center & Virtualization Technology	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand the role of data centers in cloud computing. b. Explain the concept of virtualization and its significance. c. Identify different types of virtualizations used in cloud services. d. Discuss how data centers and virtualization work together to enable cloud computing.
Teaching Aids (if any)	a. You Tube video/NPTEL Video b. Chalk & talk with board c. Case Studies (Google Data Centers, AWS Virtual Machines, VMware)
Teaching Development	1. Introduction (10 minutes) <ul style="list-style-type: none">Ask questions:<ol style="list-style-type: none">Have you ever wondered where your Google Drive files are physically stored?Link the discussion to data centers & virtualization.Show an infographic of global cloud data centers (AWS, Google, Microsoft)."A data center is a physical facility that houses computing resources, while virtualization allows multiple virtual machines (VMs) to run on a single physical machine, optimizing resources." 2. Development (30 minutes) A. What is a Data Center? (10 minutes) <ul style="list-style-type: none">Components of a Data Center:<ul style="list-style-type: none">Servers (Compute Power)Storage (Data Management)Networking (Connectivity)Power & Cooling (Efficiency)Types of Data Centers:<ul style="list-style-type: none">On-Premises Data CentersCloud Data Centers (AWS, Azure, Google Cloud)Edge Data Centers (Content Delivery Networks - CDNs)Real-life Example:<p>Google Data Centers use AI-powered cooling to reduce energy consumption by 40%.</p>



	<p>B. What is Virtualization? (10 minutes)</p> <p>"Virtualization is the creation of a virtual version of computing resources, enabling multiple workloads to run on a single physical system."</p> <p>• Types of Virtualization:</p> <ul style="list-style-type: none">• Server Virtualization – Running multiple virtual machines (VMs) on one physical server (e.g., VMware, Hyper-V).• Storage Virtualization – Pooling storage devices into a single unit (e.g., SAN, NAS).• Network Virtualization – Software-defined networking (SDN) for efficient routing (e.g., Cisco SD-WAN). <p>• Real-life Example:</p> <p>AWS EC2 instances allow users to create virtual servers on-demand, reducing costs and increasing flexibility.</p> <p>C. How Data Centers and Virtualization Work Together? (10 minutes)</p> <p>• Why Virtualization is Important for Data Centers?</p> <ul style="list-style-type: none">• Increases resource utilization.• Reduces hardware costs.• Improves scalability and flexibility.• Enhances disaster recovery. <p>• Case Study:</p> <p>Netflix runs its entire infrastructure on AWS cloud, using virtualized data centers to deliver content seamlessly.</p> <p>3. Exercise (10 minutes) Group Discussion: "Why do cloud providers prefer virtualized data centers over traditional ones?" Ask students to match different types of virtualization with real-world applications.</p> <p>YouTube Video Link: https://www.youtube.com/watch?v=Wb68Exu6jtU</p>
Closure	<ul style="list-style-type: none">• Summarize key concepts• Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p> <ul style="list-style-type: none">• Cloud Computing: Principles and Paradigms – Rajkumar Buyya (Chapter 4, Pages 71-90).

	<ul style="list-style-type: none"> Mastering Cloud Computing – Rajkumar Buyya (Chapter 5, Pages 101-120).
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> What would happen if cloud data centers didn't use virtualization? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 1.5	Course Name: Cloud Computing Cloud-Enabling Technology: Web, Multitenant and Service Technology	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand how web technologies enable cloud computing. Explain the concept of multitenancy and its role in cloud environments. Identify service technology models used in cloud computing. Discuss real-world examples of cloud applications utilizing these technologies.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board Online Quiz (Nearpod)
Teaching Development	<p>1. Introduction (10 minutes)</p> <ul style="list-style-type: none"> Ask questions: <ol style="list-style-type: none"> "Have you ever noticed how multiple users can work on the same Google Docs file in real time?" "How does Netflix provide personalized content to millions of users simultaneously?" Introducing Web, Multitenant, and Service Technology as key enablers of cloud computing. Show an infographic of cloud-based web applications (Gmail, AWS, Azure, Dropbox). "Web technology provides the foundation for cloud applications; multitenancy ensures efficient resource sharing, and service technology defines how cloud services are delivered." <p>2. Development (30 minutes)</p> <p>A. Web Technology in Cloud Computing (10 minutes)</p> <ul style="list-style-type: none"> Role of Web in Cloud Computing: <ul style="list-style-type: none"> HTTP/HTTPS protocols for communication. APIs & Web Services (REST, SOAP) to connect cloud applications. CDNs (Content Delivery Networks) for fast data access (e.g., Cloudflare). Real-life Example: <p>Netflix uses AWS and CDNs to stream high-quality content worldwide with minimal buffering.</p> <p>B. Multitenant Technology (10 minutes)</p>



"A single instance of a software application serves multiple customers (tenants) while keeping their data separate."

• **How Multitenancy Works:**

- Shared vs. Isolated resources (Logical data separation).
- Database-level vs. Application-level multitenancy.

• **Benefits of Multitenancy:**

- Cost efficiency (shared infrastructure).
- Scalability (dynamically allocates resources).
- Maintenance (updates are applied universally).

• **Real-life Example:**

Salesforce CRM provides cloud-based multitenant services to businesses of all sizes.

C. Service Technology in Cloud Computing (10 minutes)

• **Types of Cloud Service Technologies:**

- **Infrastructure as a Service (IaaS)** – Compute, Storage (AWS EC2, Google Compute Engine).
- **Platform as a Service (PaaS)** – Development platforms (Google App Engine, Heroku).
- **Software as a Service (SaaS)** – Web-based applications (Google Docs, Dropbox, Zoom).

• **Serverless Computing (FaaS - Function as a Service):**

- *"Cloud providers manage the infrastructure, and users only focus on writing code."*
- **Example:** AWS Lambda (Runs code without managing servers).

• **Real-life Example:**

Google Docs (SaaS) allows real-time collaboration without local installations.

3. Exercise (10 minutes)

Group Discussion:

"Why do cloud companies prefer multitenant architecture?"

"Which service model (IaaS, PaaS, SaaS) is best for a startup?"

YouTube Video Link:

<https://www.youtube.com/watch?v=yWMNh0bRGng>



Kot Bhalwal, Jammu



Closure	<ul style="list-style-type: none">• Summarize key concepts• Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p> <ul style="list-style-type: none">• Cloud Computing: Concepts, Technology & Architecture – Thomas Erl (Chapter 3, Pages 55-80).• Cloud Computing: Principles and Paradigms – Rajkumar Buyya (Chapter 4, Pages 90-110).
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. How do multitenant cloud platforms like Salesforce manage multiple users securely? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Kot Bhalwal, Jammu



Lesson Plan No. 1.6	Course Name: Cloud Computing Fundamental Cloud Security: Basic Terms and Concepts	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand fundamental security concepts in cloud computing. b. Identify key cloud security risks and threats. c. Learn basic security mechanisms to protect cloud environments. d. Discuss real-world cloud security breaches and best practices.
Teaching Aids (if any)	a. You Tube video/NPTEL Video b. Chalk & talk with board c. Case Studies (AWS Security Breach, Capital One Hack, Google Cloud Security)
Teaching Development	1. Introduction (10 minutes) <ul style="list-style-type: none">• Ask questions:<ol style="list-style-type: none">1. "How secure do you think your Google Drive or iCloud data is?"2. "What would happen if someone hacked your Amazon or Netflix account?"• Introduce cloud security as a major challenge in cloud computing.• Show real-time cloud security attack statistic (e.g., number of daily cyberattacks).• "Cloud security involves protecting data, applications, and infrastructure from cyber threats." 2. Development (30 minutes) A. Basic Cloud Security Terms (10 minutes) <ul style="list-style-type: none">• Confidentiality, Integrity, and Availability (CIA Triad)<ul style="list-style-type: none">• <i>Confidentiality</i>: Protecting sensitive data (e.g., encryption).• <i>Integrity</i>: Ensuring data is not altered maliciously (e.g., hashing).• <i>Availability</i>: Ensuring services are accessible when needed (e.g., DDoS protection).• Real-life Example:<ul style="list-style-type: none">• Banks use encryption (confidentiality) to secure transactions.• Cloud providers like AWS replicate data (availability) to prevent downtime. B. Key Cloud Security Threats (10 minutes) <ul style="list-style-type: none">• Common Cloud Security Threats:<ul style="list-style-type: none">• Data Breaches (e.g., Capital One Hack on AWS)• Account Hijacking (e.g., Weak passwords lead to credential theft).



	<ul style="list-style-type: none">• Denial-of-Service (DoS) Attacks (e.g., DDoS attack taking down a website).• Insider Threats (e.g., Employees leaking confidential data). <ul style="list-style-type: none">• Case Study:<ul style="list-style-type: none">• Capital One Data Breach (2019) – A misconfigured AWS server exposed 100 million customer records.• Discussion:<ul style="list-style-type: none">• "What measures could have prevented this breach?" <p>C. Basic Cloud Security Mechanisms (10 minutes)</p> <ul style="list-style-type: none">• How Cloud Providers Ensure Security:<ul style="list-style-type: none">• Encryption – Securing data with cryptographic keys.• Multi-Factor Authentication (MFA) – Verifying user identity.• Firewalls & Intrusion Detection Systems (IDS) – Preventing unauthorized access.• Access Control & Identity Management – Restricting user permissions.• Real-life Example:<p>Google requires MFA for account security, reducing hacks by 99%.</p>• Activity:<p>Students discuss: <i>"How many of you use Two-Factor Authentication (2FA) on your accounts?"</i></p> <p>3. Exercise (10 minutes)</p> <p>Group Discussion:</p> <p>"Why is cloud security more complex than traditional IT security?"</p> <p>"If you were a cloud provider, what security measure would you prioritize?"</p> <p>YouTube Video Link: https://www.youtube.com/watch?v=wZQ_DoibuoQ</p>
Closure	<ul style="list-style-type: none">• Summarize key concepts.• Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p>

	<ul style="list-style-type: none"> • Cloud Computing: Concepts, Technology & Architecture – Thomas Erl (Chapter 6, Pages 120-145). • Cloud Computing: Principles and Paradigms – Rajkumar Buyya (Chapter 7, Pages 160-180).
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <p>1. How would you secure a cloud storage service like Google Drive?</p> <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 1.7	Course Name: Cloud Computing Fundamental Cloud Security: Threat Agents and Cloud Security Threats	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand what threat agents are in the context of cloud security. Identify different types of cloud security threats. Discuss real-world cloud security breaches and attack methods. Learn about basic mitigation strategies for cloud security threats.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board Case Studies (Capital One Hack, AWS Data Exposure, Cloud Ransomware Attacks)
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Ask questions: <ol style="list-style-type: none"> "What do you think is the biggest risk of storing data on the cloud?" "Have you ever received a suspicious email asking for login details?" Introducing threat agents and cloud security threats as critical concerns in cloud computing. Show an infographic of top cloud security threats (data breaches, DDoS, insider threats, malware). "Threat agents are entities (individuals, groups, or systems) that exploit vulnerabilities in the cloud to cause harm." "Cloud security threats are specific risks that can compromise data integrity, confidentiality, and availability." Development (30 minutes) <ol style="list-style-type: none"> Threat Agents in Cloud Computing (10 minutes) <ul style="list-style-type: none"> Types of Threat Agents: <ul style="list-style-type: none"> Malicious Insiders – Employees with access who misuse data (e.g., Snowden NSA leaks). Hackers & Cybercriminals – Exploit security flaws (e.g., Ransomware attacks on cloud systems). Government & Nation-State Actors – Cyber espionage (e.g., China’s alleged cloud data breaches). Disgruntled Users – Ex-employees leaking sensitive information. Automated Bots & Malware – AI-driven cyberattacks. Real-life Example: Tesla Insider Threat (2020): A disgruntled employee tried to plant malware in Tesla’s cloud environment. Cloud Security Threats (10 minutes)



	<ul style="list-style-type: none">• Common Cloud Security Threats:<ul style="list-style-type: none">• Data Breaches (e.g., Capital One Hack on AWS)• Account Hijacking (e.g., Weak passwords lead to credential theft).• Denial-of-Service (DoS) Attacks (e.g., DDoS attack taking down a website).• Insider Threats (e.g., Employees leaking confidential data).• Case Study:<ul style="list-style-type: none">• Capital One Data Breach (2019) – A misconfigured AWS server exposed 100 million customer records.• Discussion:<ul style="list-style-type: none">• "What measures could have prevented this breach?" <p>C. Basic Mitigation Strategies (10 minutes)</p> <ul style="list-style-type: none">• How to reduce Cloud Security Risks:<ul style="list-style-type: none">• Encryption – Securing data with cryptographic keys.• Multi-Factor Authentication (MFA) – Verifying user identity.• Firewalls & Intrusion Detection Systems (IDS) – Preventing unauthorized access.• Access Control & Identity Management – Restricting user permissions.• Cloud Access Security Brokers (CASB) – Monitors and enforces security policies.• Zero Trust Security Model – "Never trust, always verify."• Regular Security Audits – Identifying misconfigurations before attackers do.• Real-life Example:<p>Google Cloud's security team detected and mitigated a large-scale botnet attack using AI-driven monitoring.</p> <p>3. Exercise (10 minutes)</p> <p>Group Discussion:</p> <p>"Why do companies like Amazon, Microsoft, and Google invest billions in cloud security?"</p> <p>"Which cloud security threat do you think is the most dangerous and why?"</p> <p>YouTube Video Link:</p> <p>https://www.youtube.com/watch?v=wZQ_DoibuoQ</p>
Closure	<ul style="list-style-type: none">• Summarize key concepts• Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p>

	<ul style="list-style-type: none"> • Cloud Computing: Concepts, Technology & Architecture – Thomas Erl (Chapter 7, Pages 150-175). • Cloud Computing: Principles and Paradigms – Rajkumar Buyya (Chapter 8, Pages 190-210).
Evaluation	<p>Reflective Questions (What, Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. If cloud security is so advanced, why do breaches still happen? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 1.8	Course Name: Cloud Computing Risk Management	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand risk management in cloud security. b. Identify key risks associated with cloud computing. c. Learn about risk assessment frameworks and mitigation strategies.
Teaching Aids (if any)	<ul style="list-style-type: none"> a. You Tube video/NPTEL Video b. Chalk & talk with board
Teaching Development	<p>1. Introduction (10 minutes)</p> <ul style="list-style-type: none"> • Ask questions: <ol style="list-style-type: none"> 1. "Have you ever lost access to your email or cloud storage due to a forgotten password or security issue?" 2. "What do you think are the biggest risks of storing data on the cloud?" • Introduce risk management as a critical aspect of cloud security. • Show an infographic of top cloud security risks (data breaches, service outages, compliance failures, insider threats). • "Cloud risk management involves identifying, assessing, and mitigating potential threats that could compromise cloud security." <p>2. Development (30 minutes)</p> <p>A. Key Cloud Security Risks (10 minutes)</p> <ul style="list-style-type: none"> • Common Cloud Risks: <ul style="list-style-type: none"> • Data Breaches – Unauthorized access to sensitive cloud data. • Data Loss – Accidental deletion, ransomware attacks. • Downtime & Service Outages – AWS or Google Cloud disruptions affecting businesses. • Compliance & Legal Risks – GDPR, HIPAA violations due to poor data handling. • Insider Threats – Employees misusing privileged access. • Shared Responsibility Model Risks – Cloud providers vs. user responsibilities. • Real-life Example: <p>AWS S3 Bucket Misconfigurations (Numerous companies exposed sensitive data due to misconfigured permissions).</p> <p>B. Cloud Security Risk Management Frameworks (10 minutes)</p> <ul style="list-style-type: none"> • Risk Management Process: <ul style="list-style-type: none"> • Risk Identification – Understanding potential threats. • Risk Assessment – Evaluating the impact and likelihood of risks.



	<ul style="list-style-type: none">• Risk Mitigation – Implementing security measures.• Risk Monitoring – Continuous evaluation and updating of security policies.• Risk Management Frameworks:<ul style="list-style-type: none">• NIST (National Institute of Standards and Technology) Framework• ISO 27001 – Cloud Security Risk Standards• CIS (Center for Internet Security) Controls for Cloud Security• Case Study: Capital One Data Breach (2019) – A poorly configured firewall allowed a hacker to exploit AWS infrastructure. <p>C. Cloud Risk Mitigation Strategies (10 minutes)</p> <ul style="list-style-type: none">• How to reduce Cloud Security Risks:<ul style="list-style-type: none">• Encryption – Securing data with cryptographic keys.• Multi-Factor Authentication (MFA) – Verifying user identity.• Firewalls & Intrusion Detection Systems (IDS) – Preventing unauthorized access.• Access Control & Identity Management – Restricting user permissions.• Cloud Access Security Brokers (CASB) – Monitors and enforces security policies.• Zero Trust Security Model – "Never trust, always verify."• Regular Security Audits – Identifying misconfigurations before attackers do.• Real-life Example: Google Cloud implements AI-driven threat detection to prevent security breaches. <p>3. Exercise (10 minutes) Group Discussion: "Why do businesses still migrate to the cloud despite security risks?" "Which risk management framework (NIST, ISO 27001, CIS) do you think is most effective?"</p> <p>YouTube Video Link: https://www.youtube.com/watch?v=wZQ_DoibuoQ</p>
Closure	<ul style="list-style-type: none">• Summarize key concepts.• Encourage students to explore cloud-based applications they use daily. <p>Suggested Reading:</p> <ul style="list-style-type: none">• Cloud Computing: Concepts, Technology & Architecture – Thomas Erl (Chapter 8, Pages 180-200).



Kot Bhalwal, Jammu



Model Institute of Engineering & Technology (Autonomous) Lesson Plan

	<ul style="list-style-type: none">• Cloud Computing: Principles and Paradigms – Rajkumar Buyya (Chapter 9, Pages 210-230).
Evaluation	<p>Reflective Questions (What, Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. If cloud security is so advanced, why do breaches still happen? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 2.1	Course Name: Cloud Computing Topic: Cloud Computing Mechanisms	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand fundamental cloud computing mechanisms. b. Identify different cloud infrastructure and security mechanisms. c. Learn about cloud service optimization techniques. d. Discuss real-world examples of cloud mechanisms in action.
Teaching Aids (if any)	<ul style="list-style-type: none"> a. You Tube video/NPTEL Video b. Chalk & talk with board c. Case Studies (AWS Auto Scaling, Google Kubernetes Engine, Azure Virtual Machines)
Teaching Development	<ol style="list-style-type: none"> 1. Introduction (10 minutes) <ul style="list-style-type: none"> • Ask questions: <ol style="list-style-type: none"> 1. "How does Netflix automatically handle millions of users streaming videos at the same time?" 2. "What happens when you upload a file to Google Drive?" • Introduce cloud computing mechanisms as the core technologies enabling cloud services. • Show an infographic of cloud computing components (storage, servers, load balancing, security mechanisms). • Cloud mechanisms are specific technologies that enable the efficient functioning of cloud services, including virtualization, scalability, and automation. 2. Development (30 minutes) <ol style="list-style-type: none"> A. Cloud Infrastructure Mechanisms (10 minutes) <ul style="list-style-type: none"> • Key Infrastructure Mechanisms: <ul style="list-style-type: none"> ○ Virtual Servers – Software-based servers running in a cloud environment (e.g., AWS EC2). ○ Cloud Storage Devices – Distributed storage systems (e.g., Google Cloud Storage, AWS S3). ○ Resource Replication – Duplicating resources for availability and backup. ○ Load Balancers – Distributing traffic across multiple servers for efficiency. • Real-life Example: <ul style="list-style-type: none"> ○ AWS Auto Scaling dynamically adjusts the number of virtual servers based on traffic demand. B. Specialized Cloud Mechanisms (10 minutes) <ul style="list-style-type: none"> • Essential Specialized Cloud Mechanisms: <ul style="list-style-type: none"> ○ Hypervisors – Enable virtualization (e.g., VMware, Xen, KVM). ○ Multi-Device Broker – Ensures seamless cloud service access from different devices.

	<ul style="list-style-type: none"> ○ Service Level Agreement (SLA) Monitor – Tracks cloud provider compliance. ● Case Study: <ul style="list-style-type: none"> ○ Netflix uses a combination of load balancing, auto-scaling, and storage replication to provide seamless video streaming. C. Cloud Security Mechanisms (10 minutes) <ul style="list-style-type: none"> ● Key Security Mechanisms: <ul style="list-style-type: none"> ○ Encryption – Protects data in transit and at rest (e.g., Google encrypts Gmail data). ○ Hashing & Digital Signatures – Ensures data integrity and authenticity. ○ Public Key Infrastructure (PKI) – Enables secure authentication (e.g., SSL/TLS in cloud websites). ○ Identity & Access Management (IAM) – Manages user access (e.g., AWS IAM, Azure Active Directory). ● Real-life Example: <ul style="list-style-type: none"> ○ AWS IAM allows businesses to define specific user roles, ensuring controlled access to cloud services.
Closure	<ol style="list-style-type: none"> 1. Summarize key concepts. 2. Encourage students to explore cloud services like AWS Free Tier, Google Cloud Compute, and Azure Virtual Machines. <p>Suggested Reading:</p> <ul style="list-style-type: none"> ● Cloud Computing: Concepts, Technology & Architecture – Thomas Erl (Chapter 9, Pages 210-230). ● Cloud Computing: Principles and Paradigms – Rajkumar Buyya (Chapter 10, Pages 250-270).
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. If cloud computing mechanisms make services so efficient, why do outages still happen? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 2.2	Course Name: Cloud Computing Topic: Cloud Infrastructure Mechanisms: Virtual Server and Cloud Storage Device	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand the concept of virtual servers and cloud storage devices. b. Identify how cloud infrastructure mechanisms improve scalability and efficiency. c. Learn about real-world cloud storage and virtual server use cases. d. Discuss security considerations for cloud storage and virtual servers.
Teaching Aids (if any)	<ul style="list-style-type: none"> a. You Tube video/NPTEL Video b. Chalk & talk with board c. NearPod Quiz Activity
Teaching Development	<ol style="list-style-type: none"> 1. Introduction (10 minutes) <ul style="list-style-type: none"> • Ask questions: <ol style="list-style-type: none"> 1. "How does Google Drive allow you to access your files from any device?" 2. "What happens behind the scenes when you run a virtual machine on the cloud?" • Introduce cloud infrastructure mechanisms as the foundation of cloud computing. • Cloud infrastructure mechanisms enable cloud computing by providing scalable virtual servers and distributed storage systems. 2. Development (30 minutes) <ol style="list-style-type: none"> A. Cloud Virtual Server in Cloud Computing (15 minutes) <ul style="list-style-type: none"> • What is a Virtual Server? <ul style="list-style-type: none"> ○ A software-based emulation of a physical server that runs on a cloud provider's infrastructure. ○ Enables multiple virtual machines (VMs) to run on a single physical server. ○ Example providers: AWS EC2, Google Compute Engine, Microsoft Azure Virtual Machines. • Benefits of Virtual Servers: <ul style="list-style-type: none"> ○ Scalability – On-demand server provisioning. ○ Cost Efficiency – Pay-as-you-go model. ○ Redundancy & High Availability – Reduced downtime. ○ Isolation & Security – Separation of workloads. • Real-life Example: <ul style="list-style-type: none"> ○ Netflix uses AWS EC2 instances to scale its video streaming services dynamically based on demand. B. Cloud Storage Devices in Cloud Computing (15 minutes) <ul style="list-style-type: none"> • What is Cloud Storage? <ul style="list-style-type: none"> ○ A distributed data storage system that allows users to store and access files remotely.



	<ul style="list-style-type: none">○ Types of Cloud Storage:<ul style="list-style-type: none">▪ Object Storage – AWS S3, Google Cloud Storage.▪ Block Storage – Amazon EBS, Google Persistent Disk.▪ File Storage – Dropbox, OneDrive, Google Drive.● Benefits of Cloud Storage:<ul style="list-style-type: none">○ Accessibility – Access from anywhere.○ Data Redundancy – Automatic backups across multiple locations.○ Scalability – Expand storage without physical limits.○ Security & Encryption – Protection against unauthorized access.● Real-life Example:<ul style="list-style-type: none">○ Google Drive allows users to store, share, and collaborate on documents in real time from different locations.
Closure	<ol style="list-style-type: none">1. Summarize key concepts.2. Encourage students to explore AWS Free Tier, Google Cloud Compute, or Azure Virtual Machines. <p>Suggested Reading:</p> <ul style="list-style-type: none">● Cloud Computing: Concepts, Technology & Architecture – Thomas Erl (Chapter 9, Pages 210-230).● Cloud Computing: Principles and Paradigms – Rajkumar Buyya (Chapter 10, Pages 250-270).
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. If cloud storage is so secure, why do data breaches still happen? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 2.3	Course Name: Cloud Computing Topic: Cloud Infrastructure Mechanisms: Usage Monitor and Resource Replication	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the concepts of Usage Monitoring and Resource Replication in cloud computing. Identify how these mechanisms enhance cloud infrastructure's efficiency and reliability. Discuss real-world applications and implications of these mechanisms.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board NearPod Quiz Activity
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Ask questions: <ol style="list-style-type: none"> How do cloud providers monitor and manage the vast number of resources to ensure optimal performance? Introduce the importance of monitoring and replicating resources in cloud environments to maintain performance and reliability. Usage Monitor: “A mechanism that tracks and analyzes the utilization of cloud resources to ensure efficient operation and billing accuracy.” Resource Replication: “The process of creating multiple instances of IT resources to enhance availability, performance, and fault tolerance.” Development (30 minutes) <ol style="list-style-type: none"> Usage Monitor in Cloud Computing (15 minutes) <ul style="list-style-type: none"> What is a Usage Monitor? <ul style="list-style-type: none"> A software program that autonomously collects and processes data on cloud resource usage. Ensures resources are utilized efficiently and helps in accurate billing. Implementation Formats: <ul style="list-style-type: none"> Monitoring Agent: Installed on cloud services to track usage metrics. Resource Agent: Interacts with resource software to monitor events like initiation, suspension, or scaling. Polling Agent: Periodically polls IT resources to collect usage data. Benefits: <ul style="list-style-type: none"> Optimize resource allocation. Detects anomalies or inefficiencies. Facilitates transparent billing.



	<ul style="list-style-type: none">• Real-life Example:<ul style="list-style-type: none">○ Amazon CloudWatch monitors AWS resources and applications, providing real-time data and insights.• B. Resource Replication in Cloud Computing (15 minutes)• What is Resource Replication?<ul style="list-style-type: none">○ Creating multiple instances of the same IT resource to enhance availability and performance.• Types of Resources Commonly Replicated:<ul style="list-style-type: none">○ Data Replication: Duplicating data across multiple storage devices or locations.• Service Replication: Running multiple instances of a service to balance load and ensure availability.• Benefits:<ul style="list-style-type: none">○ Improves fault tolerance and disaster recovery.○ Enhances load balancing and performance.○ Ensures data redundancy and reliability.• Real-life Example:<ul style="list-style-type: none">○ Google Cloud Storage replicates data across multiple locations to ensure durability and availability. <p>Youtube Video Link: https://www.youtube.com/watch?v=Imj8L-po4kw</p>
Closure	<ol style="list-style-type: none">1. Summarize key concepts.2. Reiterate the roles of usage monitoring and resource replication in maintaining efficient and reliable cloud services. <p>Suggested Reading:</p> <ul style="list-style-type: none">• Cloud Computing: Concepts, Technology & Architecture by Thomas Erl – Chapter 7, Pages 210-230.• Cloud Computing: Principles and Paradigms by Rajkumar Buyya – Chapter 10, Pages 250-270.
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What challenges might arise in implementing these mechanisms, and how can they be addressed? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 2.4	Course Name: Cloud Computing Specialized Cloud Mechanisms: Load Balancer and SLA Monitor	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the function and importance of Load Balancers in cloud environments Comprehend the purpose and operation of SLA Monitors Analyze real-time scenarios where these mechanisms are applied Relate concepts to industry use-cases and reinforce with book and video resources.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board
Teaching Development	<p>1. Introduction (10 minutes)</p> <ul style="list-style-type: none"> Begin by briefly introducing cloud architecture. Define what “specialized cloud mechanisms” Mention their role in optimizing performance, reliability, and SLA compliance. <p>2. Load Balancer (15 minutes)</p> <ul style="list-style-type: none"> Definition and Purpose: Distribute incoming service traffic across multiple servers. Ensure high availability and reliability. <p>Types of Load Balancers:</p> <ul style="list-style-type: none"> Hardware vs Software Load Balancers Layer 4 vs Layer 7 Load Balancing (explain in simple terms) <p>Real-world Example:</p> <ul style="list-style-type: none"> Example: Netflix, Amazon use load balancing to manage millions <p>3. SLA Monitor (15 minutes)</p> <p>Definition and Purpose:</p> <ul style="list-style-type: none"> SLA = Service Level Agreement; monitors ensure that cloud services meet promised performance metrics. <p>Components and Parameters:</p> <ul style="list-style-type: none"> Uptime, Latency, Response Time, Downtime thresholds <p>Real-world Example:</p>



	<ul style="list-style-type: none">• Example: Microsoft Azure and AWS provide SLA dashboards to clients. <p>NPTEL Reference:</p> <ul style="list-style-type: none">• NPTEL Lecture on SLAs in Cloud Computing (Prof. Rajkumar Buyya): https://nptel.ac.in/courses/106/105/106105167/ <p>4. Comparative Overview and Industry Usage (10 minutes)</p> <ul style="list-style-type: none">• Compare roles:<ul style="list-style-type: none">• Load Balancer: Optimizes traffic• SLA Monitor: Ensures promised service levels• Industry usage table:<ul style="list-style-type: none">• AWS: Elastic Load Balancer, CloudWatch for SLA• Azure: Traffic Manager, SLA Monitoring Tools <p>Q&A Activity:</p> <ul style="list-style-type: none">• Give mini-scenarios and ask students to identify which mechanism is applicable.
Closure	<ul style="list-style-type: none">• Reinforce the importance of specialized cloud mechanisms for service delivery.• Emphasize how these mechanisms uphold service quality and user satisfaction.• Encourage students to observe such mechanisms in apps they use daily (e.g., streaming, ride-sharing, food delivery).• Open floor for final doubts or questions (2–3 mins). <p>Suggested Reading:</p> <ul style="list-style-type: none">□ Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl Pages 142–145 (Specialized Cloud Mechanisms)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What is the function of a Load Balancer, and how does it ensure high availability in a cloud environment?2. Why are SLA Monitors critical in maintaining service reliability and trust in cloud platforms?3. Who are some of the major cloud providers using these mechanisms, and what specific tools or services do they offer for Load Balancing and SLA Monitoring? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>

Lesson Plan No. 2.5	Course Name: Cloud Computing Specialized Cloud Mechanisms: Hypervisor and Multi-Device Broker	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the role of a Hypervisor in cloud infrastructure Learn about Multi-Device Brokers and their significance in cloud interoperability Relate the concepts with real-world applications Use examples, videos, and textbook content to consolidate understanding.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Brief recap on cloud architecture. Introduce the term “Specialized Cloud Mechanisms” with reference to their purpose in managing cloud systems. Hypervisor (15 minutes) <ul style="list-style-type: none"> Definition: A hypervisor (also known as a virtual machine monitor) enables virtualization by allowing multiple operating systems to share a single hardware host. Types of Hypervisors: <ul style="list-style-type: none"> Type 1 (Bare-metal) and Type 2 (Hosted) Simple explanation with examples: VMware ESXi (Type 1), VirtualBox (Type 2) Real-world Example: <ul style="list-style-type: none"> Cloud providers like AWS use Xen Hypervisor to run virtual machines. Multi-Device Broker (15 minutes) <ul style="list-style-type: none"> Definition: <ul style="list-style-type: none"> A Multi-Device Broker facilitates interactions among different devices connected to the cloud, ensuring smooth data exchange across platforms. Purpose: <ul style="list-style-type: none"> Handles device heterogeneity, connectivity management, and protocol translation. Real-world Example: <ul style="list-style-type: none"> Smart home systems: Google Home managing lights, thermostats, and speakers.

	<p>4. Comparative Overview and Industry Usage (10 minutes)</p> <p>Comparison Table:</p> <ul style="list-style-type: none"> • Hypervisor: Resource virtualization • Multi-Device Broker: Device interoperability <p>Cloud Provider Examples:</p> <ul style="list-style-type: none"> • AWS uses Xen/KVM Hypervisors • Google Cloud supports multi-device sync across its ecosystem <p>Scenario Discussion:</p> <ul style="list-style-type: none"> • Ask students to propose a scenario that uses both (e.g., a smart city cloud management system) <p>5. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none"> • Recap key points: Role of hypervisors and brokers • Reinforce with examples and references to textbook
Closure	<ul style="list-style-type: none"> • Revisit how specialized mechanisms make cloud systems flexible and scalable • Encourage students to explore virtualization and IoT systems • Prompt students to relate today's content with real-life devices • Take last 2–3 minutes for doubts or thoughts <p>Suggested Reading:</p> <p>□ Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl Pages 146–148 (Specialized Cloud Mechanisms)</p>
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. What is a hypervisor and why is it critical in a cloud environment? 2. Why do we need a multi-device broker in the age of IoT? 3. Who are the major cloud providers using these technologies, and in what applications? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Kot Bhalwal, Jammu



Lesson Plan No. 2.6	Course Name: Cloud Computing Cloud Management Mechanisms	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand the core cloud management mechanisms and their role in cloud computing b. Identify the components and services used to manage cloud resources c. Analyze real-world use cases of cloud management d. Reinforce learning through visual examples and guided discussion.
Teaching Aids (if any)	a. You Tube video/NPTEL Video b. Chalk & talk with board
Teaching Development	<p>1. Introduction (10 minutes)</p> <ul style="list-style-type: none">• Define Cloud Management: the administrative control over cloud products and services.• Importance of cloud management for operational efficiency and cost control.• Engage students by asking: "How do you think big cloud providers like AWS manage their huge infrastructure?" <p>2. Key Cloud Management Mechanisms (20 minutes)</p> <ul style="list-style-type: none">• Audit Monitor:<ul style="list-style-type: none">• Monitors and records system-level events and user activities• Real-world example: AWS CloudTrail• Automated Scaling Listener:<ul style="list-style-type: none">• Triggers scale-out/scale-in processes automatically• Real-world example: Auto Scaling in AWS EC2• Cloud Usage Monitor:<ul style="list-style-type: none">• Tracks service usage to ensure billing and SLA compliance• Real-world example: Azure Monitor• Resource Replication:<ul style="list-style-type: none">• Duplicates resources to maintain availability• Real-world example: Google Cloud replication for data storage <p>Real-World Use Case (10 minutes)</p> <ul style="list-style-type: none">• Case Study: E-commerce website scaling during festive season<ul style="list-style-type: none">• Use of Automated Scaling, Usage Monitor, and Replication to manage load• YouTube Video:<ul style="list-style-type: none">• "Cloud Monitoring and Management in AWS" – https://www.youtube.com/watch?v=VfmmL7nCOaM• NPTEL Reference:

	<ul style="list-style-type: none"> • NPTEL Lecture on Cloud Resource Management: https://nptel.ac.in/courses/106105167 <p>4. Comparative Overview (5 minutes)</p> <p>Compare mechanisms by describing their purpose and example tools:</p> <ul style="list-style-type: none"> • Audit Monitor: Tracks activities (e.g., AWS CloudTrail) • Auto-Scaling Listener: Adjusts resources based on load (e.g., AWS Auto Scaling) • Usage Monitor: Measures resource consumption (e.g., Azure Monitor) • Resource Replication: Provides redundancy (e.g., Google Cloud Storage) <p>5. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none"> • Recap each mechanism with its purpose • Reinforce through discussion: "Which of these do you think would be most critical in a healthcare app?"
Closure	<ul style="list-style-type: none"> • Emphasize how these mechanisms ensure reliability, availability, and cost efficiency • Link with apps students use daily (streaming platforms, online stores) • Final questions and open discussion (2–3 minutes) <p>Suggested Reading:</p> <ul style="list-style-type: none"> □ Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. What are cloud management mechanisms, and how do they improve performance? 2. Why is automated scaling important in unpredictable traffic conditions? 3. Who are the major cloud providers using these tools and what services do they offer? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Kot Bhalwal, Jammu



Lesson Plan No. 2.7	Course Name: Cloud Computing Cloud Security Mechanisms: Encryption, Hashing, Digital Signatures	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none">a. Understand the importance of data security in cloud environments.b. Explain the concepts of encryption, hashing, and digital signatures.c. Distinguish between these mechanisms and know where each is applicable.d. Apply concepts to real-world scenarios and recognize their use in cloud platforms.e. Engage in discussion on modern threats and how these techniques mitigate them.
Teaching Aids (if any)	<ul style="list-style-type: none">a. You Tube video/NPTEL Videob. Chalk & talk with board
Teaching Development	<ol style="list-style-type: none">1. Introduction (10 minutes)<ul style="list-style-type: none">• Begin with the need for security in cloud computing — highlight trust, privacy, and compliance.• Ask: “What happens if your data is intercepted or modified in the cloud?”• Briefly mention CIA Triad (Confidentiality, Integrity, Availability) and how encryption, hashing, and signatures relate.2. Encryption (15 minutes) Definition & Purpose:<ul style="list-style-type: none">• Encryption converts plaintext into ciphertext to ensure confidentiality.• Two main types:<ul style="list-style-type: none">○ Symmetric Encryption: Same key for encryption and decryption (e.g., AES).○ Asymmetric Encryption: Public and private key pair (e.g., RSA). Real-world Examples:<ul style="list-style-type: none">• SSL/TLS for secure web access (e.g., HTTPS)• End-to-end encryption in WhatsApp3. Hashing (10 minutes)<ul style="list-style-type: none">• One-way transformation used to verify integrity.• Characteristics: deterministic, irreversible, collision-resistant.• Common use: password storage, file integrity checking.



	<p>NPTEL Reference:</p> <ul style="list-style-type: none">Lecture on Cryptographic Hash Functions – Prof. Debdeep Mukhopadhyay – https://nptel.ac.in/courses/106105031 <p>4. Digital Signatures (10 minutes)</p> <ul style="list-style-type: none">Combines encryption + hashing to verify origin and content integrity.Used for authentication and non-repudiation.Real-world example: e-doc signing, software validation. <p>5. Comparative Overview (5 minutes)</p> <ul style="list-style-type: none">Encryption is used to ensure confidentiality. It is used in technologies like HTTPS and AWS KMS.Hashing ensures data integrity. It is widely used in password storage and checksums.Digital Signatures provide authentication and non-repudiation. They are used in signed documents and secure email communication. <p>6. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none">Recap each mechanism: what it does and where it's used.Ask: "Which of these would be most important if you're using online banking?"Encourage students to link examples to personal use.
Closure	<ul style="list-style-type: none">Emphasize how these mechanisms together secure modern cloud applications.Encourage students to look into the security features of their cloud services.Final Q&A and discussion (2–3 minutes). <p>Suggested Reading:</p> <ul style="list-style-type: none">□ Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">What is the purpose of each mechanism?Why is it important to ensure data integrity and authentication?Who are major cloud providers implementing these security features? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>

Lesson Plan No. 2.8	Course Name: Cloud Computing Cloud Security Mechanisms: Public Key Infrastructure (PKI)	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the concept and components of Public Key Infrastructure (PKI). Explain the role of PKI in cloud security. Describe how PKI ensures secure communication. Identify real-world applications and challenges in implementing PKI.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Recall asymmetric encryption briefly. Introduce the need for managing public keys and trust—motivation for PKI. Pose a question: "If anyone can create a public key, how do we know it's authentic?" PKI Overview (15 minutes) <ul style="list-style-type: none"> Define PKI as a framework to manage digital keys and certificates. Explain its key components: <ul style="list-style-type: none"> Certificate Authority (CA) Registration Authority (RA) Digital Certificates (e.g., X.509) Public & Private Keys Certificate Revocation Lists (CRLs) PKI in Action (10 minutes) <ul style="list-style-type: none"> Use HTTPS/SSL certificate validation as an example. Show browser lock icon, inspect certificate. Explain authentication process: server sends certificate, client verifies via CA. <p>NPTEL Reference:</p> <ul style="list-style-type: none"> Lecture on Public Key Infrastructure – Prof. Debdeep Mukhopadhyay – https://nptel.ac.in/courses/106105031 Real-world Applications (10 minutes) <ul style="list-style-type: none"> Secure web browsing (SSL/TLS) Email encryption/signing (S/MIME) VPNs and enterprise authentication

	<ul style="list-style-type: none"> • Software/code signing <p>5. Challenges & Considerations (5 minutes)</p> <ul style="list-style-type: none"> • Managing trust chains and CA compromise • Certificate expiration and revocation • Scalability in large cloud environments <p>6. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none"> • Recap the role of PKI: identity verification and secure communications. • Reiterate the importance of digital trust in cloud-based systems.
Closure	<ul style="list-style-type: none"> • Final discussion: “Would you trust a cloud provider without PKI-based services?” • Q&A and prompt for further exploration of certificate transparency and zero trust models. <p>Suggested Reading:</p> <ul style="list-style-type: none"> □ Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. What is PKI and why is it necessary? 2. How do digital certificates build trust online? 3. Who are major Certificate Authorities, and how do they operate? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>

Lesson Plan No. 2.9	Course Name: Cloud Computing Cloud Security Mechanisms: Identity and Access Management (IAM)	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Define Identity and Access Management (IAM). Understand the components and importance of IAM in cloud security. Describe how IAM ensures secure access to cloud resources. Recognize real-world IAM solutions and best practices.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Start with the concept of user authentication and authorization. Define IAM as a framework of policies and technologies ensuring only the right users access the right resources at the right times. Ask students: "Have you ever shared your Netflix password? What happens if someone misuses it?" Components of IAM (15 minutes) <ul style="list-style-type: none"> User Identity Management Authentication Methods: Passwords, Multi-Factor Authentication (MFA), Biometrics Authorization: Role-Based Access Control (RBAC), Attribute-Based Access Control (ABAC) IAM Policies: Define what users can and can't do IAM in Cloud Platforms (10 minutes) <ul style="list-style-type: none"> Explain how AWS IAM, Azure AD, and Google Cloud IAM work. Demonstrate user-role-policy structure using a diagram. Highlight features like temporary credentials, session-based access, and fine-grained permissions. <p>NPTEL Reference:</p> <ul style="list-style-type: none"> Lecture on Identity Management and Access Control – https://nptel.ac.in/courses/106105031 <ol style="list-style-type: none"> Real-world Applications (10 minutes) <ul style="list-style-type: none"> Corporate cloud apps managing employees Online banking platforms Educational portals with role-based logins (student/teacher access)



	<p>5. Challenges & Considerations (5 minutes)</p> <ul style="list-style-type: none">• Over-permissioning and the principle of least privilege• Insider threats• Account lifecycle management (onboarding and offboarding users) <p>6. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none">• Recap the role of IAM in protecting cloud resources.• Reinforce the idea that IAM is foundational to secure cloud operations.
Closure	<ul style="list-style-type: none">• Final discussion: “Would you be comfortable if your cloud account was managed without IAM?”• Q&A and encourage students to check their Google account security settings. <p>Suggested Reading:</p> <p><input type="checkbox"/> Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl</p>
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What are the core components of IAM?2. Why is IAM important in the cloud?3. Who typically manages IAM in organizations? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 2.10	Course Name: Cloud Computing Cloud Security Mechanisms: Single Sign-On (SSO)	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Understand the concept and working of Single Sign-On (SSO). Explain the security and usability benefits of SSO in cloud environments. Identify real-world scenarios where SSO is implemented. Discuss potential risks and mitigation techniques.
Teaching Aids (if any)	<ol style="list-style-type: none"> You Tube video/NPTEL Video Chalk & talk with board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <ul style="list-style-type: none"> Introduce the idea of identity and access management in cloud security. Define SSO as a user authentication process that permits a user to access multiple applications with one set of login credentials. Ask: "Have you ever used your Google or Facebook account to log in to another website?" How SSO Works (15 minutes) <ul style="list-style-type: none"> Explain the authentication workflow in SSO with an identity provider (IdP) and service provider (SP). Use a diagram to demonstrate the flow: user → IdP → token → SP. Introduce protocols like SAML, OAuth, OpenID Connect briefly. Benefits of SSO (10 minutes) <ul style="list-style-type: none"> Improved user experience: fewer passwords to remember. Increased productivity and reduced IT helpdesk calls. Stronger security through centralized authentication and access control. Risks and Considerations (10 minutes) <ul style="list-style-type: none"> Single point of failure – if the SSO credential is compromised, access to all connected services is at risk. Risk mitigation strategies: MFA (Multi-Factor Authentication), session timeouts, monitoring. Discuss trade-offs: convenience vs. security. <p>NPTEL Reference:</p> <ul style="list-style-type: none"> Lecture on Identity and Access Management (IAM) – Prof. Aditya Bagchi – https://nptel.ac.in/courses/106105031

	<p>5. Real-World Use Cases (5 minutes)</p> <ul style="list-style-type: none"> • Google Workspace, Microsoft Azure AD, Okta, AWS IAM SSO. • University login portals that access multiple internal systems. <p>6. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none"> • Recap what SSO is, how it works, and where it is used. • Ask: "Would you adopt SSO for personal use? What would you watch out for?"
Closure	<ul style="list-style-type: none"> • Emphasize the growing use of SSO in modern cloud applications. • Encourage students to enable secure login options on their accounts (e.g., MFA). • Final Q&A and discussion (2–3 minutes). <p>Suggested Reading:</p> <p><input type="checkbox"/> Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl</p>
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. What is Single Sign-On and how does it work? 2. Why is SSO preferred in cloud environments? 3. Who are the major providers and adopters of SSO today? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>

Lesson Plan No. 3.1	Course Name: Cloud Computing Fundamental Cloud Architectures: Workload Distribution	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Define workload distribution in the cloud. Understand how tasks are balanced among computing resources. Recognize the benefits of distributing workloads in real-time cloud services. Identify real-world cloud platforms that use workload distribution. Compare traditional vs. cloud-based workload management.
Teaching Aids (if any)	<ol style="list-style-type: none"> PPT slides YouTube/NPTEL videos Real-life examples (YouTube, Amazon, Zoom) Chalk & board diagrams
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) <p>Ask Questions:</p> <ol style="list-style-type: none"> Ever wondered how Zoom handles thousands of classes at the same time? When you upload a video to YouTube, how does it not crash their system? <p>Transition: Introduce the concept of Workload Distribution—a fundamental mechanism in cloud architecture that helps spread work evenly across available servers/resources to optimize performance.</p> Development (30 minutes) <ol style="list-style-type: none"> What is Workload Distribution? (10 min) <p>Definition: Distribution of computing tasks across multiple servers or services.</p> <ul style="list-style-type: none"> Goals: <ul style="list-style-type: none"> Optimize performance Avoid overload Achieve fault tolerance <p>Analogy: Waiters in a restaurant – each one takes an equal number of tables for faster service.</p> Techniques Used (10 min) <ul style="list-style-type: none"> Round Robin Distribution Job Scheduling Queues Task Queuing Mechanisms Resource-Aware Task Assignment <p>Diagram: Visual representation of user requests being distributed across multiple virtual machines (VMs).</p> Real-World Examples (10 min) <ul style="list-style-type: none"> YouTube: Processes uploads by assigning them to different encoding servers. Amazon: Different services (payment, product page, search) handled by different backend nodes.



	<ul style="list-style-type: none">• Netflix: Uses Amazon EC2 to distribute video transcoding workloads.
Closure	<p>Recap Discussion:</p> <ol style="list-style-type: none">1. Why is workload distribution necessary in modern cloud applications?2. What happens if a cloud provider doesn't distribute workload effectively? <p>Prompt for Student Reflection: Think about an app you use every day. Can you imagine the kind of workloads it has to handle?</p> <p>Suggested Reading:</p> <ul style="list-style-type: none">• "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, (Chapter 6, pp. 157–163)• "Mastering Cloud Computing" by Rajkumar Buyya, (Chapter 5 , pp. 120–125)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What is the difference between workload distribution and load balancing?2. How does workload distribution improve efficiency and availability?3. Can a single server handle cloud workloads today? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 3.2	Course Name: Cloud Computing Fundamental Cloud Architectures: Resource Pooling	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Define resource pooling in cloud computing. Understand how cloud providers abstract and share computing resources. Recognize the importance of multi-tenancy in cloud environments. Identify examples of platforms that use pooled resources (e.g., AWS, Google Cloud). Differentiate between physical and virtual resource pools.
Teaching Aids (if any)	<ol style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Real-world cloud platforms: AWS EC2, Microsoft Azure Chalk & board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ol style="list-style-type: none"> Have you ever experienced a website slowing down during a sale? Why do you think that happens? What do you expect when you pay for a service (like cloud storage)? How would you react if it crashes? Development (30 minutes) <p>A. Load Balancer (15 Minutes) Key Concepts:</p> <ul style="list-style-type: none"> Definition: A system that distributes workloads across multiple computing resources. Purpose: Improve responsiveness, ensure high availability. Types: <ul style="list-style-type: none"> Hardware-based (e.g., F5) Software-based (e.g., HAProxy, AWS ELB) Techniques: <ul style="list-style-type: none"> Round-robin Least connections IP Hash <p>Real-Time Example:</p> <ul style="list-style-type: none"> Netflix: Uses AWS Elastic Load Balancer to distribute content across servers. Amazon: Product pages served from different servers depending on traffic patterns. <p>Interactive Activity:</p> <ul style="list-style-type: none"> Simulate user requests with volunteers and show how requests are redirected using a "balancing" analogy (can use a whiteboard or demo with paper). <p>B. SLA Monitor (15 Minutes) Key Concepts:</p> <ul style="list-style-type: none"> SLA (Service Level Agreement): A contract that defines the expected level of service.

	<ul style="list-style-type: none"> • SLA Monitoring: Tracks uptime, latency, throughput, etc. • Alerts and Reporting: Notify providers when SLA is breached. <p>Real-Time Example:</p> <ul style="list-style-type: none"> • AWS CloudWatch, Azure Monitor: Used to track SLA compliance. • Businesses like banks and healthcare systems need 99.999% uptime.
Closure	<p>Recap Discussion:</p> <ol style="list-style-type: none"> 1. Load Balancers distribute workload for performance and reliability. 2. SLA Monitors ensure services meet agreed standards. <p>Suggested Reading:</p> <ul style="list-style-type: none"> • “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 6, pp. 164–169) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 5 , pp. 110–118)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. How does resource pooling support scalability? 2. What are the security risks in multi-tenant environments? 3. Can a business have its own private resource pool in the cloud? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>

Lesson Plan No. 3.3	Course Name: Cloud Computing Fundamental Cloud Architectures: Service Load Balancing	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Understand the concept of service-level load balancing. Differentiate between load balancing at the hardware, software, and service layers. Explain how cloud services manage fluctuating demands. Recognize real-time examples like Netflix, AWS ELB, and Google Cloud Load Balancer. Understand the role of service replication and routing policies in balancing
Teaching Aids (if any)	<ol style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ol style="list-style-type: none"> Have you ever noticed how quickly a YouTube video loads, even during peak hours? Ever wondered how online services stay fast and responsive, even with thousands of users? Development (30 minutes) <ol style="list-style-type: none"> What is Service Load Balancing? (10 min) <ul style="list-style-type: none"> Definition: Distributing service requests across multiple identical service instances. Works at the application or service layer, unlike hardware load balancers. Ensures high availability and responsiveness. Analogy: Like having multiple counters in a bank—customers are directed to the next available teller. Mechanisms and Strategies (10 min) <ul style="list-style-type: none"> DNS-based Load Balancing Round Robin, Least Connections, IP Hash Health Checks for instance availability Service Replication for load distribution Diagram: Clients → Load Balancer → Multiple Service Instances Real-Time Cloud Examples (10 min) <ul style="list-style-type: none"> AWS ELB (Elastic Load Balancer): Balances HTTP requests to EC2 instances. Netflix: Uses service discovery + load balancing to route user requests efficiently. Google Cloud Load Balancer: Scales globally with geo-routing
Closure	Recap Discussion: <ul style="list-style-type: none"> Load balancing is essential for scalability and performance.



Kot Bhalwal, Jammu



	<ul style="list-style-type: none">• Cloud platforms automate this to ensure consistent service to users worldwide. <p>Suggested Reading:</p> <ul style="list-style-type: none">• “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 6, pp. 170–175)• “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 5 , pp. 125–130)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What is the difference between workload distribution and service load balancing?2. Why do cloud systems need dynamic load balancing?3. Give an example of a real-time application that would break without it. <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 3.4	Course Name: Cloud Computing Fundamental Cloud Architectures: Dynamic Scalability Architecture	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Define dynamic scalability in the cloud. Differentiate between vertical and horizontal scaling. Explain how dynamic resource allocation supports performance and cost-efficiency. Identify use cases like Zoom, Netflix, and e-commerce websites during peak hours. Understand auto-scaling mechanisms used by major providers like AWS and Azure
Teaching Aids (if any)	<ol style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ol style="list-style-type: none"> Ever noticed how Zoom didn't crash during the pandemic, even as millions joined classes and meetings? What if your shopping app gets 1,000 users one minute and 1,000,000 the next? Development (30 minutes) <ol style="list-style-type: none"> What is Dynamic Scalability? (10 min) <ul style="list-style-type: none"> Definition: Automatic adjustment of computing resources. Goals: Performance optimization and cost reduction. Vertical vs. Horizontal Scaling Analogy: Like opening more counters at a ticket window during a rush. Mechanisms and Tools (10 min) <ul style="list-style-type: none"> Auto-scaling groups (AWS) Virtual machine scale sets (Azure) Container-based scaling (Kubernetes) Diagram: Scale-out architecture during a spike in users. Real-World Examples (10 min) <ul style="list-style-type: none"> Zoom: Auto-scales compute and media servers during school or office hours. Amazon: Auto-scales EC2 based on real-time traffic spikes during sales. Netflix: Dynamically scales video servers based on viewing trends. <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> Auto Scaling in Cloud Computing NPTEL Lecture: Scalability in Cloud Systems – Prof. Buyya
Closure	<p>Recap Discussion:</p> <ol style="list-style-type: none"> Reiterate how scalability supports performance and resilience.



Kot Bhalwal, Jammu



	<p>2. Encourage students to observe this in apps they use daily</p> <p>Suggested Reading:</p> <ul style="list-style-type: none">• “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 6, pp. 176–182)• “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 5 , pp. 130–135)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What’s the difference between vertical and horizontal scaling?2. How does dynamic scalability help cloud providers save cost?3. Give one real-world example where this is used <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 3.5	Course Name: Cloud Computing Advanced Cloud Architectures: Hypervisor Clustering	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ul style="list-style-type: none"> a. Define hypervisor and understand its role in virtualization. b. Explain hypervisor clustering and its purpose. c. Understand high availability and resource utilization benefits. d. Distinguish between host-based and bare-metal hypervisors. e. Identify use cases from AWS, VMware, and Microsoft Azure.
Teaching Aids (if any)	<ul style="list-style-type: none"> a. PowerPoint slides b. YouTube/NPTEL video explanations c. Chalk & board
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> • What happens if a server hosting multiple virtual machines goes down? • How do we make sure users don't experience downtime? <p>2. Development (30 minutes)</p> <p>A. What is a Hypervisor? (5 min)</p> <ul style="list-style-type: none"> • Virtualization software that allows multiple OS to run on a host. • Types: Type 1 (bare-metal), Type 2 (hosted) <p>B. What is Hypervisor Clustering? (10 min)</p> <ul style="list-style-type: none"> • Group of hypervisors working as a pool to run VMs. • Provides fault tolerance, load balancing, failover, and migration. <p style="padding-left: 40px;">Diagram: Clustered hypervisors with shared storage and failover setup.</p> <p>C. Benefits and Use Cases (10 min)</p> <ul style="list-style-type: none"> • VMware vSphere: vMotion allows VM migration across clustered hosts. • Azure Stack HCI: Clustering VMs for on-premise cloud solutions. • AWS Nitro System: Low-level clustering for virtualization security and isolation. <p>D. Live Demo Video (5 min)</p> <ul style="list-style-type: none"> • Optional walkthrough using VMware UI or simulation from a video. <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> • What is Hypervisor & Types • Hypervisor Clustering Overview – NPTEL – (Prof. Buyya's module)
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> a. Hypervisors enable VM hosting. b. Clustering ensures reliability and load distribution.



Kot Bhalwal, Jammu



Model Institute of Engineering & Technology (Autonomous) Lesson Plan

	<p>Suggested Reading:</p> <ul style="list-style-type: none">• “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 190–195)• “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 7, pp. 150–158)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What is a hypervisor?2. Why is clustering necessary?3. Can a VM automatically migrate to another host? When? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 3.6	Course Name: Cloud Computing Advanced Cloud Architectures: Load Balanced Virtual Server Instances	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Understand the concept of load balancing among virtual server instances. Explain the architecture for distributing workloads across multiple VM instances. Identify the role of virtualization, hypervisors, and cloud load balancers. Examine real-world cloud implementations (e.g., AWS EC2 with ELB, Azure VM scale sets).
Teaching Aids (if any)	<ul style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> What if one virtual machine isn't enough for a large user base? How can we use multiple virtual servers and ensure users get fast response time? <p>2. Development (30 minutes)</p> <p>A. Architecture Overview (10 min)</p> <ul style="list-style-type: none"> Multiple virtual servers are hosted on different physical machines or hypervisors. Cloud load balancer distributes requests among these instances. Ensures reliability and responsiveness. <p>Diagram: User → Load Balancer → VM1, VM2, VM3</p> <p>B. Use of Auto-Scaling (10 min)</p> <ul style="list-style-type: none"> Load balancer works with auto-scaling to spawn new VM instances during high traffic. Fault tolerance: failing instance replaced automatically. <p>C. Real-World Examples (10 min)</p> <ul style="list-style-type: none"> Amazon EC2 + Elastic Load Balancer (ELB) Azure Load Balancer with VM scale sets Netflix: Scales movie streaming services globally using this model. <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> Load Balancing Virtual Machines NPTEL: Load Balancing Virtual Servers – Prof. Rajkumar Buyya
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> Load balanced VMs help in high availability and scalability. Cloud services provide tools to automate this process <p>Suggested Reading:</p> <ul style="list-style-type: none"> Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 195–201)

	<ul style="list-style-type: none"> • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 7, pp. 158–162)
Evaluation	Reflective Questions (What Why Who?). Allow students to answer and discuss. <ol style="list-style-type: none"> 3. What is the role of a cloud load balancer? 4. How do virtual server instances work together? 5. Why is redundancy important in this setup? Spend 5 minutes to wrap up and consolidate the learnings



Lesson Plan No. 3.7	Course Name: Cloud Computing Advanced Cloud Architectures: Zero Downtime	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ul style="list-style-type: none"> a. Define zero downtime in cloud infrastructure. b. Understand how systems can continue operating during maintenance or failure. c. Explore mechanisms like replication, failover, and redundancy. d. Analyze real-world examples: banking apps, e-commerce, healthcare systems.
Teaching Aids (if any)	<ul style="list-style-type: none"> • PowerPoint slides • YouTube/NPTEL video explanations • Chalk & board
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> • Have you ever seen Amazon down during festive sales? • Can a hospital system afford downtime during emergencies? <p>2. Development (30 minutes)</p> <p>A. What is Zero Downtime? (10 min)</p> <ul style="list-style-type: none"> ▪ No service interruptions, even during maintenance or server failure. ▪ Achieved via redundancy, live migration, and load balancing. <p>B. Mechanisms to Achieve It (10 min)</p> <ul style="list-style-type: none"> • Failover systems • Live VM migration • Database replication • Geo-redundancy (services deployed across multiple data centers) • Diagram: Primary and standby systems with failover paths. <p>C. Real-Time Applications (10 min)</p> <ul style="list-style-type: none"> • Banking apps: 24x7 availability required for user trust. • Amazon: Ensures smooth sales without loss of users. • Netflix: 100% uptime with seamless switching. <p>YouTube/NPTEL Videos Zero Downtime Architecture Explained – (AWS) NPTEL: Redundancy & Fault Tolerance – (Prof. Buyya)</p>
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> a. What are the trade-offs of implementing zero downtime? b. Can smaller organizations afford it? <p>Suggested Reading:</p> <ul style="list-style-type: none"> • “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 201–206) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 7, pp. 162–168)



Kot Bhalwal, Jammu



Model Institute of Engineering & Technology (Autonomous) Lesson Plan

Evaluation	Reflective Questions (What Why Who?). Allow students to answer and discuss. <ol style="list-style-type: none">1. Define zero downtime in your own words.2. List two techniques used to ensure continuous availability.3. Give one example of a real-world application that needs zero downtime Spend 5 minutes to wrap up and consolidate the learnings
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Lesson Plan No. 3.8	Course Name: Cloud Computing Advanced Cloud Architectures: Dynamic Failure Detection	Course No.: COM-601
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Objectives	<p>By the end of this lecture, students will be able to:</p> <ol style="list-style-type: none"> Understand how cloud systems detect and recover from failures automatically. Explain the architecture and mechanisms for failure detection and self-healing. Explore real-world examples like AWS EC2 health checks and Google Cloud self-repairing systems. Appreciate the role of redundancy, monitoring tools, and alerting systems.
Teaching Aids (if any)	<ul style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ul style="list-style-type: none"> Have you ever had a website crash midway while shopping? What should a cloud system do if a virtual machine fails? Development (30 minutes) <ol style="list-style-type: none"> Concepts and Need (10 min) <ul style="list-style-type: none"> Explain system health monitoring (heartbeat, ping checks, logs). Define failure types: hardware, software, VM crash, network disconnect. Role of monitoring agents and system logs. Detection and Recovery Mechanisms (10 min) <ul style="list-style-type: none"> Health checks and automated restart. Redundancy and replication. Use of orchestration tools (e.g., Kubernetes, Auto Healing in GCP). <p>Diagram: Failed VM → Monitoring Agent → Restart/New Instance</p> <ol style="list-style-type: none"> Real-World Use Cases (10 min) <ul style="list-style-type: none"> AWS EC2 Auto-Recovery Google Cloud Compute Engine's automatic repair Netflix Chaos Monkey testing system resilience via failure injection <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> AWS Health Checks and Auto Recovery NPTEL: Fault Tolerant Cloud Systems – Prof. Rajkumar Buyya
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> Cloud systems must detect and recover from failures autonomously. Monitoring + automation = self-healing systems

	Suggested Reading: <ul style="list-style-type: none"> • “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 206–211) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 7, pp. 175–183)
Evaluation	Reflective Questions (What Why Who?). Allow students to answer and discuss. <ol style="list-style-type: none"> What is meant by failure detection in cloud systems? How do health checks work in cloud platforms? Name a tool or technique used for automated recovery. Spend 5 minutes to wrap up and consolidate the learnings



Lesson Plan No. 3.9	Course Name: Cloud Computing Understanding Cloud Computing	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ul style="list-style-type: none"> a. Define Load Balancer and understand its role in the cloud. b. Explore types of load balancing (application-level vs. network-level). c. Understand how it ensures availability, performance, and fault tolerance. d. Examine case studies from AWS, Azure, and GCP.
Teaching Aids (if any)	<ul style="list-style-type: none"> • PowerPoint slides • YouTube/NPTEL video explanations • Chalk & board
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> • What happens if 1000 users hit one server at once? • How does Google ensure your search happens instantly regardless of traffic? <p>2. Development (30 minutes)</p> <p>A. What is a Load Balancer? (10 min)</p> <ul style="list-style-type: none"> • Sits between client and servers to distribute traffic. • Ensures no single server is overwhelmed. • Promotes high availability and efficient use of resources. <p>B. Types and Techniques (10 min)</p> <ul style="list-style-type: none"> • Round Robin, Least Connection, IP Hashing • Layer 4 (TCP/UDP) vs. Layer 7 (HTTP/HTTPS) load balancing <p>Diagram: Clients → Load Balancer → Server Pool</p> <p>C. Real-World Implementations (10 min)</p> <ul style="list-style-type: none"> • AWS Elastic Load Balancer (ELB) • Azure Load Balancer • Google Cloud Load Balancing <p>Example: Flipkart uses load balancing during Big Billion Days to distribute user traffic across multiple VMs.</p> <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> • What is Load Balancing? – Tech Primers • NPTEL: Load Balancers in Cloud Systems – Prof. Buyya
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> • Load Balancers prevent overload and promote uptime. • They are essential in elastic, scalable systems. <p>Suggested Reading:</p> <ul style="list-style-type: none"> • Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 163–169) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 7 , pp. 110–118)
Evaluation	Reflective Questions (What Why Who?). Allow students to answer and discuss.



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| | <p>a. What are the main responsibilities of a load balancer?</p> <p>b. What is the difference between Layer 4 and Layer 7 load balancing?</p> <p>c. Which real-world services rely on load balancing?</p> <p>Spend 5 minutes to wrap up and consolidate the learnings</p> |
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Lesson Plan No. 3.10	Course Name: Cloud Computing Understanding Cloud Computing	Course No.: COM-601
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Objectives	<p>By the end of this lecture, students will be able to:</p> <ol style="list-style-type: none"> Understand what a Service Level Agreement (SLA) is and why it matters in the cloud. Describe the role of an SLA Monitor in ensuring performance and compliance. Identify the metrics used in SLA monitoring (availability, latency, response time). Explore real-time cloud SLA examples from AWS, Azure, and Google Cloud.
Teaching Aids (if any)	<ul style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ul style="list-style-type: none"> What do you expect when a company promises 99.9% uptime? How does a cloud provider prove it met that promise? Development (30 minutes) <ol style="list-style-type: none"> Understanding SLAs (10 min) <ul style="list-style-type: none"> SLA = formal contract between provider and client (uptime, performance, support response times). Real-world analogy: Mobile internet providers claiming 4G speed – SLA enforces it. What SLA Monitor Does (10 min) <ul style="list-style-type: none"> Tracks key metrics: uptime, response time, error rate. Alerts when thresholds are breached. Records performance for audit or billing disputes. <p>Diagram: Application → SLA Monitor → Dashboard / Alert system</p> <ol style="list-style-type: none"> Use Cases (10 min) <ul style="list-style-type: none"> AWS CloudWatch, Azure Monitor, Google Cloud Operations Suite SLA breach: GCP fails to deliver 99.9% uptime → triggers credit/refund to customer. <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> Understanding SLAs & Monitoring – AWS Cloud NPTEL: SLA Management in Cloud Computing – Prof. Buyya
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> SLAs are legally binding. SLA Monitors verify provider accountability. <p>Suggested Reading:</p> <ul style="list-style-type: none"> Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 8, pp. 213–219)

	<ul style="list-style-type: none"> • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 9 , pp. 192–199)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> What is an SLA and what is monitored? How does an SLA Monitor detect a violation? Can clients penalize cloud providers for downtime? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 3.11	Course Name: Cloud Computing Advanced Cloud Architectures: Recovery Architecture	Course No.: COM-601
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Objectives	<p>By the end of this lecture, students will be able to:</p> <ol style="list-style-type: none"> Understand the concept and significance of Recovery Architecture in cloud computing. Identify various disaster recovery strategies and their applications in cloud environments. Analyze real-world examples of Recovery Architectures implemented by major cloud providers.
Teaching Aids (if any)	<ul style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board
Teaching Development	<p>1. Introduction (10 minutes)</p> <p>Ask Questions:</p> <ul style="list-style-type: none"> “What happens to cloud services during unexpected events like natural disasters or cyber-attacks?” Introduce the concept of Recovery Architecture as a framework designed to ensure business continuity and data integrity during unforeseen disruptions. “A structured approach encompassing policies, tools, and procedures to enable the recovery or continuation of vital technology infrastructure and systems following a natural or human-induced disaster.” <p>2. Development (30 minutes)</p> <p>A. Importance of Recovery Architecture in Cloud Computing (10 minutes)</p> <ul style="list-style-type: none"> Why is Recovery Architecture Essential? <ul style="list-style-type: none"> Ensures minimal downtime and data loss during disruptions. Maintains customer trust and compliance with service level agreements (SLAs). Facilitates quick restoration of services, reducing financial and reputational damage. Real-life Example: <ul style="list-style-type: none"> <i>AWS's Disaster Recovery Strategies</i> offer insights into how businesses can architect for disaster recovery, emphasizing the importance of preparation and planning. <p>B. Disaster Recovery Strategies in Cloud Environments (15 minutes)</p> <ul style="list-style-type: none"> Common Strategies: <ul style="list-style-type: none"> Backup and Restore: <ul style="list-style-type: none"> Data is backed up to the cloud and restored when needed. Suitable for less critical applications. Pilot Light: <ul style="list-style-type: none"> A minimal version of an environment is always running in the cloud. During a disaster, the environment scales up to handle the full load.



	<ul style="list-style-type: none">○ Warm Standby:<ul style="list-style-type: none">▪ A scaled-down version of a fully functional environment is always running. It can be quickly scaled up to production capacity.○ Multi-Site (Active-Active):<ul style="list-style-type: none">▪ Fully functional environments run simultaneously in multiple locations. Traffic is distributed across all sites.● Benefits and Trade-offs:○ Cost vs. Recovery Time Objective (RTO):<ul style="list-style-type: none">▪ Lower-cost solutions may have longer RTOs.○ Complexity:<ul style="list-style-type: none">▪ More advanced strategies like Multi-Site require sophisticated management but offer minimal downtime.● Real-life Example:<ul style="list-style-type: none">○ <i>Google Cloud's Disaster Recovery Planning Guide</i> provides a comprehensive overview of planning processes and strategies to ensure business continuity. <p>C. Key Components of an Effective Recovery Architecture (5 minutes)</p> <ul style="list-style-type: none">● Data Replication:<ul style="list-style-type: none">○ Ensuring copies of data are stored in geographically diverse locations. AWS Documentation+3Cutover+3Informa TechTarget+3● Automated Failover:<ul style="list-style-type: none">○ Automatic switching to a standby system when a failure is detected.● Regular Testing and Drills:<ul style="list-style-type: none">○ Conducting routine tests to ensure recovery procedures work as intended. YouTube+3Google Cloud+3Informa TechTarget+3● Clear Communication Plans:<ul style="list-style-type: none">○ Establishing protocols for informing stakeholders during and after an incident. <p>Exercise (10 minutes)</p> <ul style="list-style-type: none">● Group Discussion:<ul style="list-style-type: none">○ Consider a scenario where a company's primary data center goes offline due to a power outage. Which recovery strategy would be most appropriate, and why?
Closure	Reiterate the importance of Recovery Architecture in ensuring business continuity and safeguarding data in cloud computing. Suggested Reading: <ul style="list-style-type: none">● Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 8, pp. 213–219)● “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 9 , pp. 192–199)
Evaluation	Reflective Questions (What Why Who?). Allow students to answer and discuss. 1. How can organizations balance the cost of implementing robust recovery strategies with the potential risks of downtime?



Kot Bhalwal, Jammu

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Lesson Plan

Spend 5 minutes to wrap up and consolidate the learnings
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Lesson Plan No. 4.1	Course Name: Cloud Computing Cloud Delivery Models	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ol style="list-style-type: none"> Define and differentiate between IaaS, PaaS, and SaaS. Understand the cloud delivery stack and service abstraction levels. Identify real-life examples of each model. Classify cloud services based on their delivery model. 												
Teaching Aids (if any)	<ol style="list-style-type: none"> PPT slides YouTube/NPTEL videos Chalk & board diagrams 												
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ol style="list-style-type: none"> Do you use Google Docs or Dropbox? Ever deployed an app online? That's cloud delivery in action! Development (30 minutes) <ol style="list-style-type: none"> Delivery Model Stack (10 minutes) <ul style="list-style-type: none"> Draw stack: Infrastructure → Platform → Software Explain hierarchy: <ul style="list-style-type: none"> IaaS = foundation (servers, storage) PaaS = dev tools, app hosting SaaS = finished applications Use analogy: <i>Apartment</i> (SaaS), <i>Furnished Office</i> (PaaS), <i>Empty Plot</i> (IaaS) Definitions and Examples (15 minutes) <table border="1"> <thead> <tr> <th>Model</th> <th>Description</th> <th>Real-World Examples</th> </tr> </thead> <tbody> <tr> <td>IaaS</td> <td>Virtual servers, networks</td> <td>AWS EC2, Google Compute Engine</td> </tr> <tr> <td>PaaS</td> <td>Development platform</td> <td>Heroku, Google App Engine</td> </tr> <tr> <td>SaaS</td> <td>End-user software</td> <td>Gmail, Google Docs, Dropbox</td> </tr> </tbody> </table> <ul style="list-style-type: none"> Show short demo clips/screenshots of each. Discuss usage patterns (developer vs. business user) Classification Activity (10 minutes) <ul style="list-style-type: none"> List services (e.g., Trello, Azure VM, Firebase, Notion) Students classify them into IaaS, PaaS, SaaS in groups Discuss and correct misconceptions <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> Cloud Service Models Explained – Simplilearn (10 min) NPTEL: Cloud Computing Lecture on Service Models (Prof. Buyya) 	Model	Description	Real-World Examples	IaaS	Virtual servers, networks	AWS EC2, Google Compute Engine	PaaS	Development platform	Heroku, Google App Engine	SaaS	End-user software	Gmail, Google Docs, Dropbox
Model	Description	Real-World Examples											
IaaS	Virtual servers, networks	AWS EC2, Google Compute Engine											
PaaS	Development platform	Heroku, Google App Engine											
SaaS	End-user software	Gmail, Google Docs, Dropbox											
Closure	Recap Discussion: <ol style="list-style-type: none"> Which model do you think Gmail belongs to? Which model gives you most control? 												



	<p>Suggested Reading:</p> <ul style="list-style-type: none">• "Cloud Computing: Concepts, Technology & Architecture" by Thomas Erl, (Chapter 4, pp. 85–97)• "Mastering Cloud Computing" by Rajkumar Buyya, (Chapter 3 , pp. 58–67)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. Match the service to the model: Google Docs, AWS S3, Firebase2. Which model would a startup use for a quick app launch?3. Can a service fall into more than one model? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 4.2	Course Name: Cloud Computing Cloud Delivery Models: Cloud Provider	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Understand how cloud service providers design and manage IaaS, PaaS, and SaaS offerings. Explore the responsibilities of providers in terms of infrastructure, platform, and application layers. Analyze examples of provider-side challenges (scaling, uptime, multitenancy). Compare service model responsibilities using the shared responsibility model. 												
Teaching Aids (if any)	<ol style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Real-world cloud platforms: AWS EC2, Microsoft Azure Chalk & board 												
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ol style="list-style-type: none"> What do you think cloud providers manage behind Gmail or EC2? How do they ensure services are always available? Development (30 minutes) <p>A. What Cloud Providers Manage (10 minutes)</p> <table border="1"> <thead> <tr> <th>Model</th> <th>Provider Manages</th> <th>Example</th> </tr> </thead> <tbody> <tr> <td>IaaS</td> <td>Hardware, virtualization, networking</td> <td>AWS EC2, GCP Compute</td> </tr> <tr> <td>PaaS</td> <td>Runtime, OS, scaling, patching</td> <td>Azure App Service</td> </tr> <tr> <td>SaaS</td> <td>Entire application & infrastructure</td> <td>Google Workspace</td> </tr> </tbody> </table> <p>Diagram: Shared Responsibility Model (user vs. provider tasks)</p> <p>B. Provider Architecture Considerations (10 min)</p> <ul style="list-style-type: none"> Scalability: autoscaling infrastructure Multitenancy: supporting multiple users securely SLAs: ensuring uptime & availability Monitoring & Management tools: AWS CloudWatch, Azure Monitor <p>C. Provider Use Case Breakdown (15 min) Case Study 1: AWS</p> <ul style="list-style-type: none"> IaaS: EC2 PaaS: Elastic Beanstalk SaaS: WorkMail <p>Highlight provider responsibilities at each layer.</p> 	Model	Provider Manages	Example	IaaS	Hardware, virtualization, networking	AWS EC2, GCP Compute	PaaS	Runtime, OS, scaling, patching	Azure App Service	SaaS	Entire application & infrastructure	Google Workspace
Model	Provider Manages	Example											
IaaS	Hardware, virtualization, networking	AWS EC2, GCP Compute											
PaaS	Runtime, OS, scaling, patching	Azure App Service											
SaaS	Entire application & infrastructure	Google Workspace											



	<p>Activity: Split students into groups – each group chooses a cloud (AWS, Azure, GCP), and lists services under IaaS, PaaS, SaaS from a provider’s POV.</p> <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none">• Shared Responsibility Model – AWS (3 min)• Cloud Provider Perspective – Simplilearn (7 min)• NPTEL Cloud Computing: Service Models – Prof. Buyya
Closure	<p>Recap Discussion:</p> <ol style="list-style-type: none">1. Which model gives more control to the provider?2. How is Gmail different from EC2 in terms of provider workload? <p>Suggested Reading:</p> <ul style="list-style-type: none">• “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 4, pp. 98–106)• “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 3, pp. 67–74)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. In which delivery model does the provider manage the least?2. What challenges do providers face in SaaS compared to IaaS?3. Draw and label one example of a shared responsibility model. <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 4.3	Course Name: Cloud Computing Cloud Delivery Models: Consumer perspective	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Understand consumer-side experience and choices in IaaS, PaaS, SaaS. Learn key decision-making factors: cost, control, flexibility, ease of use. Explore real-world consumer use cases in each model 												
Teaching Aids (if any)	<ol style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board 												
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ol style="list-style-type: none"> You are launching a startup. Do you rent virtual servers (IaaS)? Use a ready-made platform (PaaS)? Or a tool like Gmail (SaaS)? Development (30 minutes) <ol style="list-style-type: none"> Key Considerations for Consumers (10 min) <ul style="list-style-type: none"> Control vs convenience Budget Technical skill Scaling needs Security and compliance Consumer Examples (15 min) <table border="1"> <thead> <tr> <th>Use Case</th> <th>Model</th> <th>Explanation</th> </tr> </thead> <tbody> <tr> <td>Host a website</td> <td>IaaS (AWS EC2)</td> <td>Full control of server</td> </tr> <tr> <td>Deploy app</td> <td>PaaS (Heroku)</td> <td>No server management</td> </tr> <tr> <td>Use office tools</td> <td>SaaS (Google Docs)</td> <td>Pay-per-use, no setup</td> </tr> </tbody> </table> Interactive Activity (10 min) Give short scenarios (e.g., “Startup wants to test app quickly”) and let students identify which model fits best and why. <p>YouTube Lecture:</p> <ul style="list-style-type: none"> AWS Cloud Models: Consumer View – 5 min Simplilearn Cloud Models Explained 	Use Case	Model	Explanation	Host a website	IaaS (AWS EC2)	Full control of server	Deploy app	PaaS (Heroku)	No server management	Use office tools	SaaS (Google Docs)	Pay-per-use, no setup
Use Case	Model	Explanation											
Host a website	IaaS (AWS EC2)	Full control of server											
Deploy app	PaaS (Heroku)	No server management											
Use office tools	SaaS (Google Docs)	Pay-per-use, no setup											
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> Which model suits a small business with no tech team? <p>Suggested Reading:</p>												

	<ul style="list-style-type: none"> • “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 4, pp. 106–113) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 3, pp. 74–78)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. Which model is easiest for end users? 2. What are the trade-offs of using PaaS? 3. What if your app needs to scale rapidly—what model works best? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 4.4	Course Name: Cloud Computing Working with IaaS service environments	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ul style="list-style-type: none"> • Understand what makes up an IaaS environment. • Identify key components: VMs, storage, networking, virtualization. • Explore providers like AWS EC2, Google Compute Engine. • Simulate IaaS selection through guided discussion/demo. 										
Teaching Aids (if any)	<ul style="list-style-type: none"> • PowerPoint slides • YouTube/NPTEL video explanations • Chalk & board 										
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> ○ How do you launch a virtual machine from your laptop in the cloud? <p>2. Development (30 minutes) A. Core Components of IaaS (10 min)</p> <table border="1"> <thead> <tr> <th>Element</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Compute</td> <td>Virtual Machines</td> </tr> <tr> <td>Storage</td> <td>Object & Block storage (e.g., S3, EBS)</td> </tr> <tr> <td>Network</td> <td>VPCs, firewalls, load balancers</td> </tr> <tr> <td>Virtualization</td> <td>KVM, Xen, Hyper-V</td> </tr> </tbody> </table> <p>B. Demo: How EC2 Works (10 min)</p> <ul style="list-style-type: none"> • Show EC2 console screenshots or video • Steps: Launch VM, choose OS, select instance type, configure networking <p>C. Use Case Discussion (10 min) What kind of businesses need IaaS?" (e.g., DevOps, testing, scalable apps)</p> <p>D. Activity (5 min)</p> <ul style="list-style-type: none"> • Ask students to configure a simple IaaS deployment (on paper or whiteboard) <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> • AWS EC2 Beginner Tutorial – 12 min • NPTEL: Cloud Infrastructure (Prof. Buyya) 	Element	Description	Compute	Virtual Machines	Storage	Object & Block storage (e.g., S3, EBS)	Network	VPCs, firewalls, load balancers	Virtualization	KVM, Xen, Hyper-V
Element	Description										
Compute	Virtual Machines										
Storage	Object & Block storage (e.g., S3, EBS)										
Network	VPCs, firewalls, load balancers										
Virtualization	KVM, Xen, Hyper-V										
Closure	<p>Recap Discussion:</p> <ol style="list-style-type: none"> 1. Would you use IaaS if you needed fast scaling and full control? <p>Suggested Reading:</p> <ul style="list-style-type: none"> • “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 5, pp. 115–123) 										

	<ul style="list-style-type: none"> • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 4, pp. 110–115)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. What’s the advantage of IaaS for startups? 2. Name three services that form the IaaS stack. 3. What are the drawbacks of managing your own VM? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 4.5	Course Name: Cloud Computing Working with PaaS service environments	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ul style="list-style-type: none"> a. Understand how PaaS simplifies application deployment. b. Explore popular PaaS platforms (e.g., Heroku, Google App Engine). c. Identify benefits and limitations of PaaS. d. Engage in discussion on developer-centric features. 								
Teaching Aids (if any)	<ul style="list-style-type: none"> a. PowerPoint slides b. YouTube/NPTEL video explanations c. Chalk & board 								
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> • If you just want to deploy code, not manage servers, what do you use? <p>2. Development (35 minutes)</p> <p>A. What is PaaS? (10 min)</p> <ul style="list-style-type: none"> • Middleware, runtime, container orchestration • Handles scaling, monitoring, databases <p>B. Example Platforms (Heroku, App Engine) (10 min)</p> <ul style="list-style-type: none"> • Deployment from Git • Scaling with a button click • Add-ons like databases, logs <p>C. Benefits and Trade-offs (10 min)</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Pros</th> <th>Cons</th> </tr> </thead> <tbody> <tr> <td>Fast deployment</td> <td>Less control</td> </tr> <tr> <td>Developer-friendly</td> <td>Limited customization</td> </tr> <tr> <td>Auto-scaling</td> <td>Locked to platform</td> </tr> </tbody> </table> <p>D. Student Discussion (5 min) Which platform would you use for a quick hackathon app?</p> <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> • Heroku PaaS Demo – 7 min • Google App Engine Tutorial – 9 min 	Pros	Cons	Fast deployment	Less control	Developer-friendly	Limited customization	Auto-scaling	Locked to platform
Pros	Cons								
Fast deployment	Less control								
Developer-friendly	Limited customization								
Auto-scaling	Locked to platform								
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> • Would PaaS suit a team of student developers with a tight deadline? <p>Suggested Reading:</p> <ul style="list-style-type: none"> • Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 5, pp. 124–128) 								

	<ul style="list-style-type: none"> • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 5, pp. 120–125)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. What’s the key advantage of PaaS for app developers? 2. Why might a developer outgrow PaaS? 3. Which cloud provider offers both IaaS and PaaS? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 4.6	Course Name: Cloud Computing Working with SaaS service environments	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Understand what defines a Software-as-a-Service (SaaS) solution. Explore how SaaS simplifies user access and business processes. Identify key SaaS providers and real-time examples. Understand backend infrastructure responsibilities in SaaS 								
Teaching Aids (if any)	<ul style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board 								
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> How many of you have used Gmail, Google Docs, or Zoom? Did you install or manage anything <p>2. Development (30 minutes)</p> <p>A. What is SaaS? (10 min)</p> <ul style="list-style-type: none"> Ready-to-use software hosted on cloud Zero infrastructure responsibility for user Subscription-based model <p>B. Popular SaaS Applications (10 min)</p> <table border="1"> <thead> <tr> <th>Application</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>Google Docs</td> <td>Collaborative writing</td> </tr> <tr> <td>Dropbox</td> <td>File storage</td> </tr> <tr> <td>Salesforce</td> <td>CRM & sales automation</td> </tr> </tbody> </table> <p>C. Business Use Cases (10 min)</p> <ul style="list-style-type: none"> HR management (Workday) Project management (Asana, Trello) Communication (Slack) <p>D. Interactive Discussion (5 min) Students list all SaaS they use in daily life. Then, map them by category (Productivity, Communication, Storage, etc.)</p> <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> <input type="checkbox"/> What is SaaS? – Simplilearn (4 min) <input type="checkbox"/> SaaS in Real Life (5 min) 	Application	Description	Google Docs	Collaborative writing	Dropbox	File storage	Salesforce	CRM & sales automation
Application	Description								
Google Docs	Collaborative writing								
Dropbox	File storage								
Salesforce	CRM & sales automation								
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> Would you prefer SaaS for launching a startup quickly? Why? <p>Suggested Reading:</p>								

	<ul style="list-style-type: none"> • “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 5, pp. 129–132) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 4, pp. 116–118)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. How does SaaS differ from PaaS in control and customization? 2. What are SaaS limitations? 3. What kind of businesses benefit the most from SaaS? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 4.7	Course Name: Cloud Computing Business Cost Metrics	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Understand cloud-based business cost structures. Learn key metrics: CapEx vs OpEx, pay-per-use, TCO, ROI. Compare cloud vs traditional IT costing. Apply cost estimation with cloud pricing calculators. 										
Teaching Aids (if any)	<ul style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board 										
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> What if you only had to pay for servers when your website had visitors? Is that cheaper? <p>2. Development (30 minutes)</p> <p>A. CapEx vs OpEx (10 min)</p> <ul style="list-style-type: none"> Traditional IT: High CapEx (hardware, setup) Cloud: OpEx (subscription, usage-based) <p>B. Important Business Metrics (15 min)</p> <table border="1"> <thead> <tr> <th>Metric</th> <th>Meaning</th> </tr> </thead> <tbody> <tr> <td>TCO</td> <td>Total Cost of Ownership</td> </tr> <tr> <td>ROI</td> <td>Return on Investment</td> </tr> <tr> <td>Pay-per-use</td> <td>Billing for actual consumption</td> </tr> <tr> <td>Elastic Costing</td> <td>Scale up/down expenses with usage</td> </tr> </tbody> </table> <p>C. Cloud Pricing Estimation (10 min)</p> <ul style="list-style-type: none"> Use AWS or Azure calculator screenshot Show how costs change by region, usage, etc. <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> CapEx vs OpEx – Cloud Model Explained (6 min) AWS Pricing Calculator Demo (7 min) 	Metric	Meaning	TCO	Total Cost of Ownership	ROI	Return on Investment	Pay-per-use	Billing for actual consumption	Elastic Costing	Scale up/down expenses with usage
Metric	Meaning										
TCO	Total Cost of Ownership										
ROI	Return on Investment										
Pay-per-use	Billing for actual consumption										
Elastic Costing	Scale up/down expenses with usage										
Closure	<p>Recap Discussion:</p> <ol style="list-style-type: none"> What makes cloud affordable for small businesses? What would be the cost risk of a poorly optimized cloud deployment? <p>Suggested Reading:</p> <ul style="list-style-type: none"> Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 145–149) “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 5, pp. 132–135) 										
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> Why is cloud considered financially efficient? Name two cost-saving strategies in cloud use. How does elasticity influence cost? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>										



Lesson Plan No. 4.8	Course Name: Cloud Computing Cloud Usage Cost Metrics	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Understand how cloud consumption affects billing. Learn about metering: storage, compute, data transfer. Explore cost control strategies and budget alerts 								
Teaching Aids (if any)	<ul style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board 								
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ul style="list-style-type: none"> If your app goes viral overnight, how does your cloud bill change? Development (30 minutes) <ol style="list-style-type: none"> Common Usage Metrics (10 min) <table border="1"> <thead> <tr> <th>Metric</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>CPU Hours</td> <td>Time your app uses the CPU</td> </tr> <tr> <td>Storage GB</td> <td>Volume of data stored</td> </tr> <tr> <td>Data Transfer</td> <td>In/out traffic between regions or services</td> </tr> </tbody> </table> Billing Practices (10 min) <ul style="list-style-type: none"> Tiered pricing Free tier limits Reserved vs On-demand pricing Cost Control (15 min) <ul style="list-style-type: none"> Set budget alerts Use usage reports & tags Auto shut-off unused resources <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> Understanding AWS Billing – 6 min Google Cloud Cost Management (7 min) 	Metric	Description	CPU Hours	Time your app uses the CPU	Storage GB	Volume of data stored	Data Transfer	In/out traffic between regions or services
Metric	Description								
CPU Hours	Time your app uses the CPU								
Storage GB	Volume of data stored								
Data Transfer	In/out traffic between regions or services								
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> Can cloud usage costs grow without you noticing? How can you prevent this? <p>Suggested Reading:</p> <ul style="list-style-type: none"> “Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 149–153) “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 5, pp. 136–140) 								
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> What metric affects your bill the most if you stream video? How would you monitor your resource use in the cloud? What is the role of budget alerts? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>								



Lesson Plan No. 4.9	Course Name: Cloud Computing Service Quality Metrics: Service Availability, Service Reliability	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ul style="list-style-type: none"> a. Understand the definitions and significance of <i>Availability</i> and <i>Reliability</i> in cloud services. b. Learn how these metrics are measured and reported. c. Analyze examples of SLAs from major cloud providers.
Teaching Aids (if any)	<ul style="list-style-type: none"> • PowerPoint slides • YouTube/NPTEL video explanations • Chalk & board
Teaching Development	<p>1. Introduction (10 minutes) Ask Questions:</p> <ul style="list-style-type: none"> • What if Google Drive was down for an hour—how would it impact you or your business? <p>2. Development (35 minutes)</p> <p>A. Definitions (10 min)</p> <ul style="list-style-type: none"> • Availability = Uptime / Total time • Reliability = Frequency and recovery from failures • Measured in "Nines": 99.9%, 99.99%, etc. <p>B. SLAs and Real-time Examples (15 min)</p> <ul style="list-style-type: none"> • AWS: 99.99% availability for EC2 • Azure SQL Database SLA • Discuss the difference: always available ≠ always reliable <p>C. Impact on Businesses (10 min)</p> <ul style="list-style-type: none"> • Downtime losses for e-commerce sites • Need for redundancy and failover <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> • Cloud SLA & Availability Explained (6 min) • What is Uptime? (3 min)
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> • Would you trust a cloud service with 95% availability? Why or why not? <p>Suggested Reading:</p> <ul style="list-style-type: none"> • Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 153–157) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 6, pp. 144–148)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ul style="list-style-type: none"> a. Why is ‘five nines’ so important for mission-critical apps? b. How do cloud providers back their SLA promises? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Kot Bhalwal, Jammu



Lesson Plan No. 4.10	Course Name: Cloud Computing Service Performance and Service Scalability	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ul style="list-style-type: none"> a. Understand the difference between performance and scalability. b. Learn how cloud systems are benchmarked and scaled. c. Identify horizontal vs vertical scaling
Teaching Aids (if any)	<ul style="list-style-type: none"> • PowerPoint slides • YouTube/NPTEL video explanations • Chalk & board
Teaching Development	<ol style="list-style-type: none"> 1. Introduction (10 minutes) Ask Questions: <ul style="list-style-type: none"> • What happens to an app during a flash sale? Can the cloud handle sudden traffic spikes? 2. Development (35 minutes) <ol style="list-style-type: none"> A. Understanding Performance (10 min) <ul style="list-style-type: none"> • Latency, throughput, response time • Monitoring tools: CloudWatch, Stackdriver B. Scalability Concepts (15 min) <ul style="list-style-type: none"> • Vertical scaling (add RAM, CPU) • Horizontal scaling (add more servers) • Elasticity in cloud = Auto-scaling C. Case Study (10 min) <ul style="list-style-type: none"> • Netflix scaling during global events • COVID-era usage surge for Zoom <p>YouTube/NPTEL Videos</p> <ul style="list-style-type: none"> • Horizontal vs Vertical Scaling (5 min) • Auto Scaling in AWS (5 min)
Closure	<p>Recap Discussion:</p> <ul style="list-style-type: none"> • How does scalability prevent performance bottlenecks in cloud apps? <p>Suggested Reading:</p> <ul style="list-style-type: none"> • Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 157–160) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 6, pp. 149–154)
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> a. Can a system be scalable but still perform poorly? b. Why is elasticity important for unpredictable workloads? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 4.11	Course Name: Cloud Computing Service Resiliency Metrics	Course No.: COM-601
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Objectives	By the end of this lecture, students will be able to: <ol style="list-style-type: none"> Understand <i>Resiliency</i> in cloud systems. Review all quality metrics in a comparative manner. Reflect on how different businesses map to delivery models and service expectations 																		
Teaching Aids (if any)	<ul style="list-style-type: none"> PowerPoint slides YouTube/NPTEL video explanations Chalk & board 																		
Teaching Development	<ol style="list-style-type: none"> Introduction (10 minutes) Ask Questions: <ul style="list-style-type: none"> How fast should a cloud service recover from a disaster? Development (35 minutes) <ol style="list-style-type: none"> Resiliency Explained (10 min) <ul style="list-style-type: none"> Ability to recover from failure quickly Includes backup, failover, fault tolerance Case Study (10 min) <ul style="list-style-type: none"> AWS region outage and automatic failover Netflix Chaos Monkey: Testing Resiliency Summary Table of Metrics (10 min) <table border="1"> <thead> <tr> <th>Metric</th> <th>Definition</th> <th>Business Impact</th> </tr> </thead> <tbody> <tr> <td>Availability</td> <td>Uptime %</td> <td>Revenue loss during downtime</td> </tr> <tr> <td>Reliability</td> <td>Consistency</td> <td>User trust</td> </tr> <tr> <td>Performance</td> <td>Speed</td> <td>UX & customer retention</td> </tr> <tr> <td>Scalability</td> <td>Handling growth</td> <td>Future-proofing</td> </tr> <tr> <td>Resiliency</td> <td>Recovery</td> <td>Disaster planning</td> </tr> </tbody> </table> <p>Activity (10 min) Group Task: Students are given a startup (e.g., food delivery, edtech, video streaming). They must:</p> <ul style="list-style-type: none"> Select a cloud model Identify key metrics most critical Suggest resiliency measures 	Metric	Definition	Business Impact	Availability	Uptime %	Revenue loss during downtime	Reliability	Consistency	User trust	Performance	Speed	UX & customer retention	Scalability	Handling growth	Future-proofing	Resiliency	Recovery	Disaster planning
Metric	Definition	Business Impact																	
Availability	Uptime %	Revenue loss during downtime																	
Reliability	Consistency	User trust																	
Performance	Speed	UX & customer retention																	
Scalability	Handling growth	Future-proofing																	
Resiliency	Recovery	Disaster planning																	
Closure	Recap Discussion: <ul style="list-style-type: none"> Which service metric would be your top priority if you launched an online exam app? 																		

	Suggested Reading: <ul style="list-style-type: none"> • Cloud Computing: Concepts, Technology & Architecture” by Thomas Erl, (Chapter 7, pp. 160–165) • “Mastering Cloud Computing” by Rajkumar Buyya, (Chapter 6, pp. 155–160)
Evaluation	Reflective Questions (What Why Who?). Allow students to answer and discuss. <ol style="list-style-type: none"> a. Can a system be resilient but not available? b. What’s the relationship between reliability and resiliency? Spend 5 minutes to wrap up and consolidate the learnings



Kot Bhalwal, Jammu



Lesson Plan No. 5.1	Course Name: Cloud Computing Advanced Cloud Practices and Case Studies: Industry Standards Organizations	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand the role of industry standards in cloud computing. b. Identify major organizations that define and regulate cloud standards. c. Explore how standards help in cloud interoperability, compliance, and security. d. Review real-world case studies illustrating the application of these standards.
Teaching Aids (if any)	a. You Tube video/NPTEL Video b. Chalk & talk with board
Teaching Development	1. Introduction (10 minutes) <ul style="list-style-type: none">• Define cloud standards as common frameworks and policies for ensuring interoperability, portability, and security in cloud environments.• Highlight the importance of avoiding vendor lock-in and ensuring compliance.• Ask: "What happens if every cloud provider has a different rule for handling your data?" 2. Major Industry Standards Organizations (15 minutes) <ul style="list-style-type: none">• ISO/IEC (International Organization for Standardization): ISO/IEC 27001, 27017 – Cloud security.• NIST (National Institute of Standards and Technology): NIST SP 800-145 – Cloud computing definition and guidelines.• CSA (Cloud Security Alliance): STAR certification, Cloud Controls Matrix.• IEEE: Cloud interoperability and portability standards.• Discuss each with brief roles and contributions. YouTube Video: <ul style="list-style-type: none">• NIST and Cloud Computing – https://www.youtube.com/watch?v=yztzsQGoHNQ 3. Importance of Standards in Practice (10 minutes) <ul style="list-style-type: none">• Facilitates secure data handling, access control, and service portability.• Helps industries adhere to compliance requirements (e.g., HIPAA, GDPR).• Promotes trust between service providers and customers.



	<p>NPTEL Reference:</p> <ul style="list-style-type: none">Lecture on Cloud Compliance and Legal Challenges – Prof. S. Sengupta – https://nptel.ac.in/courses/106105167 <p>4. Case Studies (10 minutes)</p> <ul style="list-style-type: none">Google Cloud’s compliance with ISO/IEC 27017.AWS GovCloud and NIST standards.Microsoft Azure and CSA STAR certification. <p>5. Real-World Implications (5 minutes)</p> <ul style="list-style-type: none">Enterprises rely on these standards for audit, regulation, and security.Without standards, integration across cloud providers would be chaotic. <p>6. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none">Recap the role of industry standards in cloud security, compliance, and interoperability.Ask: "As a cloud developer or architect, why should you care about these standards?"
Closure	<ul style="list-style-type: none">Encourage students to research certifications (e.g., ISO, CSA) relevant to their career paths.Final Q&A and discussion (2–3 minutes). <p>Suggested Reading:</p> <p><input type="checkbox"/> Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl</p>
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">What are industry standards in cloud computing?Why do organizations comply with these standards?Who defines and enforces them in cloud ecosystems? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 5.2	Course Name: Cloud Computing Advanced Cloud Practices and Case Studies: Data Center Facilities	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: <ul style="list-style-type: none"> a. Understand the physical and environmental infrastructure of cloud data centers. b. Identify the key components and standards followed in data center facilities. c. Explore how data center design supports cloud service reliability, availability, and scalability. d. Analyze real-world examples of major cloud provider data centers.
Teaching Aids (if any)	<ul style="list-style-type: none"> a. You Tube video/NPTEL Video b. Chalk & talk with board
Teaching Development	<p>1.Introduction (10 minutes)</p> <ul style="list-style-type: none"> • Define data centers as physical facilities that organizations use to house critical applications and data. • Highlight their significance in cloud infrastructure. • Ask: “Why is it important for cloud providers to have secure and efficient data centers?” <p>2. Core Components of a Data Center (15 minutes)</p> <ul style="list-style-type: none"> • Physical infrastructure: servers, storage systems, networking equipment. • Environmental systems: HVAC (Heating, Ventilation, Air Conditioning), fire suppression, security systems. • Power systems: UPS, generators, dual power supplies. • Tier classification (Tier I to Tier IV) for reliability. <p>3. Standards and Certifications (10 minutes)</p> <ul style="list-style-type: none"> • Uptime Institute Tier Standards. • ANSI/TIA-942: Telecommunications Infrastructure Standard for Data Centers. • ISO/IEC standards on physical security and operational excellence. <p>4. Real-World Case Studies (10 minutes)</p> <ul style="list-style-type: none"> • Google’s modular data center design. • Facebook’s data center energy efficiency in Arctic Circle. <ul style="list-style-type: none"> • Amazon’s globally distributed data centers. <p>5. Practical Implications (5 minutes)</p> <ul style="list-style-type: none"> • Data center efficiency impacts service availability and operational cost.

	<ul style="list-style-type: none"> • Emphasis on green data centers and sustainability. • Edge computing bringing mini-data centers closer to users. <p>6. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none"> • Recap core elements of data center facilities. • Ask: “Would you like to visit a real data center? What would you expect to see?”
Closure	<ol style="list-style-type: none"> 1. Stress the importance of physical infrastructure in delivering virtual services. 2. Encourage students to research how local ISPs manage their data. 3. Final Q&A and discussion (2–3 minutes). <p>Suggested Reading:</p> <p><input type="checkbox"/> Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl</p>
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> 1. What are the essential components of a data center? 2. Why is physical infrastructure important for cloud services? 3. Who ensures the data center meets operational and environmental standards? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Kot Bhalwal, Jammu



Lesson Plan No. 5.3	Course Name: Cloud Computing Advanced Cloud Practices and Case Studies: Cloud-adapted risk management framework.	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand the concept of risk in cloud computing environments. b. Identify the elements of a cloud-adapted risk management framework. c. Explore how cloud-specific risks differ from traditional IT environments. d. Analyze case studies to understand risk mitigation strategies.
Teaching Aids (if any)	a. You Tube video/NPTEL Video b. Chalk & talk with board
Teaching Development	1.Introduction (10 minutes) <ul style="list-style-type: none">• Define risk as the potential for loss or harm related to cloud assets.• Emphasize the need for a structured risk management approach in the cloud.• Ask: “Why might risk be higher or different in cloud compared to on-premise systems?” 2. Elements of a Cloud Risk Management (15 minutes) <ul style="list-style-type: none">• Risk Identification: data breaches, outages, misconfiguration.• Risk Assessment: evaluate impact and likelihood.• Risk Mitigation: encryption, backups, access controls.• Risk Monitoring and Review: audits, logs, compliance checks. NPTEL Reference: <ul style="list-style-type: none">• Cloud Security and Risk Management – Prof. S. Chandrasekaran – https://nptel.ac.in/courses/106105217 3. Differences from Traditional Risk Management (10 minutes) <ul style="list-style-type: none">• Shared responsibility model in cloud.• Dynamic and scalable resources pose unique monitoring challenges.• Multi-tenant environments introduce new risk vectors. 4. Case Studies (10 minutes) <ul style="list-style-type: none">• Capital One breach via cloud misconfiguration.• Dropbox incident related to password leak and cloud sync.• Discuss risk identification and response in each case. 5. Practical Takeaways (5 minutes) <ul style="list-style-type: none">• Importance of understanding cloud service models when assessing risks.• Regular audits and compliance as tools for managing risk.

	<ul style="list-style-type: none"> Adoption of frameworks like ISO 31000 or NIST RMF in cloud environments. <p>6. Summary & Conclusion (5 minutes)</p> <ul style="list-style-type: none"> Recap framework stages: identify, assess, mitigate, monitor. Ask: “Which stage do you think is most important in cloud environments and why?”
Closure	<ul style="list-style-type: none"> Reinforce the need for proactive, rather than reactive, risk management. Encourage awareness of risk factors even in personal cloud use. Final Q&A and discussion (2–3 minutes). <p>Suggested Reading:</p> <ul style="list-style-type: none"> Cloud Computing: Concepts, Technology & Architecture" — Thomas Erl
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> What is a risk in cloud computing? Why is a dedicated framework necessary for cloud risk management? Who is responsible for managing risks in a cloud environment? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 5.4	Course Name: Cloud Computing Advanced Cloud Practices and Case Studies Case Study: VCL – A Cloud Computing Case Study	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand the concept and architecture of Virtual Computing Lab (VCL). b. Analyze the components and workflow involved in delivering cloud services through VCL. c. Explore how VCL aligns with cloud characteristics like resource pooling, scalability, and elasticity. d. Evaluate real-world implementation and challenges in a university setting.
Teaching Aids (if any)	a. You Tube video/NPTEL Video b. Chalk & talk with board
Teaching Development	1. Introduction (10 minutes) <ul style="list-style-type: none">Introduce VCL (developed by NC State University) as one of the early academic cloud solutions.Highlight objectives: delivering software/hardware resources to users via scheduling and provisioning.Ask: “Why would a university need a private cloud platform like VCL?” 2. Architecture of VCL (15 minutes) <ul style="list-style-type: none">Core components: Management node, Database, Web interface, and Physical/Virtual resources.Explain workflow: user request → scheduler → reservation → provisioning.Emphasize use of imaging system for fast deployment of OS/software. 3. Key Features and Cloud Alignment (10 minutes) <ul style="list-style-type: none">Resource pooling: Users share a pool of computing resources.Elasticity: Dynamic allocation based on demand.Measured service: Usage-based scheduling and metering.Automation: Self-service reservation and provisioning interface. 4. Challenges and Improvements (10 minutes) <ul style="list-style-type: none">Maintenance of images and hardware.Scalability constraints as usage grows.Security measures (user authentication, image protection).Later versions integrated with virtualization platforms (e.g., VMware, KVM).

	<p>5. Summary and Conclusion (5 minutes)</p> <ul style="list-style-type: none"> Recap: What VCL is, its architecture, and how it pioneered academic cloud use. Highlight benefits for education institutions and relevance even today. Ask: “Would your university benefit from something like VCL? Why or why not?”
Closure	<ul style="list-style-type: none"> Emphasize the significance of such case studies in understanding applied cloud practices. Encourage students to explore open-source tools and cloud platforms used in academia. Final Q&A and discussion (2–3 minutes). <p>Suggested Reading:</p> <ul style="list-style-type: none"> Thomas Erl – Cloud Computing: Concepts, Technology & Architecture – Appendix 1,
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none"> What is VCL and who developed it? How does VCL align with core cloud characteristics? What are the key challenges in implementing such a platform? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Kot Bhalwal, Jammu



Lesson Plan No. 5.5	Course Name: Cloud Computing Advanced Cloud Practices and Case Studies Case Study: Amazon Web Services (AWS) – A Cloud Computing Case Study	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand the core services and capabilities of Amazon Web Services (AWS). b. Explore how AWS exemplifies Infrastructure as a Service (IaaS) and Platform as a Service (PaaS). c. Analyze the business and technical benefits realized by organizations using AWS. d. Discuss scalability, elasticity, and reliability through AWS features.
Teaching Aids (if any)	a. You Tube video/NPTEL Video b. Chalk & talk with board
Teaching Development	1.Introduction (10 minutes) <ul style="list-style-type: none">• Introduce AWS as the world’s leading cloud service provider.• Highlight its launch, service evolution, and client adoption across industries.• Ask: “What services do you think a company needs to run their applications in the cloud?” 2. AWS Service Categories and Architecture (15 minutes) <ul style="list-style-type: none">• Key service models: EC2 (compute), S3 (storage), RDS (database), Lambda (serverless), IAM (access management).• Explain architecture with focus on service regions, availability zones, and global edge locations. 3. AWS Characteristics and Cloud Alignment (10 minutes) <ul style="list-style-type: none">• Scalability: Auto Scaling Groups and Elastic Load Balancers.• High Availability and Fault Tolerance: Availability Zones and Route 53.• Security and IAM Policies for access control.• Pay-as-you-go model and cost optimization. 4. Case Applications and Benefits (10 minutes) <ul style="list-style-type: none">• Examples of businesses leveraging AWS (Netflix, Airbnb, NASA).• Business agility: Speed of deployment, experimentation, and global expansion.• Discuss operational savings and improved customer experience.



	<p>5. Summary and Conclusion (5 minutes)</p> <ul style="list-style-type: none">Recap key services, features, and case advantages.Discuss how AWS transformed IT infrastructure delivery.Ask: How does AWS compare to traditional hosting methods?
Closure	<ul style="list-style-type: none">Reinforce AWS as an enterprise-grade, highly scalable cloud solution.Encourage students to create AWS free-tier accounts for hands-on exploration.Final Q&A and discussion (2–3 minutes). <p>Suggested Reading:</p> <ul style="list-style-type: none">Thomas Erl – Cloud Computing: Concepts, Technology & Architecture – Appendix 2,
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">What are the core AWS services and their roles?How does AWS support cloud features like elasticity and reliability?What are the main benefits for businesses using AWS? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>



Lesson Plan No. 5.6	Course Name: Cloud Computing Advanced Cloud Practices and Case Studies Case Study: Salesforce – A Cloud Computing Case Study	Course No.: COM-601
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Objectives	At the end of the lesson the student shall be able to: a. Understand the architecture and services provided by Salesforce as a cloud platform. b. Explore how Salesforce delivers SaaS (Software as a Service) and PaaS (Platform as a Service). c. Examine how business processes are streamlined using cloud CRM tools. d. Analyze scalability, multitenancy, and customization features of Salesforce.
Teaching Aids (if any)	a. You Tube video/NPTEL Video b. Chalk & talk with board
Teaching Development	1.Introduction (10 minutes) <ul style="list-style-type: none">• Introduce Salesforce as a pioneer in SaaS and a leading CRM platform.• Describe its emergence as a cloud-based alternative to traditional enterprise software.• Ask: “Why would companies prefer using a CRM on the cloud rather than installing it on-premise?” 2. Salesforce Architecture and Service Model (15 minutes) <ul style="list-style-type: none">• Multi-tenant architecture: One codebase for all clients with data isolation.• Service offerings: Sales Cloud, Service Cloud, Marketing Cloud, AppExchange.• Platform capabilities: Force.com for app development. 3. Key Cloud Characteristics in Salesforce (10 minutes) <ul style="list-style-type: none">• SaaS Delivery: Users access CRM via browser.• Scalability: Auto-managed infrastructure.• Customization: Point-and-click tools for workflows.• Integration: APIs for third-party platforms. 4. Business Value and Use Cases (10 minutes) <ul style="list-style-type: none">• Improved sales tracking and customer engagement.• Reduction in IT overhead and faster deployment.• Case example: How a small business scaled using Salesforce Sales Cloud. 5. Summary and Conclusion (5 minutes)



	<ul style="list-style-type: none">• Recap Salesforce's model, advantages, and customization.• Reinforce SaaS and PaaS understanding.• Ask: How does Salesforce balance between usability and flexibility?
Closure	<ul style="list-style-type: none">• Highlight the importance of cloud-based CRM systems in modern businesses.• Encourage students to explore Salesforce Trailhead for hands-on practice.• Final Q&A and reflection. <p>Suggested Reading:</p> <ul style="list-style-type: none">• Thomas Erl – Cloud Computing: Concepts, Technology & Architecture – Appendix 3
Evaluation	<p>Reflective Questions (What Why Who?). Allow students to answer and discuss.</p> <ol style="list-style-type: none">1. What makes Salesforce a cloud-based solution?2. How does Salesforce ensure scalability and data security?3. In what ways can businesses customize Salesforce to suit their operations? <p>Spend 5 minutes to wrap up and consolidate the learnings</p>