Birla Institute of Technology & Science, Pilani
Work Integrated Learning Programmes Division
Second Semester 2023-2024

Mid-Semester Test
(EC-2 Regular)

Course No.	: CSI ZG527
Course Title	: Cloud Computing
Nature of Exam	: Closed Book
Weightage	: 35%
Duration	: 2 Hours
Date of Exam	: 17/03/2024 (AN)

No. of Pages = 2
No. of Questions = 7

Note to Students:
1. Please follow all the *Instructions to Candidates* given on the cover page of the answer book.
2. All parts of a question should be answered consecutively. Each answer should start from a fresh page.
3. Assumptions made if any, should be stated clearly at the beginning of your answer.

Q.1 Let's imagine a retail company with a complex IT infrastructure. They run an online store on a public cloud platform (like Amazon Web Services or Microsoft Azure or any other), but also have internal applications running on servers in their own data center. This is a hybrid cloud environment. As a cloud expert, suggest how the company can improve its Cloud security posture (CSP)? **Be Brief** **5 Marks**

To improve its Cloud Security Posture (CSP) in a hybrid cloud environment, the retail company should:

1. **Implement Strong Authentication and Access Controls:** Use multi-factor authentication (MFA) and role-based access control (RBAC) to ensure only authorized personnel can access sensitive data.
2. **Encrypt Data in Transit and at Rest:** Apply encryption protocols for data moving between on-premises and cloud environments and ensure data stored in both environments is encrypted.
3. **Regularly Update and Patch Systems:** Keep all systems, both on-premises and cloud-based, updated with the latest security patches to protect against vulnerabilities.
4. **Monitor and Audit Security:** Deploy comprehensive monitoring tools to track access and changes to data and applications, and perform regular security audits.
5. **Establish a Unified Security Policy:** Create and enforce a consistent security policy across both cloud and on-premises environments to manage risks effectively.

Q.2 Read the below case study and answer the questions **1+1+3 Marks**

Case Study 1: E-Commerce Migration to the Cloud

An e-commerce company that sells clothing and accessories online has been experiencing rapid growth in its customer base. Due to increased traffic and demand, the company's on-premises infrastructure is struggling to handle the load, resulting in frequent downtime and slow website performance.

The company aims to migrate its e-commerce platform to the cloud to improve scalability, reliability, and performance while reducing operational costs.

The company has decided to migrate its e-commerce platform to a cloud infrastructure provider. They opt for a scalable and cost-effective solution that allows them to easily

adjust resources based on demand. The cloud platform offers managed services for databases, storage, and content delivery to optimize performance and minimize maintenance efforts.

2.1 What challenges was the e-commerce company facing with its on-premises infrastructure?

- **Frequent Downtime:** The infrastructure cannot handle the increasing load, causing regular outages.
- **Slow Website Performance:** Increased traffic results in slow response times and degraded user experience.

2.2 What are the key benefits the company expects to achieve by migrating to the cloud?

- **Scalability:** Ability to adjust resources according to demand without the need for significant upfront investments.
- **Reliability:** Improved uptime and performance due to cloud provider's robust infrastructure and managed services.
- **Reduced Operational Costs:** Lower maintenance and operational costs compared to managing on-premises infrastructure.

2.3 How will the company ensure data security and compliance in the cloud environment.

- **Implement Encryption:** Encrypt data at rest and in transit to protect against unauthorized access.
- **Use Managed Security Services:** Leverage cloud provider's security features like firewalls, intrusion detection systems, and identity management.
- **Regular Compliance Audits:** Conduct audits to ensure compliance with relevant regulations and standards.

Q.3 Briefly discuss the role played by early technologies like grid computing, web hosting and mobile computing in the evolution of modern-day cloud computing. Your answer should be relevant to the growth of cloud computing. **5 Marks**

Early technologies like grid computing, web hosting, and mobile computing contributed to the evolution of modern cloud computing as follows:

- **Grid Computing:** Demonstrated the potential of pooling resources to solve large-scale problems and laid the groundwork for resource virtualization and distributed computing.
- **Web Hosting:** Provided the initial infrastructure for hosting web applications and services, which evolved into scalable and flexible cloud-based web services.
- **Mobile Computing:** Highlighted the need for scalable backend services that could handle variable loads and provided the impetus for the development of cloud solutions that support mobile app requirements.

Q.4 Your company has developed a new mobile app that has become very popular in a short amount of time. The app is hosted on a cloud platform that is experiencing intermittent connectivity issues. As a result, some users are unable to access the app or experience slow performance. The issue is impacting the company's reputation and revenue. As the CTO, you are tasked with addressing the issue and ensuring that the app is highly available and performs well. Identify the root cause of the connectivity issues, and describe the steps you would take to resolve the issue **5 Marks**

Root Cause Analysis:

- **Intermittent Connectivity Issues:** Likely due to network problems or insufficient resources allocated to handle peak loads.

Steps to Resolve:

1. **Analyze Network Traffic:** Use network monitoring tools to identify any network bottlenecks or issues.
2. **Increase Resource Allocation:** Scale up resources or use load balancers to distribute traffic more effectively.
3. **Optimize Application Performance:** Implement performance optimization techniques and caching mechanisms.
4. **Consult Cloud Provider:** Engage with the cloud provider to diagnose and address any underlying connectivity issues.

Q.5 Hypervisors are the software layer which enables the creation of VM's. Answer the below based on hypervisors **2 + 3 Marks**

a. Do you agree with the above statement? Justify your answer.

Yes, hypervisors enable the creation of virtual machines (VMs) by abstracting physical hardware resources, allowing multiple VMs to run on a single physical server.

b. Out of the below three, Server, OS and Application virtualization, which has the most impact on cloud computing. Explain why.

- **Server Virtualization:** Has the most significant impact on cloud computing as it allows multiple virtual servers to be hosted on a single physical server, maximizing resource utilization and enabling scalability.

Q.6 Answer the below questions in short. **3+2 Marks**

a. Currently organizations are adopting a multi-cloud strategy. What do you understand by multi-cloud strategy? Briefly describe the challenges in a multi-cloud setup.

- **Multi-cloud Strategy:** Refers to using services from multiple cloud providers to avoid vendor lock-in, increase redundancy, and optimize performance.
- **Challenges:** Include managing complexity across different platforms, integrating services, and maintaining consistent security and compliance policies.

b. Differentiate between trap & Emulate and Binary Translation. Why was BT required when Trap & Emulate was already present?

- **Trap & Emulate:** Involves trapping instructions that cannot be directly executed on the host and emulating their behavior.
- **Binary Translation (BT):** Translates the entire binary code of the guest OS into native code for the host machine.
- **Why BT was needed:** BT allows for more efficient and transparent execution of guest OS instructions compared to Trap & Emulate, reducing performance overhead and improving compatibility.

Q.7 ABC's web application is deployed in a virtual server cluster that comprised of 4 virtual servers running on 2 dedicated physical servers. The purchase price of each physical server hosting the application is Rs 7500, while the software cost is Rs 30500. Setup and application deployment charges are Rs 5500. Ongoing monthly costs are Rs 750 (environmental fees), Rs 520 (licensing fees), Rs 100 (hardware maintenance) and Rs 2600 (labor).
If the servers are leased from the cloud provider, labor costs are Rs 5500 which includes. expenses for solving interoperability issues and application setup. Monthly charges are usage fee calculated per virtual server at a rate of Rs 1.25 / hour per virtual server. The application consumption is equivalent to 2.3 servers when server instance scaling is factored in. The monthly database usage fee is Rs 327. The network usage fee is Rs 0.10 / GB per month and monthly volume is 420 GB. Labor cost per month is Rs 800. Assume that the application needs to be maintained for three-year period. **5 Marks**

a. What is the total cost of the on-premise infrastructure?

a. Total Cost of On-Premise Infrastructure:

- **Initial Costs:**
  - Physical servers: 2 servers × Rs 7500 = Rs 15,000
  - Software cost: Rs 30,500
  - Setup and deployment: Rs 5,500
  - **Total Initial Cost:** Rs 15,000 + Rs 30,500 + Rs 5,500 = Rs 51,000
- **Ongoing Monthly Costs:**
  - Environmental fees: Rs 750
  - Licensing fees: Rs 520
  - Hardware maintenance: Rs 100
  - Labor: Rs 2,600
  - **Total Monthly Cost:** Rs 750 + Rs 520 + Rs 100 + Rs 2,600 = Rs 2,970
- **Total Cost for 3 Years:**
  - Monthly Cost × 36 months = Rs 2,970 × 36 = Rs 106,920
  - **Total Cost:** Rs 51,000 + Rs 106,920 = Rs 157,920

b. Which approach is cost efficient? Justify by calculating the costs

- **Cloud Costs Calculation:**
  - Usage fee: Rs 1.25/hour × 2.3 servers × 24 hours × 30 days = Rs 1,656
  - Database usage fee: Rs 327
  - Network usage fee: Rs 0.10/GB × 420 GB = Rs 42
  - Labor cost: Rs 800
  - **Total Monthly Cost:** Rs 1,656 + Rs 327 + Rs 42 + Rs 800 = Rs 2,825
  - **Total Cost for 3 Years:** Rs 2,825 × 36 = Rs 101,700
- **Comparison:** Cloud approach (Rs 101,700) is more cost-efficient compared to on-premise infrastructure (Rs 157,920).

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