INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF SCIENCE AND TECHNOLOGY

END OF SEMESTER EXAMINATIONS - APRIL 2025

PROGRAMME: MIT
YEAR/SEM: YEAR 1/SEMESTER 2
COURSE CODE: MIT723
NAME: VIRTUALIZATION AND CLOUD COMPUTING

DATE:
TIME:

INSTRUCTIONS TO CANDIDATES:

SECTION A

Section A is Compulsory

Question 1:

QUESTION ONE: MERITS OF CLOUD COMPUTING (40 MARKS)

i. What do you understand by the term Cloud Computing. **(02 Marks)**

ii. A rapidly growing e-commerce company experiences a surge in traffic during holiday seasons, causing their on-premise servers to crash. How can cloud computing help businesses scale their infrastructure dynamically to handle fluctuating workloads? **(06 Marks)**

iii. A small startup wants to build an AI-based analytics platform but lacks the capital to invest in expensive hardware and data centers. How does cloud computing help businesses reduce upfront infrastructure costs, and what are the financial benefits of a pay-as-you-go model? **(06 Marks)**

iv. A multinational company has employees working remotely across different time zones and needs a way to collaborate efficiently. How does cloud computing enable seamless remote work and enhance collaboration among distributed teams? **(06 Marks)**

v. An IT manager at a mid-sized company is overwhelmed by the constant need to update security patches and software on their on-premise servers. How does cloud computing simplify software maintenance and security updates for businesses? **(06 Marks)**

vi. A mobile app development company wants to test new features quickly and deploy them without setting up complex infrastructure. How does cloud computing accelerate application development and deployment cycles? **(06 Marks)**

vii. A financial institution is concerned about cybersecurity threats and data breaches. They are considering moving their critical applications to the cloud. How do leading cloud providers enhance security, and what security benefits does cloud computing offer compared to on-premise infrastructure? **(04 Marks)**

viii. A media streaming service wants to expand globally and provide content delivery to users in different countries with minimal latency. How does cloud computing help companies expand their global reach and improve content delivery to end users? **(04 Marks)**

Question 2:

QUESTION ONE: DEMERITS OF CLOUD COMPUTING (40 MARKS)

i. i. A financial services company relies on cloud-based software for processing customer transactions. One day, their cloud provider experiences an unexpected outage. what

strategies can they use to minimize the impact of future outages? **(06 Marks)**

ii. ii. A tech startup chooses a cloud provider for hosting its application but later realizes that the provider's infrastructure limits their ability to customize server settings and software configurations. how can businesses mitigate vendor lock-in issues? **(06 Marks)**

iii. iii. A small e-commerce business initially benefits from the cloud's pay-as-you-go model, but over time, they notice their monthly expenses increasing significantly due to high data storage and bandwidth usage. how can businesses optimize their cloud usage to control expenses? **(06 Marks)**

iv. iv. A gaming company launches a cloud-based game streaming service, but users in certain regions experience high latency and poor performance. what strategies can be used to reduce delays? **(06 Marks)**

v. v. A company uses a cloud-based storage solution but accidentally deletes critical files. Upon requesting recovery, they realize the cloud provider does not offer long-term backups. What steps should businesses take to ensure proper backup and recovery plans? **(06 Marks)**

vi. vi. A remote team relies entirely on cloud-based applications for collaboration, but during a major internet outage, they are unable to access their work. What alternative solutions can businesses implement to maintain productivity? **(06 Marks)**

vii. vii. A disgruntled employee at a company with cloud-hosted services gains unauthorized access to sensitive files and leaks them online. What security measures should companies implement to prevent such incidents? **(06 Marks)**

SECTION B

Attempt Any Four Questions from Section B

Question 1:

QUESTION ONE: COMPUTE VIRTUALIZATION (15 MARKS)

i. i. One of your cloud-hosted virtual machines is running on a server that is about to fail. What virtualization strategies can you use to ensure business continuity and minimize service disruption?

(03 Marks)

ii. ii. A company wants to optimize its IT infrastructure by adopting virtualization. What key differences between full virtualization and para-virtualization should they evaluate before making a decision?

(03 Marks)

iii. iii. Given a Type-1 hypervisor environment, outline the process of provisioning a new virtual machine while ensuring optimal resource allocation and system stability. **(03 Marks)**

iv. iv. What are the security challenges in a virtualized environment, and how can they be mitigated?

(06 Marks)

Question 2:

QUESTION TWO: CPU VIRTUALIZATION (15 MARKS)

i. i. You need to run multiple CPU-intensive workloads on a virtualized server with limited physical cores. How would you configure CPU scheduling to balance performance and prevent resource contention?

(03 Marks)

ii. ii. A business is considering server consolidation through virtualization but is worried about CPU performance degradation. What strategies can be implemented to minimize virtualization overhead and maintain efficiency? (03 Marks)

iii. iii. What are the key challenges of virtualizing CPU resources for real-

time or latency-sensitive applications, and how can hypervisors be optimized to meet their performance requirements? (03 Marks)

iv. iv. You are provided with a virtualized environment where several VMs are exhibiting high CPU utilization. Describe how you would optimize the environment to avoid bottlenecks. (06 Marks)

Question 3:

QUESTION THREE: MEMORY VIRTUALIZATION (15 MARKS)

i. i. A virtual machine is suffering from excessive memory usage, leading to performance degradation. What techniques would you use to optimize its memory allocation, and how do memory management features like ballooning and swapping assist in this process? (03 Marks)

ii. ii. In a virtualized cloud environment, how can memory overcommitment and ballooning be used to maximize VM density on a single physical host? What are the trade-offs and risks associated with these techniques? (03 Marks)

iii. iii. Describe how virtual memory address translation works in a virtualized system. How does the hypervisor collaborate with the Memory Management Unit (MMU) to ensure secure and efficient memory access for virtual machines? (03 Marks)

iv. iv. Analyze the trade-offs between using ballooning versus swapping for managing memory over commitment in a virtualized environment. Under what circumstances would one be preferred over the other? (06 Marks)

Question 4:

QUESTION FOUR: I/O VIRTUALIZATION (15 MARKS)

i. i. A high-performance network application running in a virtualized

environment is experiencing significant I/O delays. How can SR-IOV or paravirtualized I/O improve performance, and what are the key steps to enable these technologies? (03 Marks)

ii. ii. You are troubleshooting high latency in virtual disk read/write operations in a virtualized storage setup. What factors could contribute to this issue, and what techniques can be applied to enhance storage I/O performance? (03 Marks)

iii. iii. What are the security and isolation challenges associated with I/O virtualization, especially when using direct I/O techniques like PCI passthrough and SR-IOV? What strategies can be used to mitigate these risks? (03 Marks)

iv. iv. Examine how I/O virtualization has influenced the scalability and performance of cloud computing. Provide examples of how techniques like SR-IOV and paravirtualized I/O are employed in modern cloud platforms. (06 Marks)

Question 5:

QUESTION FIVE: MAINSTREAM COMPUTE VIRTUALIZATION (15 MARKS)

i. i. You need to migrate multiple physical servers into a virtualized infrastructure to improve efficiency and reduce costs. What are the key steps in implementing compute virtualization, and what challenges might arise during this transition? (03 Marks)

ii. ii. In a virtualized environment, excessive CPU and memory overcommitment is causing performance bottlenecks. What optimization techniques can be applied to rebalance resource allocation and restore system performance? (03 Marks)

iii. iii. How do containers and virtual machines differ in terms of resource efficiency, isolation, and performance? Provide examples of scenarios where containers would be more beneficial than VMs, and vice versa. (03 Marks)

iv. iv. Analyze the importance of live migration in a compute virtualized environment. What are the potential use cases for live migration, and what challenges must be addressed to ensure minimal disruption during the migration process? (06 Marks)

Question 6:

QUESTION SIX: NETWORK VIRTUALIZATION (15 MARKS)

i. i. Explain the architecture and functionality of Software-Defined Networking (SDN) in a virtualized network environment. How does SDN improve network management, and can you provide a real-world example of its application? (03 Marks)

ii. ii. How does virtualized networking differ from traditional networking in terms of scalability, performance, and ease of management? What are the key advantages and challenges of adopting network virtualization? (03 Marks)

iii. iii. What role do hypervisors play in enabling network virtualization? Compare the impact of Type 1 and Type 2 hypervisors on virtual network performance and security.

(03 Marks)

iv. iv. A company has three departments: HR, IT, and Finance. Each department should have its own isolated network while using the same physical infrastructure.

a. Explain how you would configure VLANs to achieve this segmentation.

(02 Marks)

b. What commands would you use on a Cisco switch to create and assign VLANs?

(02 Marks)

c. How would you ensure inter-VLAN communication if needed?

(02 Marks)

Question 7:

QUESTION SEVEN: CLOUD DEPLOYMENT MODELS (15 MARKS)

i. i. An enterprise is deciding between a private cloud and a hybrid cloud for its IT infrastructure. What factors should they consider when selecting the most suitable cloud deployment model?
(05 Marks)

ii. ii. A government agency needs to implement a cloud solution while ensuring data privacy and compliance with regulations. Which cloud deployment model would be most suitable, and why?
(05 Marks)

iii. iii. Explain how Hybrid Cloud combines elements of Public and Private Cloud. What are the common use cases where a Hybrid Cloud approach provides the most benefits?
(05 Marks)

Question 8:

QUESTION EIGHT: CLOUD SERVICE MODELS (15 MARKS)

i. i. A startup company wants to develop a web application but lacks the infrastructure to host and manage servers. They are considering cloud-based solutions. Which cloud service model (IaaS, PaaS, or SaaS) would be most suitable for them, and why?
(05 Marks)

ii. ii. A large enterprise is planning to migrate its on-premises data center to the cloud. They need full control over their virtual machines, storage, and networking. Which cloud service model should they choose, and what benefits does it offer? (05 Marks)

iii. iii. A company wants to use a cloud-based email and collaboration platform without worrying about infrastructure or maintenance. Which cloud service model would be the best fit, and why?
(05 Marks)

Question 9:

QUESTION NINE: CLOUD COMPUTING ARCHITECTURE (15 MARKS)

i. i. A retail company is building its e-commerce platform using a

microservices architecture in the cloud. Different services handle tasks such as inventory management, payment processing, and user authentication independently. How does a loosely coupled architecture benefit this e-commerce platform?
(05 Marks)

ii. ii. A startup is developing a serverless web application that processes user uploads using AWS Lambda functions. The front-end application triggers Lambda functions, which process data and store results in a cloud database. How does the loose coupling between cloud components (Lambda, storage, API Gateway) improve scalability and reliability in this scenario?
(05 Marks)

iii. iii. A company deploys a cloud-based IoT system where smart devices (such as thermostats and security cameras) send data to the cloud, which processes it and sends responses back to users via mobile apps. In this IoT architecture, how does loose coupling between devices, cloud processing units, and databases enhance system performance and resilience?
(05 Marks)

Question 10:

QUESTION TEN: CLOUD INFRASTRUCTURE (15 MARKS)

i. i. A financial institution needs a disaster recovery plan to ensure its critical data remains accessible even during a system failure. It uses multiple cloud storage solutions, backup servers, and automated failover mechanisms. What roles do storage devices and cloud management software play in maintaining data integrity and disaster recovery?
(05 Marks)

ii. ii. A multinational corporation needs centralized cloud storage for its global workforce to store and share documents securely. How do storage devices, cloud management software, and network infrastructure ensure high availability, security, and performance?

(05 Marks)

iii. iii. A hospital uses a hybrid cloud model to store patient records

securely on a private cloud while using a public cloud for analytics and AI-powered diagnostics. What role do servers, storage devices, and platform virtualization play in supporting this hybrid cloud environment?
(05 Marks)

Question 11:

QUESTION ELEVEN: CLOUD INFRASTRUCTURE (15 MARKS)

i. i. Private Cloud Data centers share common security threats and vulnerabilities. Distinguish between threats, vulnerabilities.

(04 Marks)

ii. ii. Private Cloud Data centers' Vulnerabilities can take many forms, provides at least three typical examples of these vulnerabilities, along with the ways in which they could be exploited.

(03 Marks)

iii. iii. Threats to a Private Cloud Data Center are one of four kinds: interception, interruption, modification, and fabrication. Explain each of these threats, giving examples in each case.

(08 Marks).

Question 12:

QUESTION TWELVE: RISKS RELATED TO CLOUD (15 MARKS)

i. i. A large e-commerce company stores customer data, including credit card information, in the cloud. One day, hackers gain unauthorized access to the cloud storage and steal sensitive customer data. What security measures can be implemented to prevent such breaches?
(05 Marks)

ii. ii. A financial services company relies on a cloud provider to host its online banking system. Due to an unexpected cloud provider outage, customers cannot access their accounts for several hours. How can businesses mitigate the impact of cloud service outages?

(05 Marks)

iii. iii. A healthcare organization stores patient records in the cloud but later finds out that the cloud provider’s data retention policies do not comply with government regulations. The company struggles to retrieve its data. How can businesses ensure compliance and data control when using cloud services?

(05 Marks)