INTERNATIONAL UNIVERSITY OF EAST AFRICA
'Learning to Succeed'

FACULTY OF SCIENCE AND TECHNOLOGY

END OF SEMESTER EXAMINATIONS - MAY 2024/2025

PROGRAMME: MIT

YEAR/SEM: YEAR 1/SEMESTER 2

COURSE CODE: MIT723

NAME: VIRTUALIZATION AND CLOUD COMPUTING

DATE: 2025-08-06

TIME: 2:00-5:00PM

INSTRUCTIONS TO CANDIDATES:

1. Read the instructions very carefully
2. The time allowed for this examination is STRICTLY three hours
3. Read each question carefully before you attempt and allocate your time equally between all the Sections
4. Write clearly and legibly. Illegible handwriting cannot be marked
5. Number the questions you have attempted
6. Use of appropriate workplace examples to illustrate your answers will earn you bonus marks
7. Any examination malpractice detected will lead to automatic disqualification.

DO NOT WRITE ANYTHING ON THE QUESTION PAPER

Section A ATTEMPT ANY ONE QUESTIONS (40 MARKS)

Question 1:

QUESTION ONE: MERITS OF CLOUD COMPUTING (40 MARKS) **i.** Define the term *Cloud Computing* and mention any two essential characteristics **(02 Marks)** **ii.** A logistics company experiences unpredictable data processing demands due to varying shipment volumes. Explain how cloud computing allows elastic scaling to support such varying demands and ensures system reliability. **(06 Marks)** **iii.** A new education technology startup plans to launch a data-driven learning platform but has limited funds for IT infrastructure. Describe how cloud computing lowers capital expenditure and explain the economic advantages of cloud-based resource allocation. **(06 Marks)** **iv.** An international consulting firm requires real-time document collaboration and project tracking across its global offices. Discuss how cloud computing fosters efficient remote collaboration and boosts team productivity across locations. **(06 Marks)** **v.** A healthcare organization is struggling with outdated software systems that require constant manual updates. Analyze how adopting cloud computing can streamline system updates and improve overall IT management and security. **(06 Marks)** **vi.** A software development team wants to experiment with new microservices and deploy code frequently. Explain how cloud platforms support rapid prototyping, continuous integration, and faster deployment cycles. **(06 Marks)** **vii.** A government agency wants to ensure high data security while transitioning to cloud infrastructure. Highlight the key security measures implemented by cloud service providers and how these compare to traditional on-premise security models. **(04 Marks)** **viii.** A gaming company seeks to deliver smooth, real-time multiplayer experiences to users worldwide. Evaluate how cloud computing supports global service delivery and reduces latency for end-users. **(04 Marks)**

Section B Attempt Any Four Questions from this section - Each question carries 15 marks

Question 1:

QUESTION EIGHT: NETWORK VIRTUALIZATION (15 MARKS) **i.** Describe the key components of a Software-Defined Networking (SDN) architecture and explain how SDN separates the control plane from the data plane. How does this separation benefit network programmability and automation? Provide a use case. **(03 Marks)** **ii.** Compare traditional networking with virtualized networking in terms of provisioning speed, hardware dependency, and network visibility. What are the key benefits and limitations of using virtual switches in a virtualized environment? **(03 Marks)** **iii.** Hypervisors enable the creation of virtual switches for VM communication. Explain how a Type 1 hypervisor's direct access to hardware differs from a Type 2 hypervisor's reliance on a host OS, and discuss the implications for network throughput and security. **(03 Marks)** **iv.** An organization wants to segment its internal network to isolate the Marketing, Engineering, and Support departments on the same physical infrastructure. **a.** Describe how VLANs can be used to logically separate the network traffic between departments. **(02 Marks)** **b.** List and explain the Cisco IOS commands used to create VLANs and assign them to switch ports. **(02 Marks)** **c.** If users from different VLANs need to communicate with each other, what configuration or device would you use to enable inter-VLAN routing? **(02 Marks)**

Question 2:

QUESTION FOUR: CPU VIRTUALIZATION (15 MARKS) i. You are tasked with deploying multiple compute-intensive virtual machines on a host with limited CPU resources. How would you configure CPU affinity and time slicing to ensure fair resource distribution and stable performance? **(03 Marks)ii.** An organization plans to consolidate its physical servers into a smaller number of virtualized hosts. To avoid CPU performance issues, what best practices should be followed to minimize virtualization overhead and optimize resource usage? **(03 Marks)iii.** Real-time applications such as VoIP or industrial control systems are being migrated to a virtualized platform. What challenges do such workloads pose for CPU virtualization, and how can hypervisors be tuned to support their time-sensitive requirements? **(03 Marks)iv.** In a scenario where multiple virtual machines are competing for CPU time and causing noticeable slowdowns, outline the steps you would take to analyze and optimize CPU performance to reduce contention and improve overall throughput. **(06 Marks)**

Question 3:

QUESTION TEN: CLOUD SERVICE MODELS (15 MARKS)i. A small software development team wants to build and deploy applications quickly without managing the underlying infrastructure. Which cloud service model should they adopt, and what advantages does it provide in terms of development speed and resource management? **(05 Marks)ii.** An organization needs to run legacy enterprise applications in the cloud with complete control over operating systems, middleware, and storage. Which cloud service model would meet these requirements, and how does it compare to other models in terms of flexibility and responsibility?

(05 Marks)iii. A business is looking for an out-of-the-box CRM system that can be accessed via the internet with minimal setup and no internal IT support. Which cloud service model is most appropriate, and what are the benefits and limitations of using it?

(05 Marks)iv. Compare IaaS, PaaS, and SaaS in terms of user control, responsibility, and use cases. Provide an example of a suitable application or business scenario for each model. **(05 Marks)v.** A university plans to offer students access to productivity tools like document editing, cloud storage, and email without installing any software on campus computers. Which cloud service model fits this need best, and what are the key features that support this use case? **(05 Marks)**

Question 4:

QUESTION FOURTEEN: (15 MARKS)i. Differentiate between the terms *security threats* and *vulnerabilities* in the context of private cloud data centers. Why is it important to understand this distinction for effective cloud security management?

(04 Marks)ii. Identify and describe at least three common vulnerabilities found in private cloud data centers. For each vulnerability, explain how attackers might exploit it to compromise security. **(03 Marks) iii.** Security threats to private cloud environments can be categorized into interception, interruption, modification, and fabrication. Define each type of threat and provide a real-world example illustrating how it could impact a private cloud data center. **(08 Marks)**

Question 5:

QUESTION ELEVEN: CLOUD COMPUTING ARCHITECTURE (15 MARKS)i. A fintech company is designing its cloud platform with microservices for payment processing, fraud detection, and customer management. Explain how loose coupling among these services contributes to system flexibility, fault isolation, and easier maintenance. **(05 Marks)ii.** A startup uses serverless functions triggered by HTTP requests, which in turn interact with different cloud storage and messaging services. How does the loose coupling of these components help the application handle sudden spikes in traffic and reduce downtime? **(05 Marks)iii.** In a smart city project, various sensors and devices communicate asynchronously with cloud services that analyze data and send alerts. Discuss how loose coupling between edge devices, cloud analytics, and notification services improves scalability and

fault tolerance. **(05 Marks)iv.** Describe how adopting a loosely coupled architecture in a cloud-based online learning platform can enable independent updates of user authentication, course content delivery, and analytics services without disrupting the overall system.

(05 Marks)

Question 6:

QUESTION SIX: I/O VIRTUALIZATION (15 MARKS)i. A virtual machine running a data-intensive application suffers from poor network throughput. How can technologies like VirtIO or paravirtualized network drivers enhance I/O performance in such virtualized environments, and what are the key configuration requirements? **(03 Marks)ii.** During a performance audit, it is observed that a virtualized database server is experiencing slow disk I/O despite adequate physical resources. What storage-related configuration issues or I/O bottlenecks might be responsible, and how can they be resolved? **(03 Marks)iii.** Direct device assignment methods such as PCI passthrough offer near-native performance but raise concerns around isolation and multi-tenancy. What are the primary security implications of using direct I/O techniques, and how can administrators safeguard against them? **(03 Marks) iv.** Discuss the role of I/O virtualization in enabling high-performance and scalable cloud services. Using examples, explain how modern cloud providers leverage SR-IOV, NVMe over Fabrics, or paravirtualized I/O to improve network and storage efficiency.

(06 Marks)