JARAMOGI OGINGA ODINGA UNIVERSITY OF SCIENCE AND TECHNOLOGY

SCHOOL OF INFORMATICS AND INNOVATIVE SYSTEMS

UNIVERSITY EXAMINATION FOR THE DEGREE OF BACHELOR SCIENCE IN SECURITY AND FORENICS

2nd YEAR 2nd SEMESTER 2024/2025 ACADEMIC YEAR

MAIN CAMPUS

MAIN PAPER

COURSE CODE: ICB 1214

COURSE TITLE: COMPUTER SYSTEMS AND NETWORKING LAB

EXAM VENUE: CL3 **STREAM:**

DATE: 16/4/2025 **EXAM SESSION: 9.00-11.00**

TIME: 2.00 HOURS

INSTRUCTIONS:

1. **Answer Question 1 (Compulsory) and ANY other two questions**
2. **Candidates are advised not to write on the question paper**
3. **Candidates must hand in their answer booklets to the invigilator while in the examination room**

SECTION A

1. Explain what a wireless mesh network is and state two advantages it offers over traditional wired networks. **(3marks)**
2. Compare and contrast centralized computing and distributed computing. **(2marks)**
3. What is a Virtual Private Network (VPN), and what are its two main advantages? **(3marks)**
4. Explain the significance of the Address Resolution Protocol (ARP) in a network. **(2marks)**
5. What is a fully qualified domain name (FQDN), and why is it important in DNS? **(2marks)**
6. Define Simple Mail Transfer Protocol (SMTP) and explain its role in email communication. **(2marks)**
7. Explain how DHCP assigns IP addresses dynamically. What mechanisms are in place to ensure that duplicate IP addresses are not assigned, and how can DHCP reservations be beneficial in a corporate environment? **(3marks)**
8. ARP resolves IP addresses to MAC addresses. Describe a scenario in which an attacker could exploit ARP, and suggest mitigation techniques. **(3marks)**
9. A system administrator notices that some devices on the network are getting incorrect IP addresses, causing connectivity issues. The company uses DHCP for IP allocation. Describe the troubleshooting steps you would take to diagnose and resolve this issue. **(3marks)**
10. A user complains that they are unable to access a website using its domain name, but when they type the IP address directly, the site loads fine. What troubleshooting steps would you take to identify and resolve the issue? **(3marks)**
11. The Secure Shell (SSH) protocol is widely used for remote management. Explain how SSH enhances security compared to Telnet, and discuss the encryption methods used in SSH communication **(3marks)**
12. Differentiate between connection-oriented and connectionless protocols. **(1mark)**

SECTION B

QUESTION ONE

1. An organization is experiencing slow network speeds and frequent packet loss. After analyzing their infrastructure, you discover they are using a traditional bus topology. What network redesign strategy would you propose to improve performance, and why? **(5 marks)**

2. A financial institution wants to improve the speed and reliability of its network traffic, particularly for real-time transactions. Explain how Multiprotocol Label Switching (MPLS) could be beneficial and outline the key implementation steps. **(5 marks)**

3. A company wants to allow its remote employees to securely access internal resources over the internet. Explain how a Virtual Private Network (VPN) can be implemented, including the necessary components and security considerations. **(5 marks)**

4. A hospital requires a fault-tolerant network for its critical medical systems. Compare the advantages of using a mesh topology over a star topology for this purpose, and propose an optimized network design. **(5 marks)**

QUESTION TWO

a) Your organization has been assigned the network 172.16.0.0/16 and wants to divide it into eight subnets to support different departments.

   I. What subnet mask should be used to achieve this? **(2marks)**

   II. How many usable host addresses will each subnet have? **(2marks)**

   III. Why is subnetting important in large networks? **(1mark)**

b) A user complains that they cannot access network resources. After checking their system, you find that their IP address is 169.254.10.25.

   I. What does this IP address indicate? **(2 marks)**

   II. List and explain three possible steps to resolve this issue. **(3 marks)**

c) Your company has an internal network using the private IP range 192.168.1.0/24 but needs internet access using a single public IP.

   I. What type of NAT should be implemented? **(2 marks)**

   II. Explain two benefits of using NAT for security and IP address management. **(3 marks)**

d) Your organization is transitioning from IPv4 to IPv6.

   I. Identify two key differences between IPv4 and IPv6. **(2 marks)**

   II. Explain the role of an IPv6 link-local address and why it is important. (3 marks)

QUESTION THREE

a) Your company has recently expanded, and network congestion is becoming a serious issue. The current network relies on hubs for connectivity. Propose a detailed solution to improve

network performance, specifying the devices you would replace or add and justifying your choices.

(5Marks)

b) A company has multiple branch offices that need to communicate securely over the internet. Compare and recommend the best solution between site-to-site VPNs and MPLS, considering factors such as cost, security, and performance. **(5Marks)**

c) A company wants to improve its network security after experiencing data breaches. As a network administrator, propose three security measures and explain how each measure would protect the network against cyber threats. **(10marks)**

QUESTION FOUR

a) Explain the OSI model, describing each layer's function in detail. Provide real-world examples of network components or protocols operating at each layer. **(10 marks)**

b) An IT manager notices that employees frequently experience IP address conflicts, causing network downtime. Analyze the root cause of this issue and describe how implementing a DHCP server would resolve the problem. Include potential configurations that would optimize address allocation. **(5 Marks)**

c) A data center administrator is tasked with optimizing data traffic between multiple high-traffic application servers. Explain how load balancers can be used to distribute network traffic efficiently, prevent bottlenecks, and ensure high availability. **(5 Marks)**

QUESTION FIVE

a) Your organization wants to restrict external access to its internal network while allowing employees to access the internet.

I. Which IP addressing strategy should be implemented? **(1 mark)**

II. How does this strategy enhance security? **(2 marks)**

b) Your office network uses the IP range **192.168.5.0/24** with a default gateway **192.168.5.1**.

I. Explain the function of the default gateway in this network. **(2 marks)**

II. What would happen if a computer is missing the default gateway setting? **(1 mark)**

c) A user reports that they are unable to access the internet. You check their IP address and find that it is **169.254.5.12**.

I. What does this IP address indicate? **(1 mark)**

II. What steps would you take to resolve this issue? **(2 marks)**

d) Your company has been assigned the IP address **172.20.5.10/16**.

I. Identify the class of this IP address. **(1 mark)**

II. What is the default subnet mask for this address class? **(1mark)**

III. How many hosts can be accommodated in this network? **(1mark)**

e) Your organization is experiencing frequent IP conflicts, causing network connectivity issues. The company is currently using static IP addressing for all devices. As the network administrator, propose a solution to resolve this issue and explain the steps you would take to implement it. **(5 marks)**

f) SMTP, POP3, and IMAP4 are used in email communication. Explain the specific role of each protocol and why organizations might prefer IMAP4 over POP3. **(3marks)**