

**9210-121**

**Level 6 Graduate Diploma in Engineering**

Computer networks

**Sample Paper**

**You should have the following for this examination**

- one answer book
- non-programmable calculator
- pen, pencil, ruler

**No additional data is attached**

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**General instructions**

- This examination paper is of **three hours** duration.
- This examination paper consists of **nine** questions.
- Answer any **five** questions.
- All questions carry equal marks. The maximum marks for each section within a question are given against that section.
- An electronic, non-programmable calculator may be used, but candidates **must** show clearly the steps prior to obtaining final numerical values.
- Drawings should be clear, in good proportion and in pencil. Do **not** use red ink.

- 1 a) Neither the Open Systems Interconnection (OSI) model and its protocols nor the Transmission Control Protocol/Internet Protocol (TCP/IP) model and its protocols is perfect. Though the TCP/IP model is popular in the industry, it has some disadvantages. Briefly explain three (03) such disadvantages of the TCP/IP model comparing with OSI model. (6 marks)
- b) Suppose there is a change in the service (set of operations) provided by layer  $k$  of a reference model. How does this impact services at layers  $k-1$  and  $k+1$ ? (4 marks)
- c) Briefly explain two (02) facts why the layers of the OSI model are important to the network administrator. (4 marks)
- d) Bus Topology is the simplest network topology type. Though simple and cost effective, this topology type has some disadvantages. Briefly explain **three** such disadvantages. (6 marks)
- 2 a) Compare and contrast the difference between a Client-Server Architecture and a Peer-to-Peer Architecture using **four** characteristics or facts of each. (8 marks)
- b) Draw the format of a Hypertext Transfer Protocol (HTTP) packet on Ethernet with all packet headers and trailers. (No need to show the contents of the headers or trailers). (4 marks)
- c) Domain Name System (DNS) uses User Datagram Protocol (UDP) instead of Transmission Control Protocol (TCP). If a DNS packet is lost, there is no automatic recovery. Does this cause a problem, and if so, how is it solved? Explain your answer. (4 marks)
- d) Peter sends a message to Mary from his web-based email account (such as yahoo mail or gmail). Mary accesses her email from her mail server using POP3. Explain how the message gets from Peter's host to Mary's host by listing the series of application-layer protocols that are used to move the message between the two hosts. (4 marks)
- 3 a) Briefly explain the following terminologies network socket, socket API, socket address. (6 marks)
- b) Compare and contrast the difference between Stream Sockets and Datagram Sockets using **four** facts of each. (8 marks)
- c) i) A UDP-based server needs only one socket, whereas the TCP server needs at least two sockets. Why? (3 marks)
- ii) If the TCP server were to support  $n$  simultaneous connections, each from a different client host, how many sockets would the TCP server need? Explain your answer. (3 marks)
- 4 a) Everything from appliances to automobiles can be interconnected with IPv6. But an increased number of IP addresses is not the only advantage of IPv6 over IPv4. Specify and briefly explain **four** such advantages. (8 marks)
- b) Despite the problem of IPv4 address depletion, migration to IPv6 may take time. Briefly describe **two** reasons for this. (6 marks)
- c) In Internet Protocol (IP), the checksum covers only the IP header and the error in the data (payload) is not checked. Briefly explain the reason for choosing this design. (6 marks)

- 5 a) Consider the following questions for Stop-and-Wait automatic repeat request (ARQ).
- i) What is the disadvantage of having a premature-timeout? (2 marks)
  - ii) What is the disadvantage of having too long a timeout interval? (2 marks)
- b) Suppose an original data input stream of 10011101 and the generator polynomial of  $x^3 + 1$  are given for transmission with CRC.
- i) Find the actual bit string transmitted from the sender side. (4 marks)
  - ii) Supposing that the third bit from the left is inverted during transmission, explain how this error can be detected at the receiver's end. (4 marks)
  - iii) What kind of bit errors in the transmitted bit string will not be detected by the receiver? Give an example. (4 marks)
- c) You are asked to design a 100 Mbps CSMA/CD protocol in which the maximum one-way propagation delay between any two hosts is 100 microseconds. What will you use as the minimum size of a transmitted frame if you wish the transmitting node to detect a collision before completing the transmission of the frame? (4 marks)
- 6 a) TCP increases load to determine when congestion occurs and then backs off.
- i) What is the overall purpose of Flow Control and Congestion Control in TCP? (4 marks)
  - ii) How are the above tasks accomplished? (4 marks)
- b) Additive Increase Additive Decrease (AIAD), Additive Increase Multiplicative Decrease (AIMD), Multiplicative Increase Additive Decrease (MIAD), and Multiplicative Increase Multiplicative Decrease (MIMD) are some of the policies for fairness in congestion control. Discuss and compare these policies in terms of convergence to fairness and convergence to efficiency. (8 marks)
- c) If the TCP round-trip time (RTT), is currently 26 msec and the following acknowledgements come in after 28 and 22 msec, respectively, what is the new RTT estimate using the Jacobson algorithm? Use  $\alpha = 0.8$ . (4 marks)
- 7 a) Adequately explain why Ethernet LAN uses CSMA/CD and wireless LAN uses CSMA/CA. (6 marks)
- b) The Bluetooth system connects headsets and many kinds of peripherals to computers without wires.
- i) Which technology is used to avoid interference in Bluetooth? (2 marks)
  - ii) Briefly explain **two** advantages of Bluetooth that havemade this technology so popular. (4 marks)
- c) Compare and contrast Wi-Fi and Bluetooth with respect to following aspects:
- i) Connection Complexity
  - ii) Security
  - ii) Power Consumption
  - iv) Applicative Scenario. (8 marks)
- 8 a) What are the **three** main classes of internet-based Multimedia Applications? (3 marks)
- b) Redirect Server and Proxy Server are two important network elements of the Session Initiation Protocol (SIP). Compare and contrast the difference in the role of these two elements. (4 marks)
- c) Although ReSerVation Protocol (RSVP) sits on top of the IP protocol stack, it is not a routing protocol.
- i) Briefly describe the ReSerVation Protocol (RSVP). (3 marks)
  - ii) Briefly explain **two** disadvantages of this RSVP. (4 marks)
- d) Session initiation (SIP) can be used for setting up an enriched communication session such as a real-time video/voice call (rich call). SIP can also be used in several other application areas, such as instant messaging (IM), but currently the primary focus area is enabling rich call. Briefly explain what kind of rich call applications can be implemented with SIP, by using **two** examples. (6 marks)

- 9 a) Briefly explain **two** advantages of a Public Key Cryptosystem (PKC) over a symmetric cryptosystem (shared secret key) from the perspective of networking. (4 marks)
- b) Simple Network Management Protocol (SNMP) has a simple design and is thus easy to implement. This reduces its susceptibility to faults and improves the stability of the protocol. Specify and explain **three** other benefits of SNMP. (6 marks)
- c) i) Compare and contrast stateless-firewalls and stateful-firewalls by explaining **three** characteristics/facts of each firewall type. (6 marks)
- ii) Specify where the stateless-firewalls and the stateful-firewalls can perform better than the other. (4 marks)