SCHOOL OF ENGINEERING AND TECHNOLOGY

EXAMINATION FOR THE
BSc (HONS) INFORMATION TECHNOLOGY; BSc (HONS) INFORMATION TECHNOLOGY (COMPUTER NETWORKING AND SECURITY); BSc (HONS) COMPUTER SCIENCE; BACHELOR OF SOFTWARE ENGINEERING (HONS); YEAR 2.

ACADEMIC SESSION 2022

NET2201 COMPUTER NETWORKS

FINAL - DECEMBER 2022 EXAM CYCLE

TIME: 2 HOURS + 10 MINUTES READING TIME

INSTRUCTIONS TO CANDIDATES

This question booklet contains two sections.

Section A: **Compulsory Section.** Answer all questions.
Section B: Answer any **two** questions from this section.

All answers must be written in the answer booklets provided using blue or black INK

IMPORTANT NOTES TO CANDIDATES

Materials Allowed

Standard Items : Pen, Pencil, Eraser or Correction Fluid, Ruler.
Special Items : Non Programmable Calculators.

It is your responsibility to ensure that you do **NOT** have in your possession any unauthorised material/notes or any other means that would improperly help you in this exam. If you have any unauthorised materials with you, hand it to the invigilator BEFORE reading any further.

DO NOT REMOVE THIS QUESTION PAPER FROM THE EXAMINATION HALL

[This paper contains **FOUR questions** printed on **FOUR pages**]

Section A
Compulsory section

Question 1 (50 marks) (Typical Time Required: 45 Mints)

a) What are the five layers in the Internet protocol stack? Explain the functions of each layer. (15 marks)

b) Do you agree with the following statements? Justify your answer.

i) Stop-and-wait protocol must have sufficient buffer size to store packets at sender and receiver. (5 marks)

ii) The data plane of the network layer performs network-wide functions, specifically it determines routes from a source node to a destination node. (5 marks)

iii) Compared to User Datagram Protocol (UDP), Transmission Control Protocol (TCP) is more suitable for real-time media streaming. (5 marks)

iv) Congestion control regulates a source host's sending rate with the main objective of not overflowing receiver host's buffer. (5 marks)

c) What is the value of CRC bits R given that generator is G = 10011, data is D = 1010101011, and the number of CRC bits is r = 4. (5 marks)

d) Host A sends a packet of size L = 150 bits to Host B over a link of rate R = 256 kbps. The propagation speed over the link is 2.5×10^8 meter/second.

i) Suppose propagation delay d_{prop} is twice of transmission delay d_{trans}. Find d_{prop}. (3 marks)

ii) Calculate the bandwidth-delay product. (3 marks)

iii) Consider sending a packet of size L = 120 bits. What is the number of bits that will be in the link at any given time? (2 marks)

iv) Consider sending a packet of size L = 250 bits. What is the number of bits that will be in the link at any given time? (2 marks)

Section B
Answer any TWO questions from this section.

Question 2 (25 marks) (Typical Time Required: 35 mints)

a) Answer the following questions.

i) Would you use go-back-N or selective repeat when there is no buffer at the receiver? (2 marks)

ii) Would you use TCP Tahoe or TCP Reno to improve throughput performance? (2 marks)

iii) Would you use iterated query or recursive query to reduce traffic load at upper levels of the hierarchy of Domain Name System (DNS)? (2 marks)

iv) Would you use packet switching or circuit switching to avoid end-to-end signalling protocol? (2 marks)

v) Would you use Time-Division Multiplexing (TDM) or Frequency-Division Multiplexing (FDM) if time synchronization cannot be achieved? (2 marks)

(b) Figure. 1 represents a network diagram. Use the distance-vector algorithm to compute the shortest path from Node A to the rest of the nodes in the network. The link cost is indicated on each link. Assume that each node initially knows the costs to each of its neighbours. Show the distance table entries at node A. (15 marks)

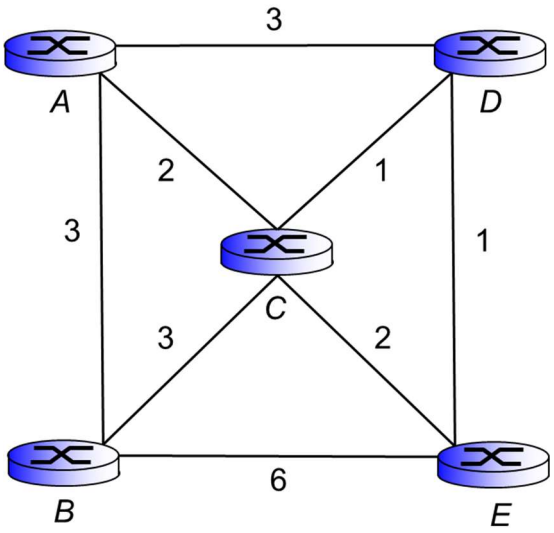

Figure . 1 A network configuration of five routers.

Question 3 (25 marks) (Typical Time Required: 25 mints)

a) There are two types of control planes in the network layer, namely per-router control plane and centralized control plane (also called software-defined networking). Explain their differences. (5 marks)

b) Do you agree with the following statements? Justify your answer.

i) Using Network Address Translation (NAT), a host in a local network must notify the outside world if its IP address changes. (4 marks)

ii) Link-state routing algorithm requires neighbouring nodes to exchange routing information (e.g., route cost) among themselves. (4 marks)

c) Consider distributing a file of F = 30 Gbits to N = 100 peers. The server has an upload rate of u_s = 50Mbps, and each peer has a download rate of d_i = 5 Mbps and an upload rate of u_i = 500 Kbps.

i) What is the estimated distribution time (in seconds) in a client-server architecture? (5 marks)

ii) What is the estimated distribution time (in seconds) in a peer-to-peer architecture? (7 marks)

Question 4 (25 marks) (Typical Time Required: 30 mints)

a) Answer the following questions.

i) Explain the effects on queue size and queuing delay when traffic intensity is close to one. (6 marks)

ii) Consider installing a web cache in an institutional network. Explain the effects on the number of requests satisfied and the total response delay when cache hit rate increases. (4 marks)

b) Using slotted ALOHA, N = 3 nodes contend to transmit in a 3 Mbps channel. Each node transmits only 30 per cent of the time.

i) What is a node's average throughput? (3 marks)
Hint: A node's average throughput is the probability that the node succeeds in a time slot.

ii) What is the probability that at least one node succeeds in time slot 5? (3 marks)

iii) What is the probability that at least one node succeeds for the first time in time slot 5? (6 marks)

iv) Suppose that the transmission probability of the entire network follows a binomial distribution. Find the probability that at any given time slot, exactly two (2) nodes transmit simultaneously. (3 marks)

~ END OF PAPER ~