SCHOOL OF ENGINEERING AND TECHNOLOGY

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

ACADEMIC SESSION : SEPTEMBER 2023 SEMESTER
SUBJECT : NET2201 COMPUTER NETWORKS
EXAMINATION : JANUARY 2024
TIME ALLOWED : 2 HOURS + 10 MINUTES READING TIME

INSTRUCTIONS TO CANDIDATES

This question booklet contains two sections.

Section A: Answer the **compulsory** questions.
Section B: Answer any two questions out of three questions.

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 notes or any other means that would improperly help you in your work. If you have any unauthorised materials with you, hand them to the invigilator BEFORE reading any further.

DO NOT REMOVE THIS QUESTION PAPER FROM THE EXAMINATION HALL

[This paper contains FOUR questions printed on FIVE pages, including the cover page]

Section A
Compulsory section

Question 1 [Typical Time Required: 50 Mints] **(Total Marks: 50)**

a) Explain the functions of Dynamic Host Configuration Protocol (DHCP). (5 marks)

b) Suppose you have been asked to design a computer network with improved network performance.

i) Would you use circuit switching or packet switching? Discuss your choice. (5 marks)

ii) Would you use stop-and-wait protocol or pipelined protocol? Discuss your choice. (5 marks)

iii) Would you use TCP Tahoe or TCP Reno? Discuss your choice. (5 marks)

c) Compare and contrast persistent and non-persistent HTTP connections. (10 marks)

d) What are the five layers in the Internet protocol stack? Explain the functions of each layer. (10 marks)

e) Explain the disadvantages of the following Medium Access Control (MAC) protocols.

i) Carrier Sense Multiple Access (CSMA) (5 marks)

ii) Time-Division Multiplexing (TDM) (5 marks)

Section B
Answer any TWO questions from this section.

Question 2 [Typical Time Required: 30 Mints] (Total Marks: 25)

a) Compare and contrast the two types of taking-turn protocols, namely polling protocol and token passing protocol. (13 marks)

b) Consider a source node *S* sends a packet of length L = 2000 bytes along a route that consists of five links to a destination node *D*. In other words, there are four packet switches along the route. Let d_i, s_i and R_i represent the length, propagation speed, and the transmission rate of link i = 1, 2, 3, 4, 5, respectively. The length of the links are d_1 = 2000 km, d_2 = 3000 km, d_3 = 4000 km, d_4 = 5000 km, and d_5 = 6000 km. The propagation speed of each link is 2.5×10^8 m/s, and the transmission rate of each link is 3 Mbps. Each packet switch incurs a processing delay d_{proc} = 10 ms. Ignoring the queuing delay, answer the following questions.

i) What is the total end-to-end delay for the packet? (7 marks)

ii) What is the number of bits that will be in the links i = 1 and i = 5, respectively? What is your observation? *(Hint: Explain what happens to the bandwidth delay product when the length of a link increases.)* (5 marks)

Question 3 [Typical Time Required: 30 Mints] (Total Marks: 25)

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

i) Selective Repeat protocol requires a sender to retransmit all sent but unacknowledged packets when its timer expires. (4 marks)

ii) Both Go-back-N and Selective Repeat allow a sender to send *N* unacknowledged packets in the pipeline. (3 marks)

iii) For the Go-back-N scheme, there are many timers at the source node. (3 marks)

iv) UDP provides flow control. (3 marks)

b) Consider an institutional network connected to the Internet as shown in Figure 1. The access link has a transmission rate R = 15 Mbps. The browsers of the institutional network generate requests to the origin servers at an average rate of β = 16 requests per second,

and the average object size of the responses received from the Internet is 550,000 bits. Let the amount of time it takes from when the router on the Internet side of the access link forwards a request until it receives the respective response is 2 seconds on average. The total average response time is the sum of the average access delay, which is the delay from the Internet router to the institution router, and the average Internet delay. For the average access delay, use $\Delta / (1 - \Delta \cdot \beta)$, where Δ is the transmission delay incurred by sending an object over the access link.

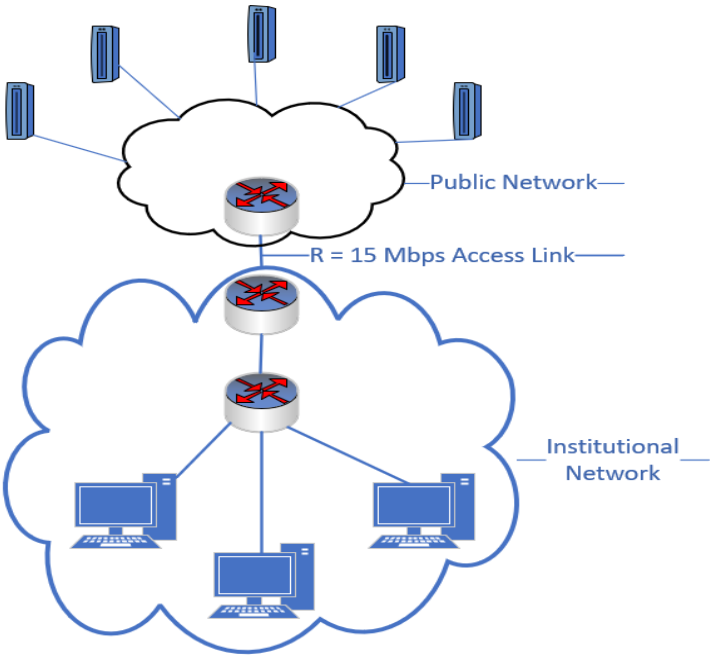

Figure 1. Institutional Network Connected to the Internet

i) Calculate the total average response time. (6 marks)

ii) Now suppose a cache is installed in the institutional network and the miss rate is 0.4. Find the total response time. Explain your answer. (6 marks)

Question 4 [Typical Time Required: 30 Mints] **(Total Marks: 25)**

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

i) If the traffic intensity is larger than 0.9, congestion becomes severe. (5 marks)

ii) A control plane based on software-defined networking in the network layer enables each router to compute its own forwarding table. (5 marks)

b) Consider the following network of Figure 2:

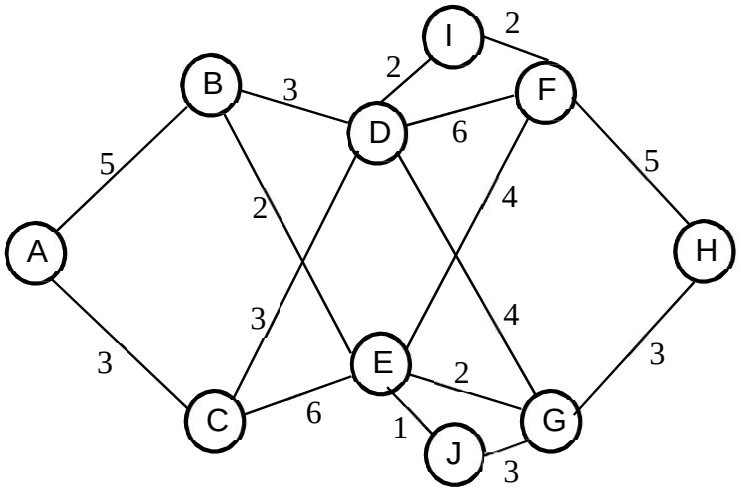

Figure 2: The Network Diagram

i) Use Dijkstra's shortest path 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. Fill in Table. 1 to demonstrate your answer. (9 marks)

Table .1 Routing Algorithm Output

Step	N'	D(B) p(B)	D(C) p(C)	D(D) p(D)	D(E) p(E)	D(F) p(F)	D(G) p(G)	D(H) p(H)	D(I) p(I)	D(J) p(J)
0										
1										
2										
3										
4										
5										
6										
7										
8										
9										

ii) Show the least-cost path tree for the network. (3 marks)

iii) Show a forwarding table for node *A*. (3 marks)

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