



UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 5 Examination in Engineering: May 2023

Module Number: EE5302

Module Name: Computer Networks (C-18)

[Three Hours]

[Answer all questions, each question carries 10 marks]

Notes: All notations have their usual meaning.

- Q1 a) How do the physical properties of copper cables, fiber optics, and wireless media affect their performance in terms of transmission speed, distance, and reliability? [3.0 Marks]
- b) Generate the Manchester line encoded output of following binary data stream.
0110100110101101 [2.0 Marks]
- c) Suppose we have a communication system that uses quadrature amplitude modulation (QAM) with a constellation size of 64. The bandwidth of the channel is 5 MHz, and the signal-to-noise ratio (SNR) is 18 dB.
- i) Calculate the capacity limit C of the channel using the Shannon's formula.
 - ii) Identify if the given modulation scheme is sufficient to achieve the capacity limit or else the required constellation size to achieve the capacity limit.
 - iii) Calculate the number of bits per symbol. [3.0 Marks]
- d) Explain the difference between bandwidth allocation in circuit switching and packet switching. [2.0 Marks]
- Q2 a) Compare and contrast the protocols of Carrier Sense Multiple Access with Collision Detection (CSMA/CD) and Carrier Sense Multiple Access with Collision Avoidance (CSMA/CA). How do they differ in their approach to handling collisions in a network? [1.0 Mark]
- b) Consider a network with five stations A, B, C, D, and E. They use Slotted ALOHA protocol with transmission probabilities 0.2, 0.3, 0.1, 0.4, and 0.2, respectively. Calculate the probability of exactly one station transmitting in a given time slot. [3.0 Marks]
- c) Explain the concept of Address Resolution Protocol (ARP) spoofing and how it can launch man-in-the-middle attacks in a network. Provide an example to

illustrate your answer. Discuss the potential consequences of such an attack and the measures that can be taken to prevent it.

[1.0 Mark]

- d) Consider a network with four stations A, B, C, and D connected by an Ethernet hub. The network uses the Ethernet protocol with a data rate of 10 Mbps and a frame size of 1500 bits. Suppose that the four stations have 1000 bits, 1500 bits, 2000 bits, and 2500 bits to be transmitted, respectively.

- Calculate the time it takes for each station to transmit its data. Note that there are no collisions, and the inter-frame gap is 96-bit times.
- Discuss the impact of the maximum frame size on each station's transmission time.

[4.0 Marks]

- e) Define what is Native VLAN and explain its purpose within a network. Provide an example of how Native VLANs can improve network performance.

[1.0 Mark]

- Q3 a) i) With the help of a diagram, explain the main concept behind hierarchical routing in OSPF using point form.
- ii) Briefly explain in point form the reason behind implementing different inter and intra autonomous system routing protocol.

[3.0 Marks]

- b) ABC Corporation has 5 departments, and each department has a different number of hosts. The departments and their host requirements are given in Table Q3.1.

Table Q3.1

Department	Number of Hosts
Marketing	68
Sales	50
Human Resources	28
Finance	12
IT	10

You have been assigned the IP network 192.168.0.0/24 for subnetting. Perform variable length subnetting (VLSM) for efficient allocation of IP addresses to each department based on their host requirements. Determine the Network address, subnet masks, and usable IP range for each department.

[5.0 Marks]

- c) Write the following IPv6 addresses in the compressed form.

- 2001:0db8:0000:0000:1428:0000:0000:57ab
- fe80:0000:0000:0000:0202:b3ff:fe1e:8329

[2.0 Marks]

Q4 a) Briefly explain in point form, the difference between connection-oriented demultiplexing and connectionless demultiplexing in the transport layer. [2.0 Marks]

b) Briefly explain the following fields in a TCP header. Your answer should include the purpose and content of each field.

- i) Sequence number
- ii) Acknowledgement number
- iii) Receive window

[1.5 Marks]

c) Answer the following in point form in relation to the TCP timeout value.

- i) What is meant by *TCP timeout* value and why it is required?
- ii) What are the consequences of the TCP timeout value being too long or too short?
- iii) Explain how you would estimate a proper TCP timeout value?

[3.0 Marks]

d) Briefly explain in point form the TCP fast retransmit principle using a sequence diagram.

[2.0 Marks]

e) What is the difference between *congestion control* and *flow control* performed in TCP?

[1.5 Marks]

Q5 a) Answer the following questions in point form using your knowledge on HTTP.

- i) Explain what is meant by HTTP being a *stateless* protocol. What are the challenges on maintaining states in HTTP?
- ii) Explain the main difference between *non-persistence* HTTP and *persistence* HTTP connections.
- iii) With the help of a sequence diagram obtain an expression for the *Non-persistent* HTTP response time for transmitting a single object.
- iv) With the help of a diagram, explain *head of the line* (HOL) blocking experienced in HTTP/1.1.
- v) How does the HOL issue mentioned in iv) is mitigated in HTTP/2?
- vi) Explain three advantages of using web caching.

[7.0 Marks]

b) Considering the hierarchical DNS levels briefly explain in point form how DNS name resolution is performed in recursive query approach.

[2.0 Marks]

c) List two advantages of using DHCP for the dynamic allocation of IP addresses compared to static allocation methods?

[1.0 Mark]