

**University of Ruhuna - Faculty of Technology**  
**Bachelor of Information & Communication Technology Honours Degree**  
**Level 1 (Semester II) Examination, November/December 2023**  
**Academic Year 2021/2022**

**Course Unit: ICT 1253 - Computer Networks (Written)**

**Duration: 2 hours**

.....  
This question paper contains **five (05) pages** including this instruction page.

**IMPORTANT INSTRUCTIONS**

- The medium of this examination is **English**.
- This is a **Closed Book** examination.
- This Examination consists of **four (04)** questions.
- You must **answer all four (04) questions** in this examination.
- Each question carries **equal 100** marks.

1.

- a) As computer networks grow in size and complexity, internetworking devices are used to connect them. Provide four (04) examples of internetworking devices.

[08 marks]

- b) Briefly discuss the differences between Unshielded Twisted Pair (UTP) cable and Shielded Twisted Pair (STP) cable based on the criteria provided below.

- i. Data rate
- ii. Cable length
- iii. Easiness of installation
- iv. Cost

[16 marks]

- c) List four (04) advantages and three (03) disadvantages of fiber optics.

[21 marks]

- d) "*Unguided signals can travel from the source to destination in several ways.*" Briefly explain the difference between ground propagation and sky propagation.

[10 marks]

e)

- i. Briefly explain the process of Multiplexing in data transmission.

[10 marks]

- ii. Identify three (03) types of Multiplexing and briefly discuss any two (02) of them.

[17 marks]

- f) Consider a noiseless channel with a bandwidth of 25 kHz assigned for data communication. The requirement is to send 200 kbps over the channel. Using **Nyquist Theorem**, calculate the number of signal levels needed for the data transmission.

[18 marks]

2.

- a) Distinguish three (03) main differences between IPv4 and IPv6 addresses.

[12 marks]

- b) Identify the class of the following classful IP addresses.

- i. 11100001 11000101 11110011 10110001
- ii. 01011000 01110111 10010001 11101000
- iii. 150.200.192.204
- iv. 221.60.73.25

[12 marks]

- c) The IP address block of the class C network that you have subnetted is **200.78.10.0/26**.
- i. What is the subnet mask? **[4 marks]**
  - ii. What is the maximum number of subnets that you can create? **[10 marks]**
  - iii. Calculate the number of usable hosts per subnet. **[10 marks]**
  - iv. Identify the following parameters of the first two subnets.
    - I. Network address
    - II. Broadcast address
    - III. Usable IP range**[16 marks]**

- d) The "Eagle" firm operates an institute dedicated to providing certificate and diploma courses in Information Technology. Within this institute, there are three separate labs, each equipped with a varying number of computers. The institute's IP address block is **195.10.5.0/24**. Each lab operates on its unique subnet, optimizing the allocation of IP addresses based on the varying number of hosts per network to minimize wastage.

Lab A – 48 hosts

Lab B – 23 hosts

Lab C – 11 hosts

Using **unequal subnetting** concept, find the following for each department.

- i. Subnet mask
- ii. Network address
- iii. Broadcast address

**[36 marks]**

3.

- a) The Data Link Layer provides services to the network layer, including functions such as framing, flow control, and error control.
- i. Briefly explain what framing is. **[05 marks]**
  - ii. Indicate the structure of a frame with brief explanation. **[12 marks]**
  - iii. Suppose that the number of bits allocated for the header, payload, and trailer of a fixed-size frame is 24, 15, and 24, respectively. Calculate the required number of frames if 240 bits of actual data are to be transmitted in frames. **[10 marks]**
  - iv. Byte Stuffing is a mechanism to recognize the starting and ending boundaries of a frame. Consider the following dataset which is ready to transmit to the receiver's end. Rewrite the dataset again after performing the **Byte Stuffing** mechanism on them.

A. 

X
---

ESC
-----

Y
---

B. 

X
---

ESC
-----

FLAG
------

Y
---

[12 marks]

b) Suppose that the received sum of data at the receiver's side is 11100001 when the transmitted data unit by the sender is 10011101 10000010 00111100 1000101. Assuming that an **8-bit checksum** is used,

i. Calculate the checksum value generated at the sender's side.

[22 marks]

ii. Justify the existence or non-existence of an error.

[10 marks]

c) R.W. Hamming introduced a method called the "**Hamming code**" which is used for error control during network transmission. Consider the 7-bits Hamming code to answer the following questions.

i. The data bits of a 7-bit Hamming code word are given as **1101**. Estimate all the parity bits and find the 7-bit Hamming code word accordingly. Assume even parity and state whether the received code is correct or incorrect.

[21 marks]

ii. Suppose that the received code word is **1100101** when a 7-bit Hamming code is used. Assuming even parity, determine the position of the error bit in the received code.

[08 marks]

4.

a) Consider the following statement regarding the Network Layer of OSI reference model.

*"The network layer is responsible for routing of packets".*

i. Briefly explain the purpose of routing algorithms.

[05 marks]

ii. Briefly describe three (03) characteristics of routing algorithms.

[12 marks]

b)

i. List three (03) factors that can cause congestion in a network.

[06 marks]

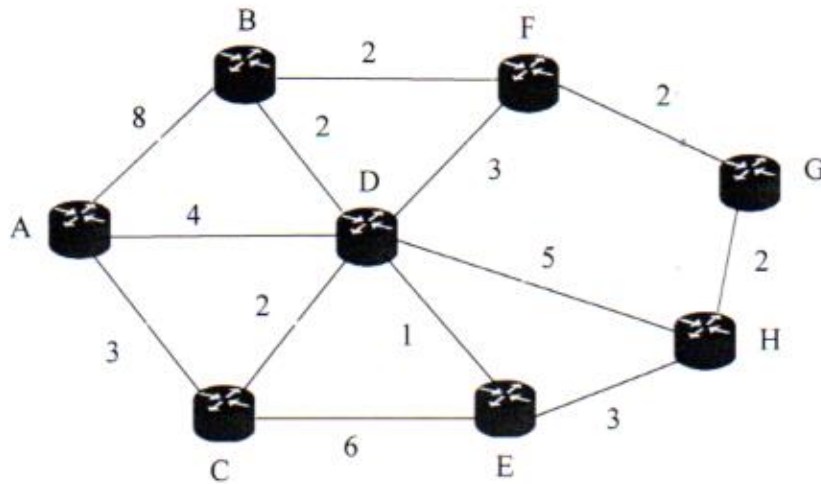
ii. Briefly explain the difference between choke packet and explicit signaling mechanisms in congestion control.

[10 marks]

- iii. Briefly explain the following open-loop congestion control mechanisms.
- I. Discarding policy
  - II. Retransmission policy

[10 marks]

- c) Consider the following network topology in which the cost of each link is given. Find the shortest path from Router A to every other router in the topology using the link-state routing algorithm. Provide the steps using a table.



[ 57 marks]

----- End of the Paper -----