United International **University** (**UIU**)

Dept. of Computer Science and Engineering (CSE)

Final Exam Year: **2024** Semester: **Summer**

Course: **CSE 3711/EEE 4413** Title: **Computer Networks (Section – A)**

Marks: **50** Time: **2 Hours**

[Any examinee found adopting unfair means will be expelled from the trimester/program as per UIU disciplinary rules.]

There are **4 (Four)** questions. Answer **all 4 (Four)** questions.

Q.1 a) **Fill up** the following table according to the responsibilities of the **transport layer**, **network layer** and **data link layer** (if more than one layers apply, list all layers). **[3]**

Responsibility	Layer(s)	Responsibility	Layer (s)	Responsibility	Layer (s)
1. Uses MAC address		2. NAT/PAT		3. Does error correction	
4. MAC protocols		5. Flow control		6. Forwarding packets	
7. Uses port number		8. Uses ARP		9. Framing and link access	

b) Please **show calculations** under these questions. The sender buffer's **SendBase** is **800**. The **last TCP sequence** number sent was **1700** in a segment with **500 bytes** of data. A segment is received with **TCP acknowledgement number 1200** and **window 2000**. The **MSS** is **512**. Until another **ACK** is received: **[1 x 5 = 5]**

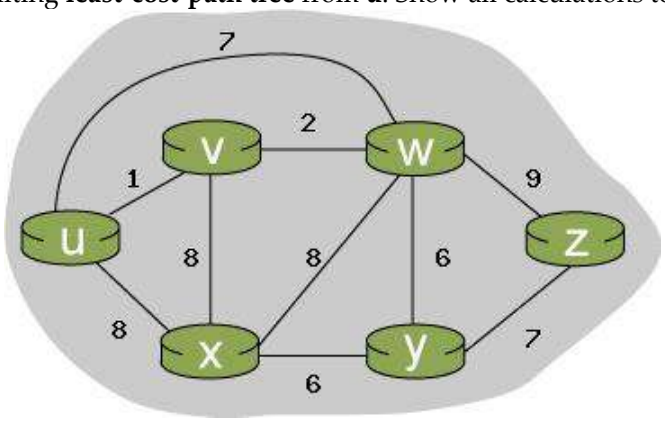
i. **Draw a sequence diagram** for the above scenario.
ii. What is the **new value of SendBase**?
iii. What is the **last byte #** that can be sent with certainty that the receiver's buffer will not overflow?
iv. What is the **next byte (number)** that will be sent?
v. **How many bytes** still can be sent (**after last segment K**) without overflowing receiver's buffer?

c) **Host A** and **B** are communicating over a TCP connection, and **Host B** has already received from **Host A** all bytes up to **byte # 700**. Suppose **Host A** then sends **two segments** to **Host B** back-to-back. The first and second segments contain **300** and **200 bytes of data**, respectively. In the **first segment**, the **sequence number** is **701**, the **source port number** is **5999**, and the **destination port number** is **21**. **Host B** sends an acknowledgement whenever it receives a segment from **Host A**.

i. For the **second segment** sent from Host A to B, what are the **sequence number, source port number,** and **destination port number**? **[1]**
ii. If the **second segment** arrives before the **first segment**, in the acknowledgment of the first arriving segment, what is the **acknowledgment number, source port number,** and **destination port number**? **[2]**
iii. Suppose the **two segments** sent by A arrive in order at B. The **first acknowledgement is lost** and the second acknowledgement arrives **after** the first timeout interval. **Draw a timing diagram**. Describe **what will happen** after the **first timeout interval**? Retransmission, or new segment? **[3]**

Q.2 a) Why **Fragmentation** is necessary? How it is different than **Segmentation** in **Transport layer**. A datagram of **5,000 bytes** arrives at a router that should be forwarded to a link with an **MTU of 1,400 bytes**. Suppose the original datagram is stamped with **an identification number of 222**. Assume that the size of the **IP header is 40 bytes**. With a diagram show different fragments including the length, ID, ***fragflag*** and offset values. **[1 + 1 + 3 = 5]**

b) Consider the network shown in the following diagram as a graph $G = (N, E)$, where ***N*** is the set of routers and ***E*** is the set of links, use **Dijkstra's link-state routing algorithm** to compute the least cost path from **node u** to all other nodes and show the resulting **least-cost-path tree** from **u**. Show all calculations to get full credit. **[5 + 2 = 7]**



Q.3 a) Assume an **IP packet** carrying an **HTTP request** is going from a local (i.e. home) area network onto the wider Internet through a **NAT router**. Name all **header fields** that the **NAT router needs to change** in the given packet? **Explain** your answer. **[1 + 2 = 3]**

b) **Rakib** and **Sajib** are two students of UIU browsing Internet. Both **Rakib** and **Sajib** are at home behind their NAT routers, **A** and **B** respectively. **Rakib**'s IP address is **10.0.0.2** and **Sajib**'s IP address is **172.16.78.90**. **Router A** is using public IP **201.110.50.166** and port numbers from **5001 to 6000** for NAT. **Router B** is using public IP **211.99.88.101** and port numbers **6001 to 7000** for NAT. Also, assume that **Gmail Server's** IP address is **88.76.54.32** and **Google Server**'s IP address is **128.83.83.20**.

i. Suppose, **Rakib** is accessing **Gmail Server** from his PC using client **port # 5600**. What will be the **source** & **destination IP address** and **port numbers** in the packet arriving at the **router A** from **Gmail Server**. **[2]**

ii. Now, suppose both **Rakib** and **Sajib** are **checking E-mail** (using server port # 25 and client port # 5678) and **searching some materials in Google** (using server port # 80 and client port # 5679) simultaneously. Show the **corresponding entries** in **NAT table** for both router A & B. **[4]**

c) The **forwarding table** of a router looks like this:

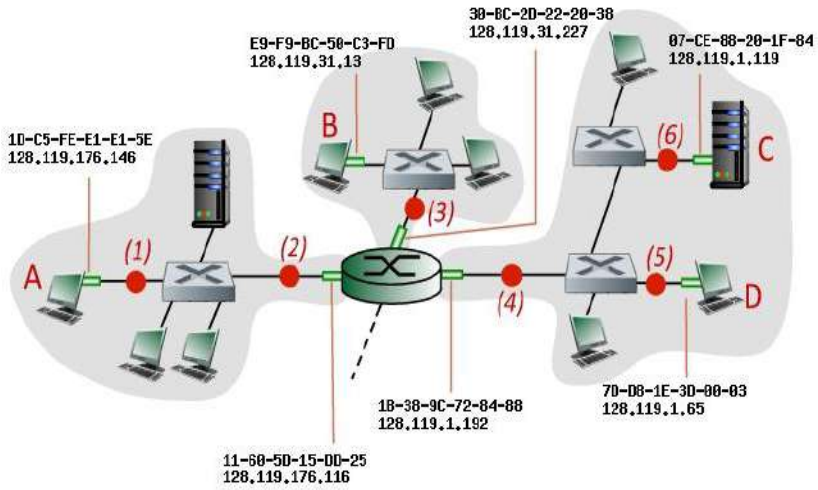
Subnet Number	Subnet Mask	Destination Interface
172.58.128.0	255.255.128.0	Fa0/0
172.58.160.0	255.255.224.0	S0/0/0
172.58.192.0	255.255.224.0	Fa1/0
Default Route	----------	S0/1/1

What will be the **output interface** for the following destinations for the router's outgoing packets?

i. 172.58.188.98 ii. 172.58.125.6 iii. 172.58.204.36 iv. 172.58.193.11 **[4]**

Q.4 a) What is **Address Resolution Protocol (ARP)**? **Why** is it needed? How **default gateway** plays an important role in ARP? **[3]**

b) Consider the figure below. The IP and MAC addresses are shown for nodes A, B, C and D, as well as for the router's interfaces.



Consider an IP datagram being sent from node **A** to node **D**. Assume, ARP tables are empty.

i. **List the steps** for the packet to successfully be sent from **Host A** to **Host D**. **[2]**

ii. How does B learn the IP address of the router? How does B learn the Router R's MAC address? **[2]**

iii. What will be the **destination MAC address** of the **ARP request** sent by **A**? **[1]**

iv. **Which IP address** will send **ARP reply**? **[1]**

v. Give the **source and destination MAC addresses**, as well as the **source and destination IP addresses** encapsulated within the Ethernet data frame at points ***(1),(2),(4)*** and ***(5)*** in the figure. **[2]**

←End of Paper – Thank You→