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

There are **3 (Three)** questions. Answer **all 3 (Three)** questions. All questions are of values indicated on the right-hand margin.

Q1. a) How are packets organized by end systems when an end system has data to send to another end system over the network? **[2]**

b) With the aid of diagrams show all the layers' functions of TCP/IP protocol suite. For the **TCP/IP layered architecture**, show Layer *vs* Protocol mapping for the following protocols: **IPv6**, **WiFi**, **UDP**, **SMTP**, **SSH**, and **OSPF**. **[2]**

c) Suppose that a host wants to send **1200 bits** of packet onto a twisted-pair copper wire. Find the transmission delay and the propagation delay, if the distance **and** the transmission rate are **500 km** and **1.5Mbps, respectively. Also,** calculate the total nodal delay. **[1 + 1 + 0.5 = 2.5]**

d) What is throughput? Suppose that a server sends bits into two pipes at rate R_s **bits/sec** and R_c **bits/sec**. What are the average end-end throughputs, if $R_s < R_c$ *and* $R_s > R_c$? Find the transmission rate of the bottleneck link. **[1 + 0.5 + 0.5 + 0.5 =2.5]**

e) How do you differentiate between **circuit-switching** and **packet-switching** technologies? Why is packet switching more efficient than circuit switching? **[0.5 + 0.5 = 1]**

Q2. a) Assume that a website is composed of three objects including the base HTML file. The RTT between the client and the server is **400 msec**, the size of each object is **40 Kbyte** and the bandwidth between the client and server is **0.5 Mbps**. Calculate the total response time required to download the entire website when (i) **non-persistent** and (ii) **persistent HTTP** are being used. **[2 + 2 = 4]**

b) UDP does not provide any reliability, flow control or congestion control. Then, why do we need UDP at all? Justify your answer with one example application that runs over UDP. **[2]**

c) A browser contains a file **abcd.html** in its cache memory and sends a **conditional GET** request to the server. Suppose, the file is not updated after the last-modified: date stored in the browser. Should the server explicitly return the contents of the file? How can you tell? **[2]**

d) Suppose **Sadiq**, with a Web-based e-mail account (sadiq@hotmail.com), sends an email to **Reshma** (reshma@yahoo.com), who accesses her email using IMAP. With a diagram explain how the email moves from Sadiq's host to Reshma's host. Be sure to identify the application-layer protocols that are used to move the email between the two hosts. Note that you have to draw the diagram only. **[2]**

Q3. a) What is **network topology**? Does the topology of a network determine the flow of data over the network? If yes, how? If no, why not? Explain. **[3]**

b) What are the aspects that an application layer protocol defines? **[2]**

c) Draw a diagram showing the **recursive query** for DNS name resolution. **[2]**

d) Suppose **10 cars** are traveling together as a caravan, following each other in a fixed order. Think of **each car** as a **bit** and **the caravan** as a **packet**. Also suppose that each tollbooth services (that is, transmits) a car (1 bit in this case) at a rate of one car per **12 seconds**, and that it is late at night so that the caravan's cars are the only cars on the highway. A car can propagate at **100 km/hr**. If the setting is as in Fig. 1,
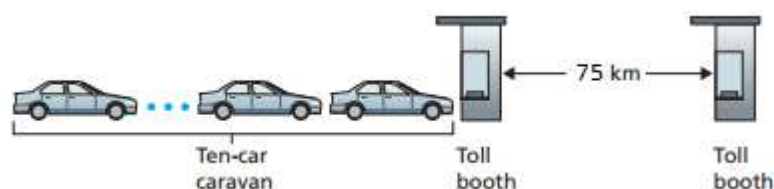

Fig. 1.

i.   How long will it take for the caravan to be lined up before 2nd toll booth? **[2]**

ii. Will there be any car left at the first toll booth after 1 hour? **[1]**

-- **END of Question** --