

**EE673A : Digital Communication Networks**  
**Mid Semester Examination**  
**(Maximum Marks: 80)**

12th September 2021

Time Allowed: 2 hours

**INSTRUCTIONS**

1. There are a total of 14 questions. Answer all of them.
  2. This is a closed-book exam. You are not supposed to refer any material during the exam.
  3. The questions in each section carry different marks. First Section - 2 marks each, Second Section - 4 marks each, Third Section - 10 marks each.
  4. All students should turn on their video in the zoom call. Please try to point the camera towards the notes/paper on which you write your answers.
  5. Any plagiarism or malpractices will be dealt very seriously. Any student found to be involved in such activities will be dropped from the course and reported to the institute disciplinary committee for further action.
  6. **Submission Instructions:** All answers should be written on paper and the scanned copy has to be submitted in the hello iitk portal. I would prefer that you upload a single pdf file, which is generated out of the scanned images. Applications like this may be helpful for generating pdf from images: <https://smallpdf.com/jpg-to-pdf>
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## 1 Two Mark questions

1. If you were to choose a transport layer protocol (TCP or UDP) for each of the following applications, explain what you would choose and why:
  - (a) Video conference
  - (b) File download
2. Consider a situation, where we are deploying multiple servers to handle the same application as a single server is not able to handle the requests from all the clients. How will a browser sending the request to that application know which of the multiple servers to send the request to? Which application helps in this process?
3. Supposing an application at an end-host wants to send  $n$  packets to an application at a different end-host over the Internet using TCP. What are the guarantees that TCP provides on the delivery of these  $n$  packets at the receiving application?

## 2 Four Mark questions

4. What are the five layers in the Internet protocol stack? Describe the principal service provided by each layer. Also give an example for a protocol / technology / application at each layer.
5. Define the following terms, and specify their units:
  - (a) throughput
  - (b) round-trip time
  - (c) processing delay
  - (d) router capacity
6. What is the domain name system (DNS) used for? Supposing you want to visit a webpage at the server `www.cse.iitk.ac.in`, describe the sequence of events that happens when you perform a DNS lookup for that domain name from your computer.
7. For e-mail communications, explain the need to have a mail server? Why can't the end systems directly establish a connection between them and send the email? In e-mail, for each of the communications listed below, which of

the protocols (more than one option can be selected if applicable) can be used?

- (i) Mail Server  $\rightarrow$  Mail Server
- (ii) Sender User agent  $\rightarrow$  Mail Server
- (iii) Mail Server  $\rightarrow$  Receiver User agent

Protocol options:

- (a) HTTP
  - (b) SMTP
  - (c) IMAP
  - (d) POP3
8. HTTP uses which transport layer protocol? What are the persistent and non-persistent connections? If a browser is downloading a web page which contains some html text and 5 images, how many TCP connections are required if we use (a) persistent connection (b) non-persistent connections ?
9. Answer the following questions with TRUE or FALSE along with appropriate justification.

Consider that two laptops are connecting to the same server running an application using UDP at the same time. Let Laptop 1 connect to the server at port  $P_{S1}$  through its local port number  $P_{C1}$ . Similarly, let  $P_{C2}$  and  $P_{S2}$  be the client and server side port numbers for the connection established by Laptop 2.

- (a)  $P_{S1}$  and  $P_{S2}$  can be the same.
- (b)  $P_{C1}$  and  $P_{S1}$  cannot be the same.
- (c)  $P_{C1}$  and  $P_{C2}$  cannot be the same.
- (d)  $P_{C2}$  and  $P_{S2}$  can be the same.

### 3 TEN Mark questions

**Note:** For every question in this section, Timing diagrams showing the windows (wherever applicable) after each event are to be drawn clearly.

10. Consider a packet of length 1,500 bytes which begins at end system A and travels over three links to a destination end system B. These three links are connected by two packet switches S1 and S2. Refer Figure 1 below. The propagation speed on the three links are  $1.25 \times 10^8$  m/s,  $2.5 \times 10^8$  m/s and  $10^8$  m/s respectively, the transmission rates of all three links are 2, 20 and 10 Mbps respectively, the packet switch processing delay is 3 ms, the length of the first link is 5,000 km, the length of the second link is 4,000 km, and the length of the last link is 1,000 km. When the packet arrives at the switch S1 it finds four other packets of the same size waiting to be transmitted, also when it arrives at switch S2 it finds one other packet is halfway done being transmitted on this outbound link and ten other packets of the same size are waiting to be transmitted. Consider packets are transmitted in order of arrival. Find the propagation delay, queuing delay and transmission delay at each hop. Also find end to end delay. Draw a timing diagram clearly showing all these delay quantities.

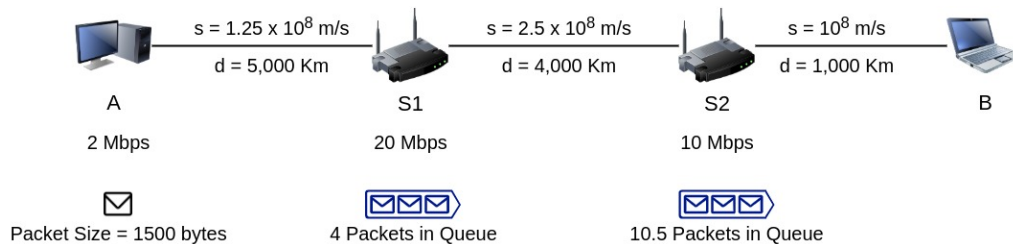


Figure 1: Network for Q10

11. Draw transmitter and receiver side state diagrams for a stop-and-wait Reliable Data Transfer protocol that operates over a channel with **Bit errors** and uses one bit for representing packet sequence.
12. In Go-Back-4 protocol, if every 6th packet being transmitted is lost and if we have to send 10 packets then how many transmissions are required? Clearly explain with appropriate timing diagram(s).
13. Which reliable transfer protocol among Go-Back-N and Selective Repeat do you think is better? Based on your choice answer the following questions with clear timing diagrams.
- Can you construct one example where Go-Back-N performs better than Selective Repeat?
  - Can you construct one example where Selective Repeat performs better than Go-Back-N?

14. For Reliable Data Transfer over a channel with variable delay, a protocol that uses only one bit sequence may experience issues. Clearly show an example for such an issue arising for each of the following cases:
- (a) When there is a large delay for some packet sent by the transmitter
  - (b) When an acknowledgment takes a very long time to reach the Tx

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