Note: There are four questions. Attempt all.

1. Suppose we have a Chord DHT with 5-bit key space and there are 7 nodes in the network, with node ID equal to 2, 5, 8, 13, 19, 20, 26. Further, there are 11 content objects with hashed IDs 00,01,05,08,10,12,19,21, 26, 30,31 already stored on DHT. Answer the following questions:

   (a) Draw a ring to represent the DHT key space; indicate where the 7 peers are situated on this ring.

   (b) Give the finger table for each peer.

   (c) Show the distribution of content objects.

   (d) Suppose you are at peer with ID=8. You have a query for content object that hashes to value 2. Indicate the routing steps that leads you to find the peer that stores the desired content object.

   (e) Suppose now a new node with ID=29 joins the node, write ALL the changes in each peer (finger, successor, predecessor and stored keys).

   (f) Now node 08 wants to unjoin (informed leave) the overlay, write ALL the changes in each peer (finger, successor, predecessor and stored keys), considering the changes already made by part (e).

2. Consider the scenario shown in Figure.1 in which a server is connected to a router by a 100 Mbps link with a 50ms propagation delay. Further, This router is also connected to two routers, each over a 50Mbps link with a 200ms propagation delay. A 1 Gbps links connects a host and a cache (if present) to each of these routers and these links have 0 propagation delay. All packets in network are 20,000 bits long.
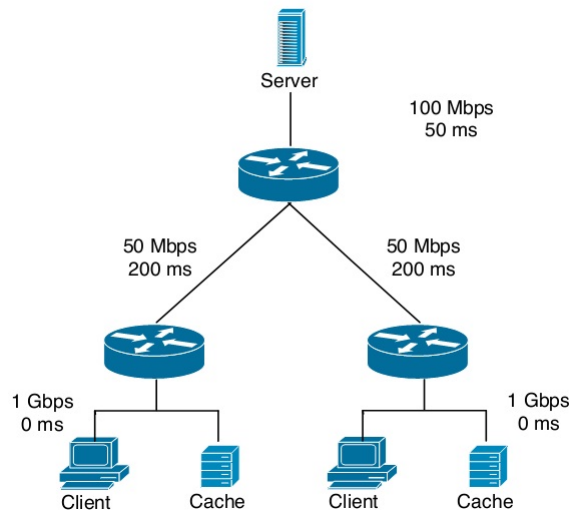

Figure 1: Figure for Question.1

   (a) What is the end-to-end delay from when a packet is transmitted by the server to when it is received by the client? In this case, you can assume that there are no caches, there is no queuing delays at the routers, and the packet processing delays at nodes and routers are all 0.

   (b) If we assume that caches are off and client sends requests for file transfer directly to server, what is the maximum rate at which the server can deliver data to single client if no other client is making request.

(c) Now if we assume that client on right hand side and client on left hand side are part of peer to peer network. What is the end-to-end delay from when a packet is transmitted by the right hand client to when it is received by the left hand client? In this case, you can assume that there are no caches, there is no queuing delays at the routers, and the packet processing delays at nodes and routers are all 0.

(d) Finally, if we assume that there is only one active client but in this case caches are on and behave like HTTTP caches. The client's HTTP GET request is always first sent to its local cache. If 70 % of requests are satisfied by the cache, what is the average rate at which client can recieve data.

3. To connect to IIT Delhi website from MNNIT Allahabad, a machine PC11 is used. Ganesh is the local DNS server. Explain the process of resolving the name www.iitd.ernet.in from PC11 at MNNIT Allahabad under the assumption that it is not cached at the local DNS server and that the local DNS server has not cached an entry for the .ernet and .in DNS server. You have to clearly mention what resource records would be returned during the resolution process when different DNS queries are made. You can choose different IP addresses and names of intermediate DNS servers as follows:

- MNNIT Allahabad DNS server name: ganesh and IP 210.213.50.11
- IIT Delhi DNS server name: iitkdns and IP 210.214.50.11
- Ernet DNS server name: ernetdns1 and IP 210.215.50.11
- India DNS server name: indns1 and IP 110.120.100.5
- Root DNS server name: root1 and IP 90.15.30.5. Any thing else if needed please assume and state clearly.

4. (a) Suppose that Mayank wants to send an email message to Manoj. This will involve four entities: Mayank's mail client (for email composition and sending), Mayank's outgoing mail server, Manoj's incoming mail server, and Manoj's mail client (for email retrieval and viewing). Between which of these four entities does the SMTP protocol operate? What about the IMAP protocol?

(b) What is the purpose of the HTTP "COOKIE:" field? Are the values in the HTTP message's cookie field stored at the client or server or both? Explain briefly.

(c) Suppose that we want to change the IP address of cse.mnnit.ac.in from 128.119.40.186 to 128.119.40.187 and change this mapping in the DNS authoritative name server for cse.mnnit.ac.in. Once this mapping is changed in the authoritative name server, will all future references (generated anywhere in the Internet) to cse.mnnit.ac.in then be sent to 128.119.40.187? Explain briefly.

(d) We saw that TCP and UDP provide two very different service models. Suppose that an application wants all of the functionality provided by UDP but only some of the functionality provided by TCP (e.g., the application wants reliable message transfer and flow control, but not congestion control). How would an application get this different service in today's Internet?

(e) Assume there is an HTTP cache in proxy server of any institute network. We have to make sure that users do not get served an outdated HTML page from the cache. There is an HTTP mechanism that prevents this from happening. Explain this with an example containing HTTP requests and responses.