PES Institute of Technology, Bangalore
(Autonomous Institute under VTU, Belgaum)

CS 301

CONTINUOUS INTERNAL EVALUATION (CIE) B. E. 5TH SEMESTER – Sep. 2012
TEST – 1
CS 301 - Computer Networks-I

Note:
1. All 5 questions are compulsory and carry equal marks.
2. This is an open book exam and making use of printed material, hand notes etc is permitted.
3. However, use of electronic devices (laptops, cellphone, etc) is prohibited
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Time: 1½ Hrs Answer All Questions Max Marks: 50

Q1	Source A is connected to destination B over a network consisting of 3 switches. First and third switch uses store and forward switching and second uses cut-through switching. For cut through switching, switch starts forwarding packets immediately after reading initial 10000 bits. The transmission speed of link between 2nd and 3rd switch is 2Mbps and for all other links it is 1Mbps. Compute End to End delay when source A transmits a file of size 12.5Mbytes to destination B in packets of 1Mbits size. Assume network is congestion free and there is no processing and queuing delay in the network and this is the only traffic between A and B.	10
Scheme	2 mark: computing number of packets i.e. 100 3 marks: for computing transmission delay at A, 1st switch, and 3rd switch 2 marks: for computing transmission delay at 2nd switch 2 marks: for accounting computing delay for all packets 1 mark: for adding all delays to compute end to end delay	
Ans	File Size in bits: 100Mbits (12.5*8)Mbits Each packet size: 1Mbits Total number of packets: 100 Time taken for first packet from A to reach 1st switch: 1s (=1Mb/1Mbps) Time taken for first packet from 1st switch to reach 2nd switch: 1s (=1Mb/1Mbps) Time taken for first packet from 2nd switch to reach 3rd switch: 0.005s (=10000/2Mbps). The 2nd switch is using cut-through switching and thus will cause delay due to first 10000bits and not for the entire packet. Time taken for first packet from 3rd switch to reach B: 1s (=1Mb/1Mbps) Total time taken for first packet to reach B: 1+1+.005+1 = 3.005s. Second packet will start from A after first packet is transmitted by A i.e. after 1 s. The last packet (i.e. 100th packet) will start from A after 99 seconds. Thus end to end delay = 3,005 + 99 = 102.005s.	
Q2	Suppose 4 users share a 5 Mbps outgoing link connected via a router. Also, suppose each user transmits continuously at 1.5 Mbps when transmitting but each user transmits only 20% of the time. Compute the probability when there is no queuing on outgoing link. Does this probability increases or decreases when total number of users increases from 4 to 5? Explain.	10

Scheme	1 mark for identifying probability of transmission and non-transmission 2 marks for identifying up to 3 users transmitting for no queuing delay 2 marks for computing each probability (0, 1, 2 and 3 users) 2 mark for adding all probabilities for no queuing delay 2 marks for computing probabilities when no of users are 5 1 mark for explaining change in probability	
Answer	Probability (p) of a user transmitting = 0.2 Probability (1) of a user not transmitting = 0.8 (=1 – 0.2) When will queue build up at router: when 4 or more users starts transmitting simultaneously since each users transmits at 1.5Mbs, and thus 4 users will require 6Mbps. When 3 users transmit simultaneously, then BW requirement is 4.5Mbps and since outgoing link is 5Mbps, there will be no queue build up. Thus, when up to 3 users transmit, there will be no queue build-up. Probability P0 of no user transmitting = combine(4,0) * p^0* q^(4-0)= 1 * 1 * .4096 = .4096 Probability P1 of 1 user transmitting = combine(4,1) * p^1 *q^(4-1) = 4 * .2 * .512 = .4096 Probability P2 of 2 users transmitting = combine(4,2) * p^2 * q^(4-2) = 6 * .04 * .64 = .1536 Probability P3 of 3 users transmitting = combine(4,3) * p^3 * q^(4-3) = 4 * .008 * .8 = .0256 Thus probability of no queue i.e. up to 3 users transmitting = P0 + P1 + P2 _ P3 = .4096+.4096+.1536+.0256 = 0.9984 When number of users increase to 5, the probability value will change as follows P0 = .32768 (1 * .2^0 * .8^(5-0) P1 = .4096 (5 * .2^1 * .8^(5-1) P2 = .2048 (10 * .2^2 * .8*(5-2) P3 = .0512 (10 * .2^3 * .8^(5-3) thus total probability of no queuing with 5 users = .99328 The probability of no queuing decreases. This is because total number of users has increased, the probability of more users transmitting are high and thus probability of no queuing is likely to decrease	
Q3	Compute the minimum distribution time when a file of 25MBytes is to be transferred from a server to 50 peers using P2P communication architecture. The network has following characteristics. Each peer transmits data using a chunk size of 2 Mbits. The server upload speed is 10 Mbps. Each of the peer has upload speed of 2Mbps and download speed of 8Mbps. Assume there are no processing delay and no protocol overheads.	10
Scheme	2 marks for computing number of chunks 2 marks identifying 5 peers to receive 1 chunk each in first second 1 mark : time a peer takes to transmit(send) one chunk to another peer 5 marks: computing the total time	
Answer	File size: 25MB Chunk Size: 2Mbits Number of chunks in file = 25*8/2 = 100	

	Thus, number of chunks each peer needs = 100 Total number of chunks to be transmitted in the network = 100*50 = 5000 Upload speed of peer = 2Mbps Download speed of peer = 8Mbps (does not really play any role) Total bits to be transferred in network: 200Mbits*50 = 10000Mbits Cumulative Network upload speed (when all peers transmit) = 10+50*2 = 110Mbps Minimum distribution time – 10000Mbits/110Mbps = 90.9s Time to transmit(send) one chunk by one peer to another = 2Mbits/2Mbps = 1s Number of chunks server can transmit in 1s = 10Mbps/2Mbits = 5 Approach: To speed up distribution time, implement an approach that makes all peers active i.e. have some chunks as soon as possible so that each peer can start (uploading) sharing chunks. Thus, when all 50 peers receive some chunks, then network can work at full capacity i.e. upload 55 chunks (5 from Server, 50 from peers) in each second. During second 1, 5 chunks are transmitted: 5 new peers receive one chunk each from server. During second 2, 10 chunks are transmitted: 5 new peers receive chunks from server, 5 new from existing peers. Thus, total active peers become 15 (5+5+5)), and total chunks transmitted = 15 During second 3, 20 chunks are transmitted: 5 new peers receive from server, 15 new peers receive from existing peers. Total active peers become 35 (15+5+15), and total chunks transmitted = 35 During second 4, 40 chunks are transmitted: 5 new peers receive from Server, 10 new peers receive from existing peers and 25 peers exchange among themselves. Total chunk transmitted are 75. During second 5, 55 chunks are transmitted: 5 from server, all 50 peers exchange among themselves. From this time onwards, during each 1 second interval, 55 chunks are transmitted. Total chunks transmitted are 130 (=75+35). Now remaining number of chunks to be transmitted are 5000-130=4870. Thus time needed to transmit these chunks = ceiling(4870/55) = ceiling(88.54) = 89s. Thus minimum distribution time = 89+5 = 94s.	
Q4	Suppose you are using POP3 to download the emails to your desktop (client) from a mail server using username as ISE and password as PESIT. Consider that before starting the session, your mailbox on the server has 2 emails (of size 1000 bytes). For the following two communication sessions between desktop client and mail server, specify the protocol communication (commands) in proper sequential order to access email from the mailbox on the server. i. In the first session, client retrieves 2 emails and deletes only first one.	10

	ii. In the second session client retrieves all the emails and deletes all the emails. However, before 2nd session starts, 3 new emails (of size 1500 bytes) have been added to the mailbox on the server.	
Scheme	1 mark for username/password in first session 1 mark for listing command and its response 2 marks for retrieving 2 emails 1 mars for deleting 1st email. 1 marks for username/password in second session 1 mark for listing output 2 marks for retrieving all 4 emails 1 marks for deleting all 4 emails	
Answer	Communication during first session. "C:" represents client, and "S:" represents mail server. Client connects to server on port 100 S: +OK server ready C: user ISE S: +OK C: pass PESIT S: +OK C: list S: 1 1000 S: 2 1000 S: . C: retr 1 S: <message 1 contents> S: . C: dele 1 C: retr 2 S: <Message 2 contents> S: . C: quit S: +OK At this time, mailbox on server has only 1 message. Before the next client sessions, 3 new emails have arrived. So, communication during 2nd session when clients connects to server on port 110 is as follows: S: +OK server ready C: user ISE S: +OK C: pass PESIT S: +OK C: list S: 1 1000 S: 2 1500	

	S: 3 1500 S: 4 1500 S: . C: dele 1 C: retr 2 S: <Message 2 contents> S: . C: dele 2 C: retr 3 S: <message 3 contents> S: . C: dele 3 C: retr 4 S: <Message 4 contents> S: . C: dele 4 C: quit S: +OK	
Q5	A web browser uses maximum of 3 number of persistent connections to access the website http://www.pes.edu. Assuming the home page of www.pes.edu contains 6 embedded objects which are accessed via URLs http://www.pes.edu/obj1, ..., http://www.pes.edu/obj6. Also, assume further that first embedded object contains another 2 embedded objects to be accessed via URLs http://www.pes.edu/obj11, and http://www.pes.edu/obj12. Assume web server takes 2 seconds to serve each URL. Consider the following for retrieval of this web page. i. First request from the web browser to the web server is made at 9:45am on Sep 17, 2012 ii. All these objects are accessed using HTTP GET method. iii. The browser sends at least one header field i.e. "Host: www.pes.edu" in its request message iv. The web server sends at least following two headers in its response message a. Server: Apache2.2 b. Date: DDD, DD MMM YYYY HH:MM:SS , where DDD corresponds to Day of the week (e.g. Mon, Tue, …,) DD corresponds to Date of the month (e..g 01, 02, …), MMM corresponds to Month (e.g. Jan, Feb, …), YYYY corresponds to year (e.g. 2012), HH:MM:SS corresponds to hours, minutes and seconds v. The object http://www.pes.edu/obj12 does not exist i.e. removed from server vi. The object http://www.pes.edu/obj5 has been moved to http://pesit.pes.edu/ise Provide the complete HTTP protocol communication (including all headers and data) between browser and web server for each connection. For the data part of webserver response, just put "XYZ…" as the content.	10

Scheme	1 mark for creating 3 connection 1 mark for keeping the header Connection: keep-alive in each connection 1 mark for status code 302 (or 301) in response to obj5 1 mark for status code 404 in response to obj12 1 mark for making another request to redirected URL http://pesit.pes.edu 3 marks (1 mark each) for making requests in proper order and proper order 1 mark for keeping responding with proper value of Date: field with updated values 1 mark for not putting the data XYZ… in response to obj12 and obj5
Answer	To access webpage www.pes.edu, browser makes the first connection to the server and receive web page consisting of 6 embedded objects. Since browser makes 3 persistent connection, on the same connection it will a request for obj-1, and opens another two connection and requests for obj2 and obj3 respectively. Assuming the responses are received in the order requests are made, it will request obj4 on connection-1, obj5 on connection-2 and obj6 on connection-3. Subsequently, it will request obj11 on connection-1 and obj12 on connection-2. When response of obj5 comes back, it will contain status code of 302 and it will make new request to retrieve URL pesit.pes.edu/ise on the next available connection i.e. connection-3. Response to request for obj12 on connection-2 will result in HTTP Status code of 404 (file Not found). Thus, the HTTP communication on each connection will look as follows Communication on Connection-1 GET / HTTP/1.1\r\n Host: www.pes.edu\r\n Connection: keep-alive\r\n \r\n HTTP/1.1 200 OK\r\n Date: Mon, 17 Sep 2012 09:45:02 IST\r\n Connection: keep-alive\r\n \r\n XYZ… GET /obj1 HTTP/1.1\r\n Host: www.pes.edu\r\n Connection: keep-alive\r\n \r\n HTTP/1.1 200 OK\r\n Date: Mon, 17 Sep 2012 09:45:04 IST\r\n Connection: keep-alive\r\n \r\n XYZ… GET /obj4 HTTP/1.1\r\n Host: www.pes.edu\r\n Connection: keep-alive\r\n

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\r\n
HTTP/1.1 200 OK\r\n
Date: Mon, 17 Sep 2012 09:45:10 IST\r\n
Connection: keep-alive\r\n
\r\n
XYZ…
GET /obj11 HTTP/1.1\r\n
Host: www.pes.edu\r\n
Connection: keep-alive\r\n
\r\n
HTTP/1.1 200 OK\r\n
Date: Mon, 17 Sep 2012 09:45:16 IST\r\n
Connection: keep-alive\r\n
\r\n
XYZ…

Communication on Connection-2
GET /obj2 HTTP/1.1\r\n
Host: www.pes.edu\r\n
Connection: keep-alive\r\n
\r\n
HTTP/1.1 200 OK\r\n
Date: Mon, 17 Sep 2012 09:45:06 IST\r\n
Connection: keep-alive\r\n
\r\n
XYZ…
GET /obj5 HTTP/1.1\r\n
Host: www.pes.edu\r\n
Connection: keep-alive\r\n
\r\n
HTTP/1.1 302 Moved \r\n
Date: Mon, 17 Sep 2012 09:45:12 IST\r\n
Connection: keep-alive\r\n
Location: http://pesit.pes.edu/ise\r\n
\r\n
The document has moved
GET /obj12 HTTP/1.1\r\n
Host: www.pes.edu\r\n
Connection: keep-alive\r\n
\r\n
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	HTTP/1.1 404 File Not Found\r\n Date: Mon, 17 Sep 2012 09:45:18 IST\r\n Connection: keep-alive\r\n \r\n File Not Found Communication on Connection-3 GET /obj3 HTTP/1.1\r\n Host: www.pes.edu\r\n Connection: keep-alive\r\n \r\n HTTP/1.1 200 OK\r\n Date: Mon, 17 Sep 2012 09:45:08 IST\r\n Connection: keep-alive\r\n \r\n XYZ… GET /obj6 HTTP/1.1\r\n Host: www.pes.edu\r\n Connection: keep-alive\r\n \r\n HTTP/1.1 200 OK \r\n Date: Mon, 17 Sep 2012 09:45:14 IST\r\n Connection: keep-alive\r\n \r\n XYZ… GET /ise HTTP/1.1\r\n Host: pesit.pes.edu\r\n Connection: keep-alive\r\n \r\n HTTP/1.1 200 OK \r\n Date: Mon, 17 Sep 2012 09:45:20 IST\r\n Connection: keep-alive\r\n \r\n XYZ… Alternatively, after request obj1, obj2, and obj3, it can also request obj11 on connection-1, and obj-12 on connection-2 and obj-4 on connection-3,and subsequently obj5 on connection-1 and obj6 on connection-2 and since obj5 response will contain 302, it will make another request for pesit.pes.edu/ise on on either connection-3 or connection-1.