CS:307 Computer Networks
CS-Department (FAST-NUCES)
Final (Spring 2015)

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Total Marks: 120 points **Time Limit: 180 mins**

Guidelines:

- **Attempt all the questions in the answer script including the MCQs.**
- **Attempt the questions in proper sequence if you would like them to be graded.**

Section 1: MCQs [10 points]

1: Buffer at the router stores the packets and helps avoiding the packet loss in case packet arrival rate is higher than the processing rate, it is implemented at:

a) Input Port
b) Switching Fabric
c) Output Port
d) Both A & C

2: Typical Length of IP Version 4 Datagram is

a) 32 Bytes
b) 40 Bytes
c) 20 Bytes
d) 16 Bytes

3: What will be the subnet mask of IP 172.30.118.230/23

a) 255.2555.240.0
b) 255.255.255.240
c) 255.255.254.0
d) 255.255.0.0

4: What packet will be sent by a client who wants to get an IP address over the network, if IP of the DHCP server is unknown?

a) DHCP Request
b) DHCP Discover
c) DHCP Find
d) DHCP Search

5: In spanning tree creation

a) Each node sends the broadcast message to all nodes in its routing table.
b) Each node sends the unicast join message to a node with least cost path.
c) Each node sends a broadcast discover message to discover the center node.
d) Each node sends the unicast join message to the center node.

6: Slotted Aloha is:

a) Less efficient than pure Aloha
b) A Single node can use the full bandwidth of the channel
c) No chances of collision because of the time slots
d) All of the Above

7: Protocols avoid collision:

a) CSMA
b) ALOHA
c) Polling
d) CSMA/CD

8: Following is one of the error correcting method

a) CRC
b) Checkum
c) Uni dimensional parity
d) Two dimensional parity

9: Internet transport-layer protocols provide delay and bandwidth guarantees.

a) True
b) False

10: Network layer protocols must be defined in every router

a) True
b) False

Section 2: Problem Set

2.1 Consider an application that transmits data at a steady rate (for example, the sender generates an *N*-bit unit of data every *k* time units, where *k* is small and fixed). Also, when such an application starts, it will continue running for a relatively long period of time. Answer the following questions, briefly justifying your answer: [5 points]

a) Would a packet-switched network or a circuit-switched network be more appropriate for this application? Why?
b) Suppose that a packet-switched network is used and the only traffic in this network comes from such applications as described above. Furthermore, assume that the sum of the application data rates is less than the capacities of each and every link. Is some form of congestion control needed? Why?

2.2. Can you configure your browser to open multiple simultaneous connections to a Web site? What are the advantages and disadvantages of having a large number of simultaneous TCP connections? [5 points]

2.3. Assume a UDP transport has received a datagram which consists of the following 16- bit words and the given checksum. Please verify the checksum. [5 points]

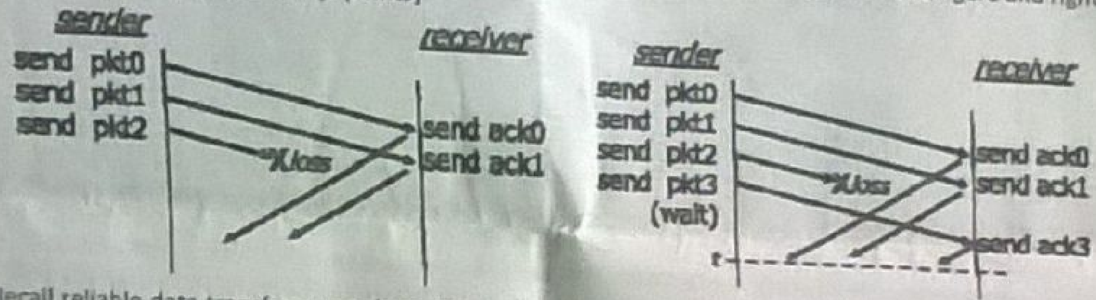
- 1010 1010 1010 1010 (1st 16 bit word)
- 1011 1011 1011 1011 (2nd 16 bit word)
- 1100 1100 1100 1100 (3rd 16 bit word)
- 1110 1100 1100 1100 (received checksum)

2.4. TCP Congestion Control. Suppose that in TCP, the sender window is of segment size $N = 200$, the base of the window is at sequence number 600, and the sender has just sent a complete window size of segments. Let RTT be the sender-to-receiver-to-sender round trip time of 200 ms and Maximum Segment Size MSS = 1 000 bytes. [5 points]

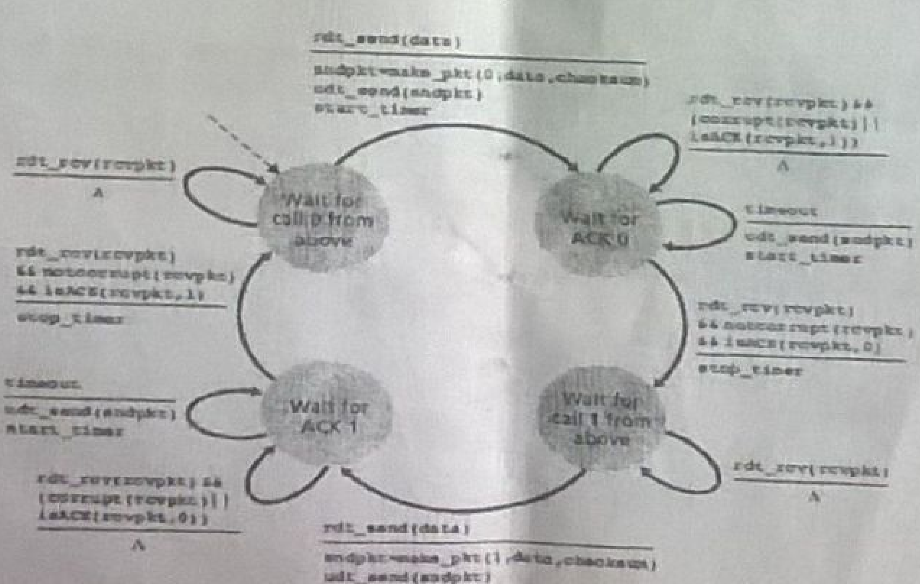
a) Assuming no loss, what is the throughput (in terms of MSS and RTT and in terms of Megabit/s) of this message exchange?

b) Suppose TCP is in its congestion avoidance phase. Assuming no loss, what is the window size (in terms of segment) after the $N = 200$ segments are acknowledged?

2.5. Consider the sliding window protocol in the following figures. Do these figures indicate that Go-Back-N is being used, Selective Repeat is being used, or there is not enough information to tell? Use left hand figure and right hand figure as reference in your answer. [6 points]



2.6. Recall reliable data transfer over a lossy channel with bit errors: rdt 3.0. In case of packet losses the protocol uses a time based retransmission mechanism which requires a countdown timer which interrupts the sender after a given timeout. Hence in such a protocol the sender will need be able to a) start the timer each time a packet (either a first-time packet or a retransmission) is sent b) respond to a timer interrupt (taking appropriate actions) c) stop the timer. Given the FSM (Finite State Machine) of a sender in the figure below please provide the FSM (Finite State Machine) of the receiver. [10 points]



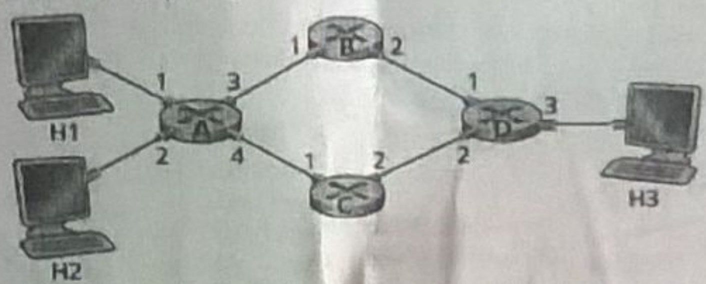
2.7. A provider has been assigned the network 128.30.0.0/23 and wants to divide it among three customers. Customer A needs to accommodate up to 220 hosts, customer B needs to accommodate up to 110 hosts and customer C needs to accommodate up to 80 hosts. Fill the following table in your answer script with the details of the sub-networks that the provider can create to fit its customers' needs. [5 points]

Subnet No.	Network Addr	Netmask	Host Range	No. Of Hosts
Cust. A				
Cust. B				
Cust. C				

2.8. Convert the following IP addresses into their binary notion or decimal notion: [6 points]

- 134.76.249.227
- 192.168.0.1
- 11100011100001100000111110101010

2.9. Consider the network below. [8 points]



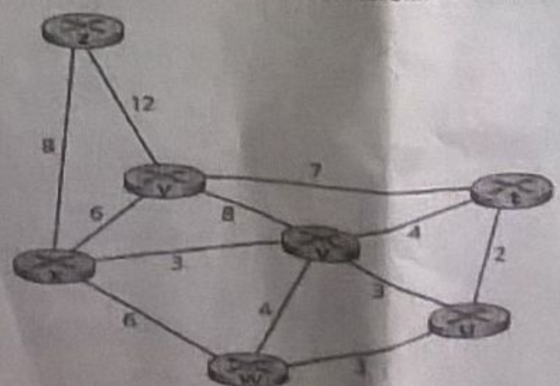
a) Suppose that this network is a datagram network. Show the forwarding table in router A, such that all traffic destined to host H3 is forwarded through interface 3.

b) Suppose that this network is a datagram network. Can you write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4? (Hint: this is a trick question.)

c) Now suppose that this network is a virtual circuit network and that there is one ongoing call between H1 and H3, and another ongoing call between H2 and H3. Write down a forwarding table in router A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4.

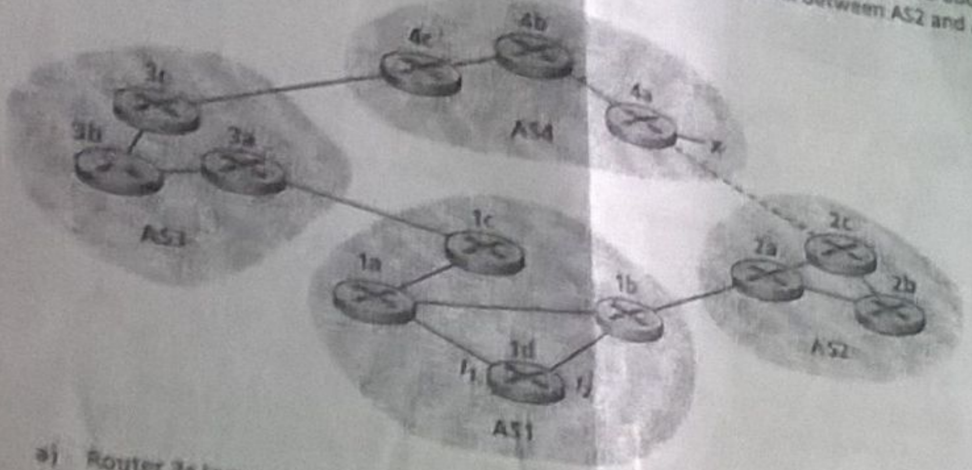
d) Assuming the same scenario as (c), write down the forwarding tables in nodes B, C, and D.

2.10. Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from x to all network nodes. State of initial routing table is shown below. [10 points]



STEP	Node	D(s),p(s)	D(t),p(t)	D(u),p(u)	D(v),p(v)	D(w),p(w)	D(x),p(x)	D(y),p(y)
0	x	∞	∞	∞	∞	∞	∞	∞

2.11. Consider the network shown below. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is no physical link between AS2 and AS4. Answer the following questions. (8 points)



a) Router 3c learns about prefix x in AS4 from which routing protocol: OSPF, RIP, eBGP, or iBGP?
b) Router 3a learns about x from which routing protocol?
c) Router 1c learns about x from which routing protocol?
d) Router 1d learns about x from which routing protocol?

2.12. A Packet is divided into fragments if MTU (Maximum Transfer Unit) of the link is smaller than the size of datagram. How does IP Version 6 address this problem if the MTU size is smaller than the length of the datagram? (5 points)

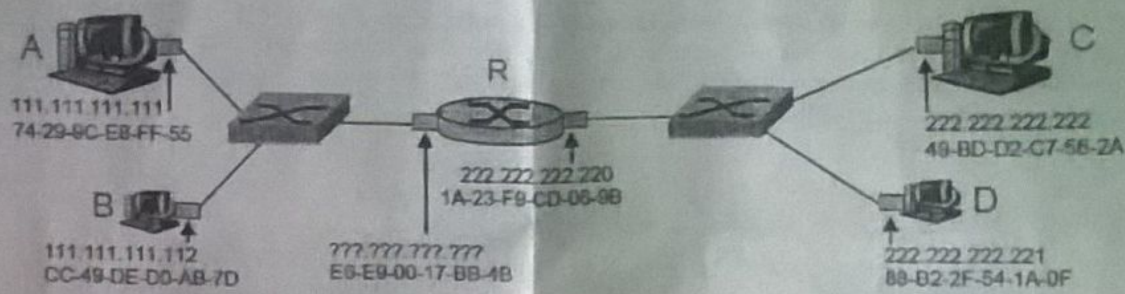
2.13. A 1000 byte packet is sent from your home to a server. It is first sent over a 1 Mbps cellular link. Once it has been received completely, it is then sent over a 100 Mbps ISP link. The propagation delay of the cellular link is 1 ms and the propagation delay of the ISP link is 5 ms. How long does it take for the packets to reach the server? (5 points)

2.14. Assume you have a 4,000 byte long datagram (20 bytes of IP + 3980 bytes of Payload) which needs to be fragmented for a 1,500 bytes MTU. Fill the following table in your answer script. (5 points)

No.	Length	Frag Flag	Offset = (MTU Header/8)

2.15. Calculate the CRC Checksum of D = 0101 1101 1010 0101 1110 0000. Use the 4 bit generator G = 1101 (6 points)

2.16. Consider the LAN scenario below and answer each question *briefly*, e.g., *in a few words or a sentence or two at most.* (Really, please be brief) [16 points]



a) Assign an IP address to the leftmost interface of the router, given that the subnet part of IP addresses are 24 bits.

b) Suppose A wants to send an IP datagram to B and knows B's IP address. Must A also know B's MAC address to send the datagram to B? If so, how does A get this info? If not, explain why not.

c) Suppose A wants to send an IP datagram to C and knows C's IP address. Must A also know C's MAC address to send the datagram to C? If so, how does A get this info? If not, explain why not.

d) Suppose that R has a datagram (that was originally sent by A) to send to C. What are the MAC addresses on the frame that is sent from R to C? What are the IP addresses in the IP datagram encapsulated within this frame?

e) Suppose the switches above are learning switches and suppose that the switch has just been turned on. Suppose now A sends an Ethernet frame to B.
   i. On how many outgoing switch interfaces will this first frame be carried?
   ii. Now suppose that B replies to A and A sends a second frame to B. On how many outgoing switch interfaces will this second frame be carried?

Suppose now (for the two questions below) that the router is removed from the scenario above

f) Can the nodes keep their IP addresses the same as shown in the picture above? Explain in one or two sentences.

g) Suppose that the network manager wants to assign A and C to the same VLAN and B and D to a different VLAN. When a frame is forwarded between switches, how does the receiving switch know which VLAN the frame is destined to?