Name: ______________________________ J#: ___________________

Jackson State University
CSC 435/CSC 524 Computer Networks, Spring 2020
Instructor: Dr. Natarajan Meghanathan
Exam 3
Due: March 30th, (Monday), 11.59 PM in Canvas **Maximum Points: 100**

Note: If I find that two or more students have copied the answers for even one question, everybody involved in this activity will get a ZERO for the ENTIRE EXAM. There should be strictly NO COPYING.

Note: You need to use this document and submit your answers in the space provided in one of the following ways.

Submission Options (choose one of the three): You can either

(a) Print this exam, write the solutions in the space provided, scan and upload as a PDF file or

(b) Use the space provided to type the solutions, save the file to a word or PDF and upload or

(c) Write the solutions for some questions by hand and type the solutions for some other questions. In this case, you should scan the written text to a PDF file, merge it with the PDF file for the typed content and submit everything together as a single PDF file.

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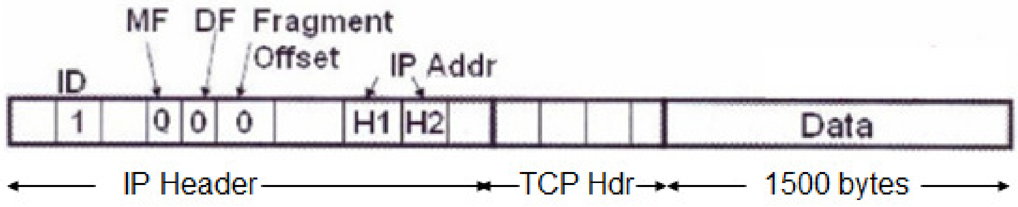
Q1) (15 pts) Consider fragmenting the IP datagram shown below. Show the structure of all the fragments of this datagram along with the values for the MF bit, DF bit, Offset field, the starting and ending byte number for the portion of actual data in each fragment. Assume the Maximum Transmission Unit (MTU) of the network is 512 bytes. Use the minimum size value for the IP header and TCP header.



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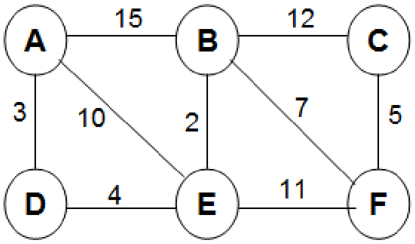
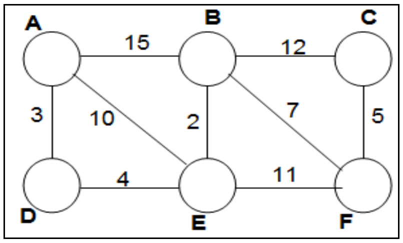
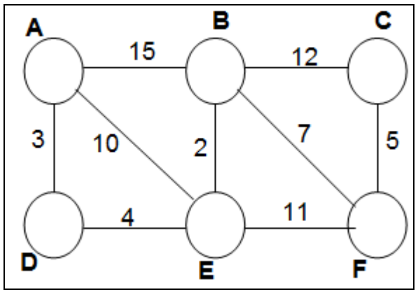
Q2) (16 pts) Consider the weighted network graph shown below. Let the edge weights to be bandwidth (in Mbps). Determine the largest bottleneck paths from vertex A to every other vertex in the graph.



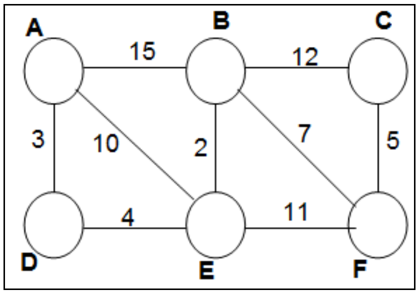
Given Graph



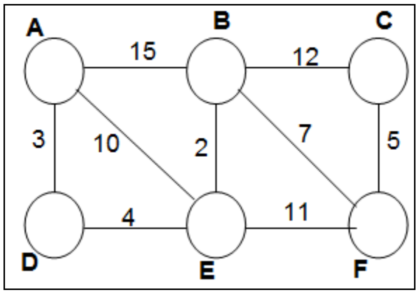
Initialization



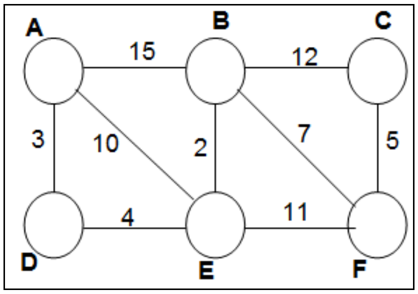
Iteration 1



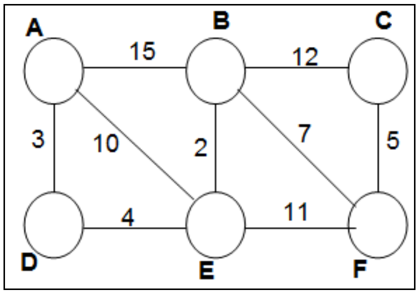
Iteration 2



Iteration 3



Iteration 4



Iteration 5

Largest Bottleneck Path Tree

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Q3) (12 pts) Suppose a router has built up the routing table shown in the following table. The router can deliver packets directly over interfaces 0 and 1, or it can forward packets to routers R1, R2 or R3.

Network Prefix/ Destination Network	**Subnet Mask**	**Next Hop**
189.145.60.0	255.255.255.128	Local Interface 0
189.145.60.128	255.255.255.128	Local Interface 1
189.145.67.0	255.255.255.192	R1
189.145.67.128	255.255.255.192	R2
Default		R3

Determine what the router does with a packet addressed to each of the following destinations:

(a) 189.145.60.225

(b) 189.145.67.225

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Q4) (18 pts) Assume a full 5-ary rooted multicast tree of height 8, where each intermediate node has exactly 5-children and the root node is at height 0. If all the leaf nodes of this tree are part of the multicast group and the root node is the sender, compute the number of link transmissions involved in multicasting vs. multiple unicasting.

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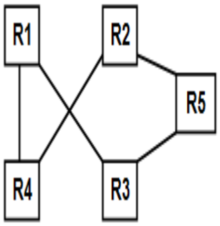
Q5) (18 pts) Use the Distance Vector routing protocol to determine the routing table at the routers shown for the internetwork below.



Routing Tables at Time Slot 0

R1

R1		
R2		
R3		
R4		
R5		

R2

R1		
R2		
R3		
R4		
R5		

R3

R1		
R2		
R3		
R4		
R5		

R4

R1		
R2		
R3		
R4		
R5		

R5

R1		
R2		
R3		
R4		
R5		

Routing Tables at Time Slot 1

R1

R1		
R2		
R3		
R4		
R5		

R2

R1		
R2		
R3		
R4		
R5		

R3

R1		
R2		
R3		
R4		
R5		

R4

R1		
R2		
R3		
R4		
R5		

R5

R1		
R2		
R3		
R4		
R5		

Routing Tables at Time Slot 2

R1

R1		
R2		
R3		
R4		
R5		

R2

R1		
R2		
R3		
R4		
R5		

R3

R1		
R2		
R3		
R4		
R5		

R4

R1		
R2		
R3		
R4		
R5		

R5

R1		
R2		
R3		
R4		
R5		

Routing Tables at Time Slot 3

R1

R1		
R2		
R3		
R4		
R5		

R2

R1		
R2		
R3		
R4		
R5		

R3

R1		
R2		
R3		
R4		
R5		

R4

R1		
R2		
R3		
R4		
R5		

R5

R1		
R2		
R3		
R4		
R5		

Finalized Routing Tables (after **minimizing the # entries using default entry**, as and when possible):

R1	R2	R3	R4	R5

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Q6) (21 pts) Let an IP packet is fragmented into 15 fragments, each with a 2% (independent probability) of loss.

(a) With one transmission of all the 15 fragments, what is the probability of losing the whole packet due to the loss of a fragment?

Also, what is the probability of loss of the whole packet if the packet is transmitted twice,

- (b) assuming all fragments received must have been part of the same transmission?
- (c) assuming any given fragment may have been part of either transmission?