Question 1: MCQs – Set # 1 [20 Marks]

S. No.	A	B	C	D	E	S. No.	A	B	C	D	E
01		X				21				X	
02		X				22			X		
03	X					23				X	
04			X			24	X				
05				X		25	X				
06			X			26				X	
07	X					27			X		
08	X					28		X			
09	X					29			X		
10				X		30	X				
11		X				31	X				
12	X					32	X				
13				X		33	X				
14			X			34		X			
15		X				35	X				
16			X			36	X				
17	X					37	X				
18			X			38	X				
19			X			39			X		
20			X			40	X				

Question 2 (part-a) [10 Marks]

1.
Subnet 1:

- Router 1 Interface 0: 192.168.1.1
- Host A: 192.168.1.2
- Host B: 192.168.1.3

Subnet 2:

- Router 1 Interface 1: 192.168.2.1
- Router 2 Interface 0: 192.168.2.2
- Host C: 192.168.2.3
- Host D: 192.168.2.4

Subnet 3:

- Router 2 Interface 1: 192.168.3.1
- Host E: 192.168.3.2
- Host F: 192.168.3.3

2.

Assigning MAC addresses to the adapters:

- Router 1 Interface 0: MAC_A
- Router 1 Interface 1: MAC_B
- Router 2 Interface 0: MAC_C
- Router 2 Interface 1: MAC_D
- Host A: MAC_E
- Host B: MAC_F
- Host C: MAC_G
- Host D: MAC_H
- Host E: MAC_I
- Host F: MAC_J

3.

Steps for sending an IP datagram from Host E to Host B:

1. Host E checks its ARP table to find the MAC address for 192.168.3.1 (Router 2 Interface 1). Suppose the MAC address is MAC_D.
2. Host E encapsulates the IP datagram destined for Host B inside an Ethernet frame.
    - Source IP: 192.168.3.2 (Host E's IP address)
    - Destination IP: 192.168.1.3 (Host B's IP address)

    - Source MAC: MAC_I (Host E's MAC address)
    - Destination MAC: MAC_D (Router 2 Interface 1's MAC address)
3. Host E sends the Ethernet frame onto its LAN.
4. The Ethernet frame reaches Router 2 Interface 1.
5. Router 2 checks its ARP table to find the MAC address for 192.168.1.3 (Host B). Suppose the MAC address is MAC_F.
6. Router 2 encapsulates the received Ethernet frame inside a new Ethernet frame.
    - Source IP: 192.168.3.1 (Router 2 Interface 1's IP address)
    - Destination IP: 192.168.1.3 (Host B's IP address)
    - Source MAC: MAC_D (Router 2 Interface 1's MAC address)
    - Destination MAC: MAC_F (Host B's MAC address)
7. Router 2 sends the new Ethernet frame onto its LAN.
8. The Ethernet frame reaches Host B.
9. Host B receives the frame, extracts the IP datagram, and processes it.

Question 2 (part-b) [10 Marks]

Solution:
The full solution for figure 1 is shown below:

10001111 01110101 0
00010000 10100110 1
00110111 00000111 0
00111010 00001011 1
10111001 00001010 1
00101011 11010101 1

1. The parity bits for the 16 columns is: 00101011 11010101

2. The parity bits for the 5 rows is: 01011

3. The parity bit for the parity row is: 1

4. The bit that was flipped in figure 2 is (9,2):

00111111 10001100 1
01000010 11110110 0
00000111 01110000 1
00000001 11110100 0
11101110 01000100 0
10010101 11111010 0

5. Yes, with 2D parity, you can detect and correct a single flipped bit

Question 3: MCQs – Set # 2 [15 Marks]

S. No.	A	B	C	D	E	S. No.	A	B	C	D	E
41					X	56		X			
42	X					57	X				
43				X		58	X				
44				X		59			X		
45				X		60			X		
46	X					61				X	
47	X					62				X	
48					X	63	X				
49			X			64				X	
50			X			65			X		
51	X					66				X	
52			X			67			X		
53			X			68				X	
54		X				69			X		
55				X		70			X		

Question 4 [10 Marks]

After obtaining first SampleRTT 106 ms:
DevRTT = 0.75*5 + 0.25 * | 106 - 100 | = 5.25 ms
EstimatedRTT = 0.875 * 100 + 0.125 * 106 = 100.75 ms
TimeoutInterval = 100.75+4*5.25 = 121.75 ms

After obtaining 120 ms:
DevRTT = 0.75*5.25 + 0.25 * | 120 – 100.75 | = 8.75 ms
EstimatedRTT = 0.875 * 100.75 + 0.125 * 120 = 103.16 ms
TimeoutInterval = 103.16+4*8.75 = 138.16 ms

After obtaining 140 ms:
DevRTT = 0.75*8.75 + 0.25 * | 140 – 103.16 | = 15.77 ms
EstimatedRTT = 0.875 * 103.16 + 0.125 * 140 = 107.76 ms
TimeoutInterval = 107.76+4*15.77 = 170.84 ms

Question 5: MCQs – Set # 3 [10 Marks]

S. No.	A	B	C	D	E	S. No.	A	B	C	D	E
71	X					81		X			
72			X			82	X				
73			X			83	X				
74		X				84			X		
75			X			85		X			
76	X					86	X				
77				X		87			X		
78				X		88				X	
79		X				89		X			
80			X			90		X			

Question 6 [25 Marks]

Question 6 (part-a) [10 Marks]

1. The address 160.24.10.0/24 is public.

2. Maximum number of hosts = 2^x - 2 = 2^8 - 2 = 254. The reason we have to subtract 2 from the final number is because there are always 2 addresses allocated for each address block: the subnet ID (the first address) and the broadcast address (the last address); for example, if you have 5 bits for hosts, you can have 30 hosts, because 2 of the addresses are for the subnet ID and the broadcast address which when added equals 32, which is 2^5.

3. Subnet A has 21 hosts, so it will need at least 23 addresses (for the subnet ID and broadcast address). The least number of bits that satisfy this is 5 bits. Knowing that, we take the prior subnet and add 32, the result of which is 160.24.10.64/27

4. The broadcast address of subnet A (160.24.10.64/27) is 160.24.10.95, because it is the last address in the IP range.

5. The first IP address of subnet A (160.24.10.64/27) is 160.24.10.65, found by adding 1 to the subnet address.

6. The last IP address of subnet A (160.24.10.64/27) is 160.24.10.94, found by subtracting 1 from the broadcast address (160.24.10.95).

7. Similar to the prior subnet, subnet B has 45 hosts, so it will need at least 47 addresses (for the subnet ID and broadcast address). The least number of bits that satisfy this is 6 bits. Knowing that, we take the prior subnet and add 64, the result of which is 160.24.10.0/26

8. The broadcast address of subnet B (160.24.10.0/26) is 160.24.10.63, because it is the last address in the IP range.

9. The first IP address of subnet B (160.24.10.0/26) is 160.24.10.1, found by adding 1 to the subnet address.

10. The last IP address of subnet B (160.24.10.0/26) is 160.24.10.62, found by subtracting 1 from the broadcast address (160.24.10.63).

Question 6 (part-b) [15 Marks]:

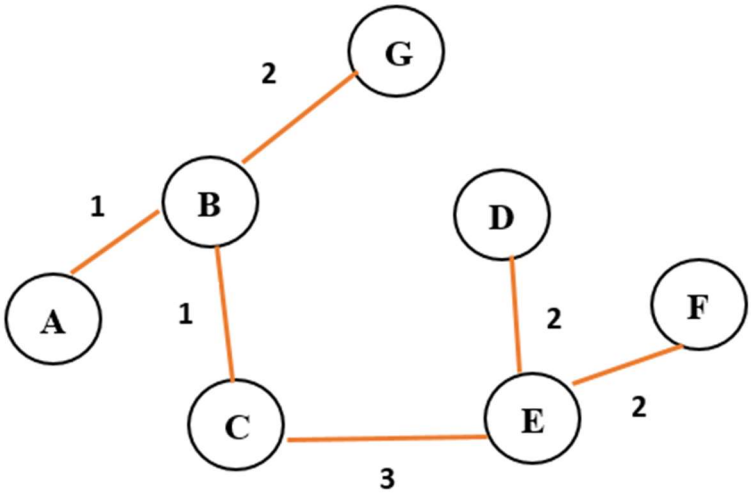
Show your steps in the table below [12 Marks].

		B	**C**	**D**	**E**	**F**	**G**
Step	N'	D(B),P(B)	P(C), P(C)	D(D),P(D)	D(E),P(E)	D(F),P(F)	D(G),P(G)
0	A	1, A	3, A	∞	∞	10, A	∞
1	AB		2, B	8, B	6,B	10, A	3, B
2	ABC			8, B	5, C	10, A	3, B
3	ABCG			8, B	5, C	10, A	
4	ABCGE			8,B		7, E	
5	ABCGEF			7, E			
6	ABCGEFD						
…							
…							

1) List the vertices in the order which you marked them known [1 Mark].

   ABCGEFD

2) Draw the shortest path tree from node A [1 Mark].



3) Fill out the following forwarding table for A to all the destination nodes [1 Mark].

Destination	Link
B	(A, B)
C	(A, B)
D	(A, B)
E	(A, B)
F	(A, B)
G	(A, B)