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Course Code: CS5403
Date: 21/12/21

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Solution 1)

a) 6 Mb → 1 sec

(19.5 MB * 8) Mb → (time for Computer to transmit data) ??

time for Computer to transmit data = total bits / max trans rate

$$= \frac{19.5\ MB \times 8\ bits/byte}{6\ Mbps} \quad \because \left[ \frac{MBytes \times \frac{bits}{Byte}}{Mb} \right]$$

$$= \frac{156\ Mb}{6\ Mb/s}$$

= 26 S

4 Mb → 1 sec

actual data sent on network → 26 sec

actual data sent on network in 26 sec = network rate × 26 S

= 4 Mb/S × 26 S

= 104 Mbits [1 byte = 8 bits]

= 13 Mbytes

[Bucket Size = (19.5 - 13) MB]

= 6.5 MB

OR

52 Mb

Now this 52 Mb is the data which will be transmitted by computer but it cannot be transmitted by network because it is more than what network can transmit so 52Mb or 6.5MB must be saved in bucket.

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Solution 1) b).

Given frame size = 2000 bytes

transmission rate at Sender Size = 20 kbps.

Size of ack = 200 bytes

transmission rate at ~~Sender~~ Receiver Side = 26 kbps.

Propagation delay = 100ms

now the sender throughput = ?

Now, total time = Trans. time + 2* prop. time + Ack. time. ---- (1)

$$\text{Trans. time} = \frac{\text{Packet size}}{\text{Bandwidth}} = \frac{2000 \times 8}{20 \times 1000} = 0.8$$

2* prop. delay = 2* 100 ms = 0.2sec.

$$\text{Ack Time} = \frac{\text{Size of Ack}}{\text{Bandwidth}} = 0.26 \text{ sec}$$

$$\text{Total time} = 0.8 + 0.2 + 0.26$$
$$= 1.26 \text{ sec}$$

$$\text{Throughput} = \frac{\text{length of data packet}}{\text{total time}}$$

$$= \frac{2000}{1.26} = 1587.3 \text{ bytes/sec.}$$

Solution 1) c)

Go-Back-N ARQ provides for sending multiple frames before receiving the acknowledgement for the first frame. The frames also sequentially numbered and a finite number of frames. The maximum number of frames that can be sent depends upon the size of sending window. If the acknowledgement of a frame is not received within an agreed upon time period, all frames starting from that frame are retransmitted.

The size of the sending window determines the sequence number of the outbound frames.

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Solution 1) c)
Continue... If the sequence number of the frames is an n-bit field, then the range of sequence numbers that can be assigned is 0 to $2^n - 1$.
Consequently the size of the sending window is $2^n - 1$. Thus in order to accomodate a sending window size of $2^n - 1$, a n-bit sequence number is chosen.

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Solution 2)

a) Current mask = 255.255.255.0

Bits needs for 10 subnets = $4 = 2^4 = 16$ possible subnets

Bits needs for 12 hosts = $4 = 2^4 = 16 - 2 = 14$ possible hosts.

So our mask in binary = 11110000 = 240 decimal

Final mask = 255.255.255.240.

Hosts on subnets 0, 1, 2, 3, 10

- Subnet 0 host 1 IP address = 195.1.1.1 · 0000 0001
- Subnet 1 host 1 IP address = 195.1.1.17 0001 0001
- Subnet 2 host 1 IP address = 195.1.1.33 0010 0001
- Subnet 3 host 1 IP address = 195.1.~~9~~1.49 0011 0001
- Subnet 10 host 1 IP address = 195.1.1.161 1010 0001

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Solution 2> b> Total no. of host Id required for NIT PATNA

(I) $= 820\times5 + 120\times4 + 200 + 600 + 100$

$= 5460$

here $5480 < 2^{13}$

So we need 13 bits for host Id . representation.

range : 128.0.0.0 to 191.0.0.0

So, we take Class B (128 to 191) IP address, which will provide

$2^{16}-2 = 65534$ host ID

If we want to use Classless IP addressing then we can use IP address with 19 bits reserved.

For host id i.e. 32-13 (19 bits)
represent Network Id

(II) we need 12 Subnet

for major dept, no. of host id $= 820 < 2^{10}$

for minor dept, no. of host id $= 120 < 2^{7}$

For teaching dept, no. of host id $= 200 < 2^{8}$

For non-teaching dept, no. of host id $= 600 < 2^{10}$

For Guest users, no. of host id $= 100 < 2^{7}$

For 12 subnet we need 4 bits to represent subnetwork Id.

For maximum, 800 users in 1 subnet, we need 10 bits.

So, in total we require $10+4 = 14$ bits for our network division.

we can easily do it using Class B IP address.

(III) Since we are using Class B IP address and Class B network supports 65,534 hosts which is too large resulting in wastage of so many addresses.

Solution 2>c> Difference between Leaky Bucket and Token Bucket.

| Leaky Bucket | Token Bucket |
|---|---|
| 1. when the host has to send a packet, packet is thrown into bucket. | 1. In this leaky bucket holds tokens generated at regular intervals of time |
| 2. Bucket leaks at constant rate. | 2. Bucket has maximum capacity |
| 3. Bursty traffic is converted into uniform traffic by leaky bucket | 3. If there is a ready packet, a token is removed from bucket and packet is send. |
| 4. In practice bucket is a finite queue outputs at finite rate. | 4. If there is no token in bucket, packet can not be send |

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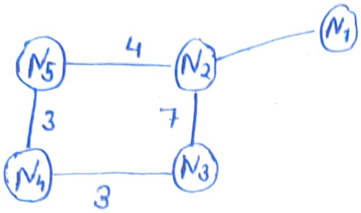
Solution 3)
a)




Distance vector for all noes at initial stage.

| For | $N_1$ | $N_2$ | $N_3$ | $N_4$ | $N_5$ |
|---|---|---|---|---|---|
| $N_1$ | 0 | 2 | x | x | x |
| $N_2$ | 2 | 0 | 7 | x | 4 |
| $N_3$ | x | 7 | 0 | 3 | x |
| $N_4$ | x | x | 3 | 0 | 3 |
| $N_5$ | x | 4 | x | 3 | 0 |

after applying distance vector routing protocols, once the vectors become stable, the distance vector table for different nodes will be updated as follows.

| For | $N_1$ | $N_2$ | $N_3$ | $N_4$ | $N_5$ |
|---|---|---|---|---|---|
| $N_1$ | 0 | 2 | 9 | 9 | 6 |
| $N_2$ | 2 | 0 | 7 | 7 | 4 |
| $N_3$ | 9 | 7 | 0 | 3 | 6 |
| $N_4$ | 9 | 7 | 3 | 0 | 3 |
| $N_5$ | 6 | 4 | 6 | 3 | 0 |

The Cost of line $N_2$ to $N_3$ reduces to 1.

So distance for $N_2$ & $N_3$ are:-

$N_2$: ( 2,0,7,7,4 )
$N_3$ : ( 2,7,0,3,6 )

∴ Distance Vector at $N_3$ after reduction

$N_1$ $N_2$ $N_3$ $N_4$ $N_5$
Ans → $N_3$ = (3, 1, 0, 3, 5)

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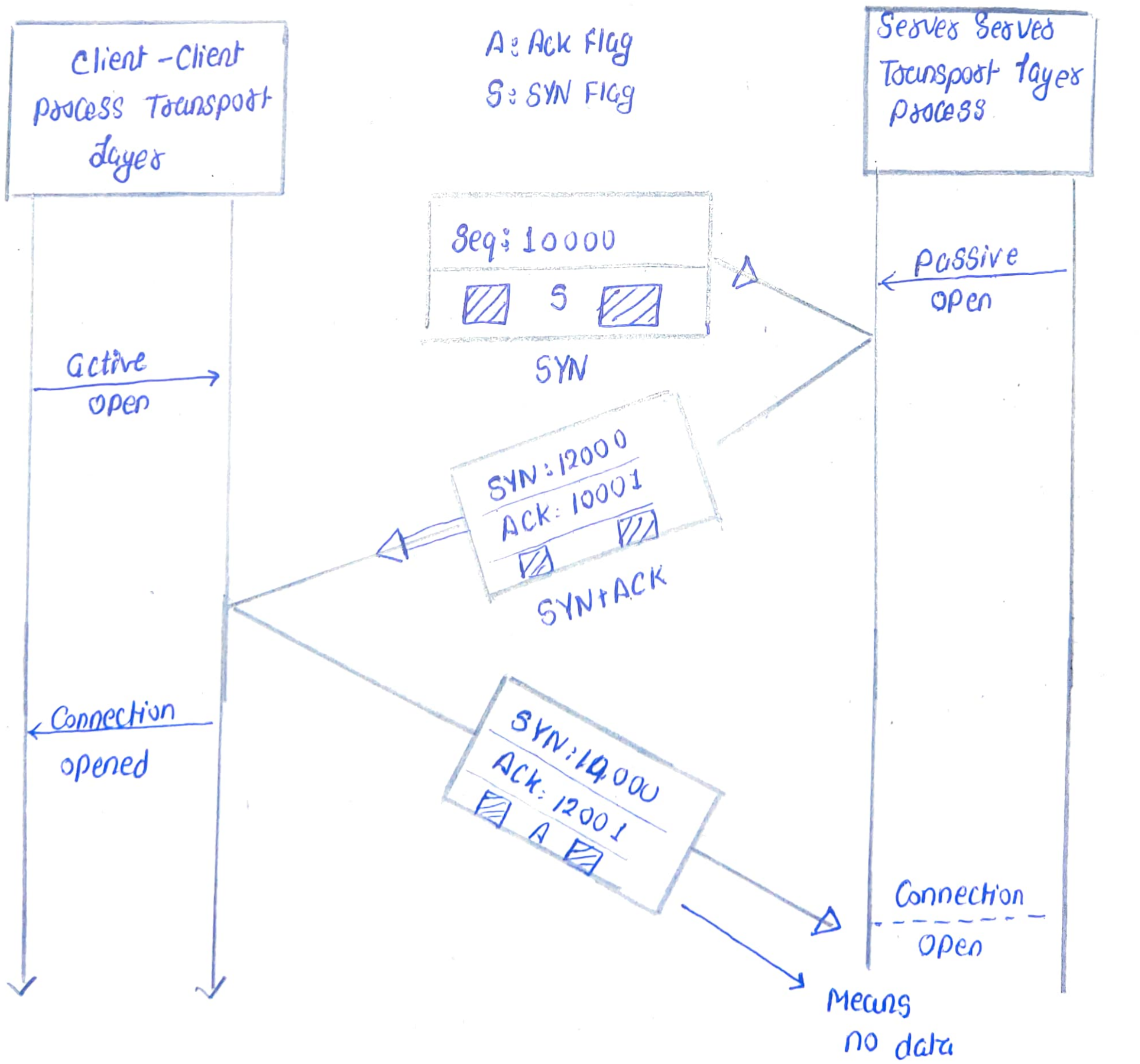
Solution 3)

b)

| | Segment No. | Range |
|---|---|---|
| Segment 1 | 10001 | 10000 to 12000 |
| Segment 2 | 12001 | 12000 to 14,000 |
| Segment 3 | 14001 | 14000 to 16,000 |
| Segment 4 | 16001 | 16,000 to 18,000 |
| Segment 5 | 18001 | 18000 to 20,000 |
| Segment 6 | 20001 | 20000 to 22,000 |

Connection Establishment



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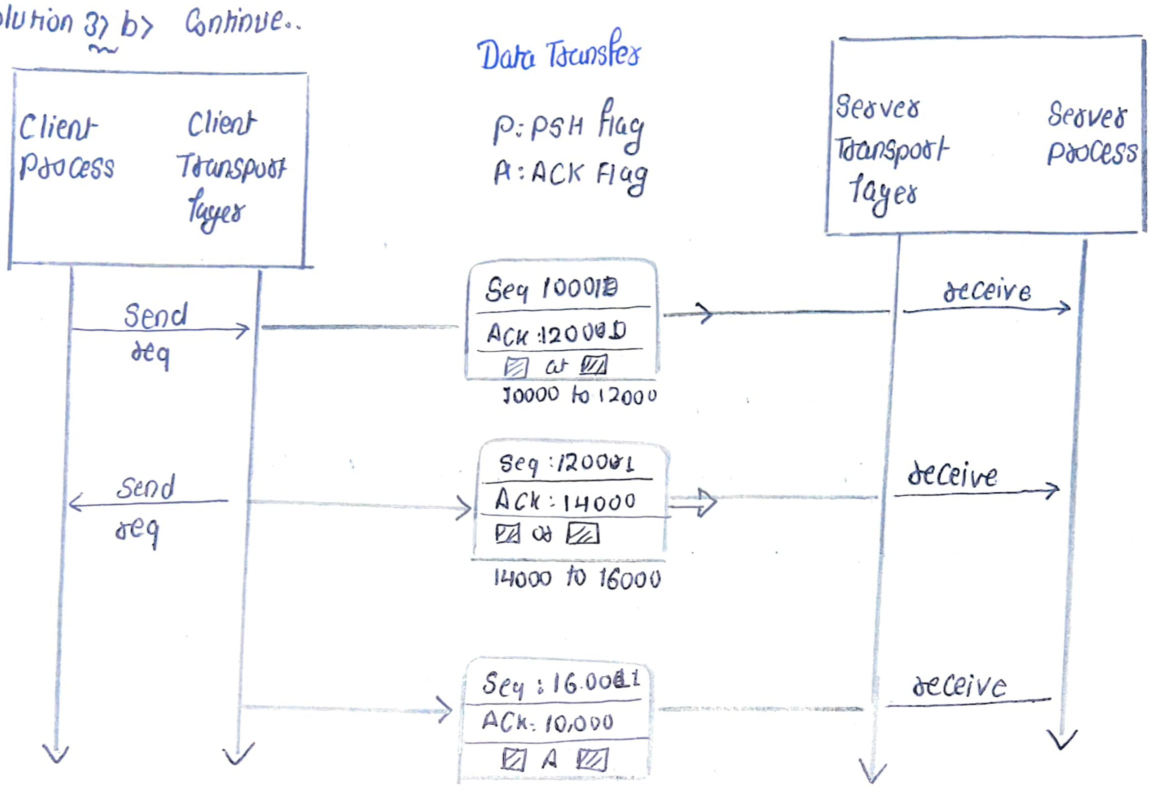
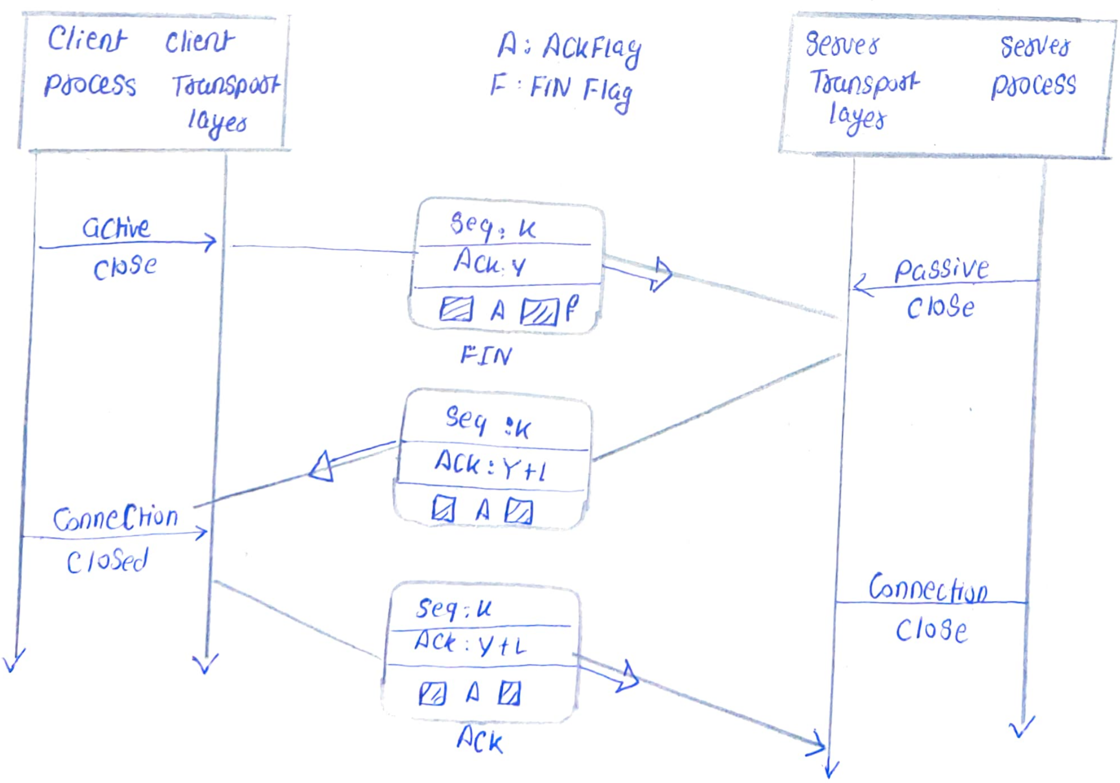
Solution 3) b) Continue..

Data Transfer




Connection Termination:



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Solution 3) C)

| Distance Vector Routing | Link State Routing |
| --- | --- |
| → Bandwidth required is less due to local sharing, small packets and no flooding. | → Bandwidth required is more due to flooding and sending large link state pakets. |
| → Based on local knowledge since it updates table based on information from neighbours. | → Based on global knowledge i.e. it have knowledge about entire network. |
| → Make use of Bellman Ford algo | → Make use of Dijkastra's algo. |
| → Traffic is less | → Traffic is more |
| → Practical implementation RIP and IGRP | → Practicle Implementation OSPF ISIS. |

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Solution 3) c)
Continue...

disadvantages of distance vector Routing protocol:-

1. Count to infinity problem.
2. Converges slowly i.e. spread slowly.
3. Persistent looping problem i.e. loop will there be forever.
4. local view available (no global view of network)

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Solution 4>

a>

Data word to be sent = 1101

Divisor = $x^6+x^3+1$

$= 1\cdot x^6 + 0\cdot x^5 + 0\cdot x^4 + 1\cdot x^3 + 0\cdot x^2 + 0\cdot x + 1$

Key will be = 1001001 --- 7 bits.

Now we will augment the binary data first by adding (7-1) Zeros and then we will perform module binary division.

Sender Side:

```
                 1100
            ______________
1001001    | 1101000000
             1001001
             ----------
              1000010
              1001001
             ----------
                10110
```

Therefore: CRC = 101100

∴ Data to be send from the sender side

= 1101101100

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Solution 4) Encode a binary word 11001 into the even parity hamming Code :-
b)

Given, number of data bits, n=5.

To find the number of bits, n=5

To find the number of redundant bits:

Let us try P=4.

$2^{b} \geq 5+4+1$

~~So total~~ The equation is satisfied and so 4 redundant bits are selected.

So, total Code bit = n+P=9

The redundant bit are placed at bit position 1,2,4 and 8

Construct the bit location table:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Bit Location | 9 | 8 | 7 | 6 | 5 | 4 | 3 | 2 | 1 |
| Bit Designation | $D_5$ | $P_4$ | $D_4$ | $D_3$ | $D_2$ | $P_3$ | $D_1$ | $P_2$ | $P_1$ |
| Binary representation | 1001 | 1000 | 0111 | 0110 | 0101 | 0100 | 0011 | 0010 | 0001 |
| Information bits | 1 | | 1 | 0 | 0 | | 1 | | |
| Parity bits | | 1 | | | | 1 | | 0 | 1 |

To determine the parity bits:

For P1: Bit locations 3,5,7 and 9 have three 1s. To have even parity, P1 must be 1

For P2: 3,6,7 have two 1s. To have even parity, $P_2$ must be 0.

For P3: Bit locations 5,6,7 have one 1s, $P_3$ must be 1.

For $P_4$ : 8,9 have one 1s, To have even parity $P_3$ must be 1.

Thus, The encoded 9-bit hamming Code is 111001101

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Solution 4)
c) A TCP connection goes through a series of states during its lifetime. Figure on next page shows the state transition diagram. Each state is indicated by an arrow, and the associated label indicates associated events and actions. Connection establishment begins in the CLOSED state and proceeds to ESTABLISHED state. Connection termination goes from the ESTABLISHED state to the CLOSED state. The normal transitions for a client are indicated by thick solid lines, and the normal transitions for a server are denoted by dashed lines.

The client normally initiates the termination of the connection by sending a FIN. The associated state trajectory goes from the ESTABLISHED state, to FIN WAIT 1 while it waits for an ACK, to FIN WAIT 2, while it waits for the other side's FIN, and then to TIME WAIT after it sends the final ACK. When the TIME WAIT period expires, the connection is closed at that time.

Note that the state transition diagram does not show all error conditions that may arise, especially in relation to TIME WAIT state. The server normally goes from the ESTABLISHED state to CLOSE-WAIT state after it receives a FIN, to the LASTACK when it sends its FIN.

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Solution 4> c>