CN Numericals

Module 1

10. **What is the propagation time if the distance between the two points is 12,000 km? Assume the propagation speed to be 2.4 × 10^8 m/s in cable.**

Propagation time = Distance / Propagation speed

$$\text{Propagation time} = \frac{12{,}000 \times 1000}{2.4 \times 10^8} = 50 \text{ ms}$$

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11. **What are the propagation time and the transmission time for a 2.5-kbyte message (an email) if the bandwidth of the network is 1 Gbps? Assume that the distance between the sender and the receiver is 12,000 km and that light travels at 2.4 × 10^8 m/s.**

Propagation time = Distance / Propagation speed

Transmission time= Message size / Bandwidth

$$\text{Propagation time} = \frac{12{,}000 \times 1000}{2.4 \times 10^8} = 50 \text{ ms}$$

$$\text{Transmission time} = \frac{2500 \times 8}{10^9} = 0.020 \text{ ms}$$

- Here, for the message size, we need to convert 2.5kbyte into bits

1. Converting 2.5kbyte to bytes = 2.5 x 1000
2. Converting bytes to bits = 2.5 x 1000 x 8
3. 1 Gb = 1000 Mb = 1000 x 1000 Kb = 1000 x 1000 x 1000 b = 10^9 bits

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12. What are the propagation time and the transmission time for a 5-Mbyte message (an image) if the bandwidth of the network is 1 Mbps? Assume that the distance between the sender and the receiver is 12,000 km and that light travels at 2.4×10^8 m/s.

A) Propagation time = Distance / Propagation speed

Transmission time= Message size / Bandwidth

$$\text{Propagation time} = \frac{12{,}000 \times 1000}{2.4 \times 10^8} = 50 \text{ ms}$$

$$\text{Transmission time} = \frac{5{,}000{,}000 \times 8}{10^6} = 40 \text{ s}$$

Q. A Device is sending out Data at the rate of 2000 bits per second

a) How long does it take to send out 100 bits

b) How long does it takes to send out a character (8 bits)

c) How long does it take to send a file of 1 lakh characters

→ a) 2000 bits = 1sec

$$1 \text{ bit} = \frac{1}{2000} \text{ sec}$$

$$100 \text{ bit} = \frac{1}{2000} \times 100 \text{ s}$$

$$100 \text{ bit} = 0.05 \text{ sec}$$

b) $$\frac{8}{2000} = 4 \times 10^{-3} = 0.004 \text{sec}$$

c) $$\frac{1}{2000} \times 8 \times 100000 = 400 \text{sec}$$

2 What is the bit rate for each of the following signals

a) A signal in which two bit lasts 0.001s

b) A signal in which 5 bit lasts 4 ms

c) A signal in which 15 bit lasts 20 μs

→ a) $2 \div 0.001 = 2000$ bits/sec

$= 2$ kbps

b) $5 \div 4 \times 10^{-3} = 1.25 \times 10^{-3}$

$= 1.25$ kbps

1000 bit = 1 kb

c) $15 \div 20 \times 10^{-6} = 750$ kbps

3 A 600 Byte packet is send over a 20 kbps point to point link whose propagation delay 10 ms. After how much delay will the packet reach destination

Propagation time $= \frac{600 \times 8}{20 \times 10^3}$

$= \frac{24}{10^2} = 0.24 s$

Latency $= 10 ms + 0.24 s$

$= 10 ms + 240 ms$

$= 250 ms$

4 How many bits can fit on a link with a 2 ms delay if the bandwidth of the link is 10 mbps

Transmission time = Message size / Bandwidth

Message size $= 2 \times 10^{-3} \times 10 \times 10^6$

$= 20 \times 10^3$ bits

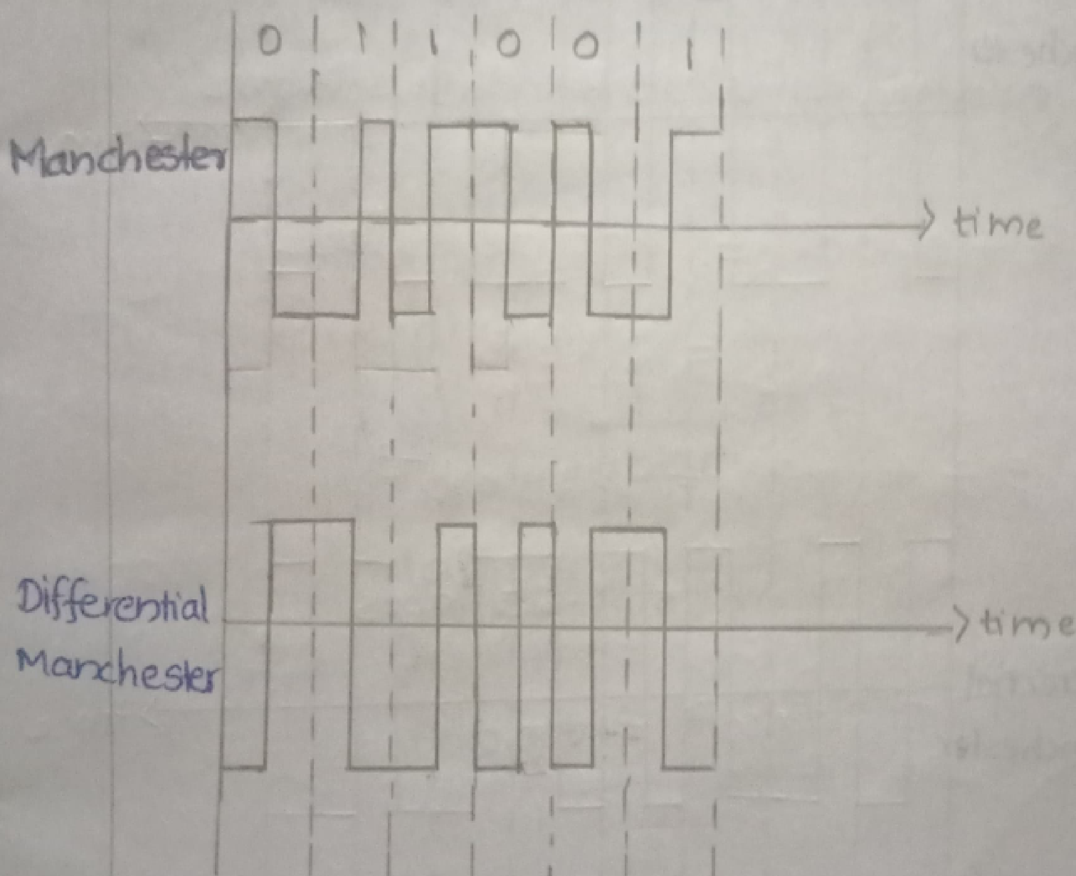
$= 20 kb.$

Module 2

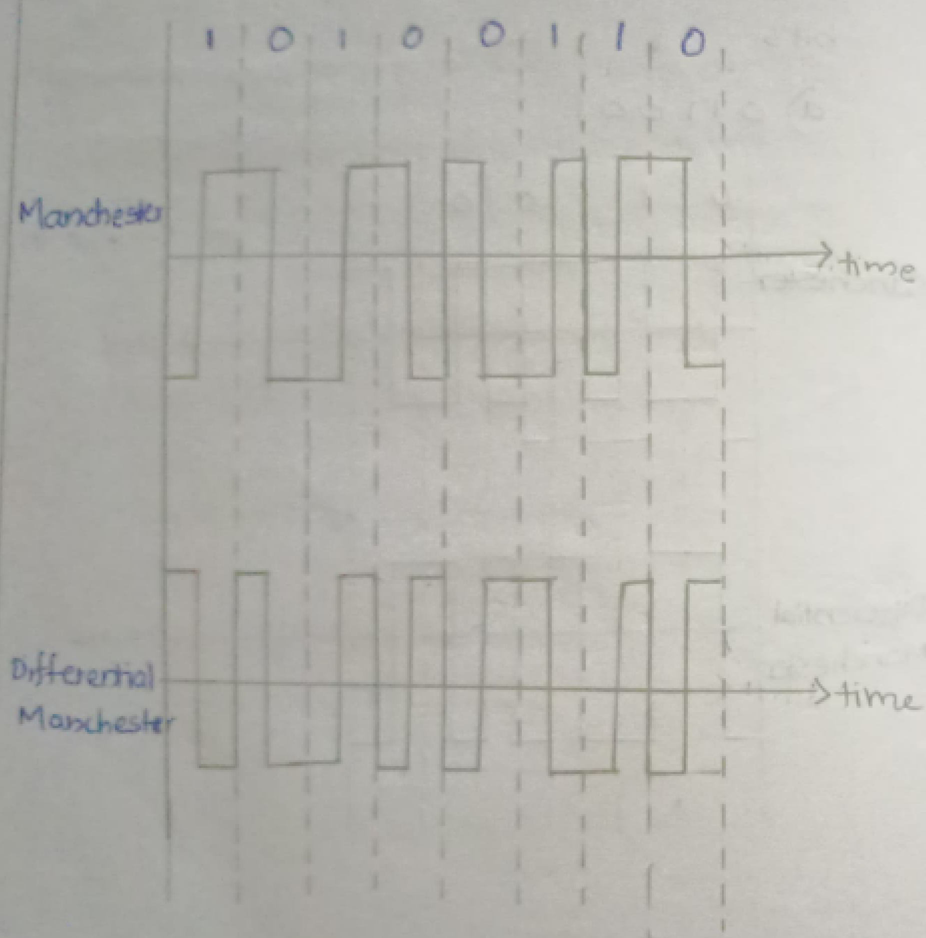
Manchester and differential Manchester

Sketch the waveform in Manchester and Differential Manchester Encoding for the bits.

a) 011001



b) 10100110



(i) Assume Dataword 1011 is to encoded using even parity hamming code. what is the binary value after encoding?

(ii) suppose this second bit from the left is inverted during the transmission show that this error is corrected at the receiver's end

→ (i) $K = 4$, $2^r \geq K + r + 1$

$r = 0$, $2^0 \geq 4 + 0 + 1$ ×

$r = 1$, $2^1 \geq 4 + 1 + 1$ ×

$r = 2$, $2^2 \geq 4 + 2 + 1$ ×

$r = 3$, $2^3 \geq 4 + 3 + 1$ ✓ $C(7, 4)$

7	6	5	4	3	2	1
a_3	a_2	a_1	r_2	a_0	r_1	r_0
1	0	1	_	1	_	_

$3 = 1 + 2$
$5 = 1 + 4$
$6 = 2 + 4$
$7 = 1 + 2 + 4$

$\cancel{pos1 = r_0 = a_0 + a_1 + a_3}$

$pos1 = r_0 = a_0 + a_1 + a_3 = 1 + 1 + 1 = 1$

$pos2 = r_1 = a_0 + a_2 + a_3 = 1 + 0 + 1 = 0$

$pos4 = r_2 = a_1 + a_2 + a_3 = 1 + 0 + 1 = 0$

7	6	5	4	3	2	1
a_3	a_2	a_1	r_2	a_0	r_1	r_0
1	0	1	0	1	0	1

(ii)

7	6	5	4	3	2	1
b_3	b_2	b_1	q_2	b_0	q_1	q_0
1	1	1	0	1	0	1

$3 = 1 + 2$
$5 = 1 + 4$
$6 = 2 + 4$
$7 = 1 + 2 + 4$

$pos1 = S_0 = q_0 + b_0 + b_1 + b_3 = 1 + 1 + 1 + 1 = 0$

$pos2 = S_1 = q_1 + b_0 + b_2 + b_3 = 0 + 1 + 1 + 1 = 1$

$pos4 = S_2 = q_2 + b_1 + b_2 + b_3 = 0 + 1 + 1 + 1 = 1$

Given the dataword 1010001101 and the divisor 110101, show the generation of CRC codeword and the sender site using binary division.

Dataword - 1010001101
Divisor - 110101
Aug. Dataword - 101000110100000

```
              1101010110
110101 ) 101000110100000
         110101
          111011
          110101
           011101
           000000
            111010
            110101
             011111
             000000
              111110
              110101
               010110
               000000
                101100
                110101
                 110010
                 110101
                  001110
                  000000
                   01110
```

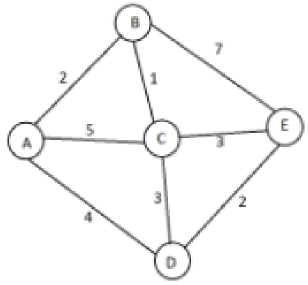
codeword - 101000110101110

```
              1101010101010
110101 ) 101000110101110
         110101
          111011
          110101
           011101
           000000
            111010
            110101
             011111
             000000
              111110
              110101
               010111
               000000
                101111
                110101
                 110101
                 000000
                  110101
                  000000
                  000000
                   000000
```

No error

Module 3

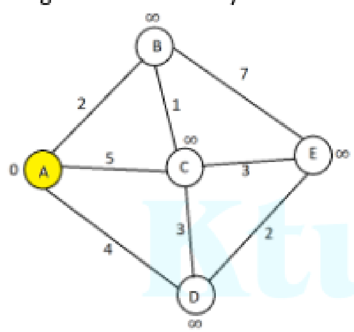
Q10: Find the shortest path from node A to all other nodes using Dijkstra's algorithm.



A:

Source vertex: A

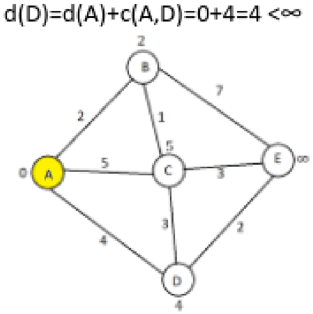
Assign distance infinity to all vertices, except source.



d(B)=d(A)+c(A,B)=0+2=2 < ∞

d(C)=d(A)+c(A,C)=0+5=5 < ∞

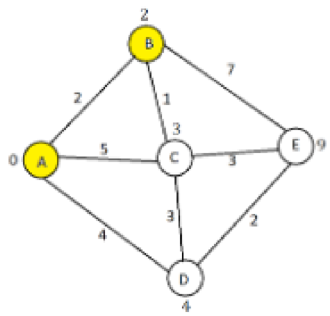
d(D)=d(A)+c(A,D)=0+4=4 <∞



Select vertex B

d(C)=d(B)+c(B,C)=2+1=3 < 5

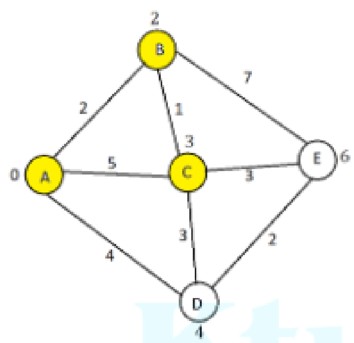
d(E)=d(B)+c(B,E)=2+7=9<∞



Select vertex C

d(E)=d(C)+c(C,E)=3+3=6<9

d(D)=d(C)+c(C,D)=3+3=6>4 (no updation)



Select vertex D

d(E)=d(D)+c(D,E)=4+2=6 (no updation)

Therefore, shortest distance from source vertex A to all other vertices is given as

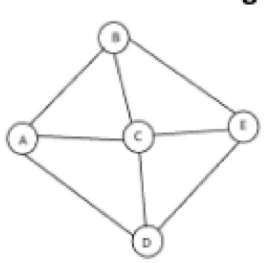
A to B=2

A to C=3

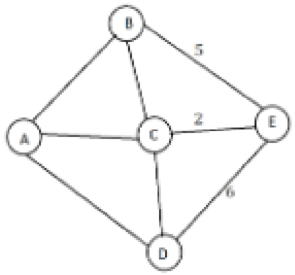
A to D=4

A to E=6

Q11: Consider the following subnet. Distance vector routing is used and the following have just come in to router E: from B: (13,0,6,10,4), from C: (11,7,0,10,1) and from D: (3,16,3,0,9). The measured delays to B,C and D are 5,2,6 respectively. What is E's new routing table? Give both the outgoing line to use and the expected delay.



A:



B's TABLE

	A	B	C	D	E
A					
B	13	0	6	10	4
C					
D					
E					

C's TABLE

	A	B	C	D	E
A					
B					
C	11	7	0	10	1
D					
E					

D's TABLE

	A	B	C	D	E
A					
B					
C					
D	3	16	3	0	9

E					

Measured delay for B=5, So add 5 to B's table
Outgoing line through B: (18,5,11,15,9)
Measured delay for C=2, so add 2 to C's table
Outgoing line through C: (13,9,2,12,3)
Measured delay for D=6, so add 6 to D's table
Outgoing line through D: (9,22,9,6,15)
Taking minimum for each destination (except E):
E's table: (9,5,2,6,0)
Outgoing lines are: (D,B,C,D,-)

E's TABLE

	A	B	C	D	E
A					
B	18	5	11	15	9
C	13	9	2	12	3
D	9	22	9	6	15
E	9	5	2	6	0

Token bucket problem

- Time Taken = Total size/(Network speed - Token bucket speed)

Q: A computer on a 6 ~~megabits~~ m.b/s network is regulated by token bucket. The token bucket is filled at a rate of 1Mbps. It is initially filled to capacity with 8 Mb. How long can be the computer transmit at the full 6 Mbps.

$C = 8\ Mb$

$M = 6\ Mbps$

$\rho = 1\ Mbps$

$S = C/(M-\rho)$

$= 8/(6-1)$

$= 8/5$

$= \underline{\underline{1.6\ s}}$

Module 4

4. A network on the internet has a subnet mask of 255.255. 240.0. What is the maximum number of hosts it can handle..?

To determine the maximum number of hosts that a network can handle with a given subnet mask, you can use the formula:

$$\text{Number of Hosts} = 2^{(\text{Number of Host Bits})} - 2$$

In this case, the subnet mask is 255.255.240.0. To find the number of host bits, subtract the number of bits set to 1 in the subnet mask from the total number of bits in an IPv4 address (32 bits).

The subnet mask 255.255.240.0 in binary is:

$$11111111.11111111.11110000.00000000$$

Now, count the number of bits set to 1 in the subnet mask, which is 20 bits.

So, the number of host bits is $32 - 20 = 12$ bits.

Now, use the formula:

$$\text{Number of Hosts} = 2^{12} - 2 = 4094$$

Therefore, the network with a subnet mask of 255.255.240.0 can handle a maximum of 4094 hosts. The subtraction of 2 is because the first address (all 0s) is reserved as the network address, and the last address (all 1s) is reserved as the broadcast address.

10. Given IP Address – 172.16.0.0/25, find the number of subnets and the number of hosts per subnet. Also, for the first subnet block, find the subnet address, first host ID, last host ID and broadcast address.

Solution:

- This is a class B address.
- Number of subnets : 2^(Given bits for mask – No. of bits in default mask)
  - No of bits in mask = 25
  - No of bits in default mask = 16
  - **Number of subnets = 2^(25-16) = 2^9 = 512.**
- Number of hosts per subnet : 2^(32 – Given bits for mask) – 2

  = 2^(32-25) – 2 = 2^7 – 2 = 128 – 2 = 126
- Subnet address : AND result of subnet mask and the given IP address
  - **For the first subnet block, we have subnet address = 0.0**
- First Host ID : Subnet address + 1
  - **first host id = 0.1,**
- Last Host ID : Subnet address + Number of Hosts
  - No of hosts = 126
  - **last host id = 0.126**
- Broadcast address : By putting the host bits as 1 and retaining the network bits as in the IP address
  - **broadcast address = 0.127**

First address, Last address, number of address

- 32-subnet mask = number of bits to be converted
- Convert the address to binary
- For first block
  - Convert the bits to 0
- For last block
  - Convert the bits to 1

? A block of address is granted to small organisation. We know that one of the address is 167.199.170.82/27

a) What is the address of first block?

b) Find the last address of the block?

c) Find the number of address?

→ The binary representation of given address is

10100111 11000111 10101010 01010010

a) If we set 32-27 right most bit to 0, we get

10100111 11000111 10101010 01000000

(167.199.170.64)

b) If we set 32-27 rightmost bit to 1, we get

10100111 11000111 10101010 01011111

(167.199.170.95)

c) The value of n is 27 that means the number of addresses is

$2^{32-27} = 2^5 = 32$

Contigous address

2 Suppose an organization is assigned a block of 2048 contiguous addresses starting at address 128.211.168.0, what will be the last address of this block.

$2048 = 2^{11}$

Binary representation of the given address is

10000000 11010011 10101000 00000000

If we set rightmost 11 bits to 1 as get

10000000 11010011 10101111 11111111

(128.211.175.255)

- Same method is used, but the 32-subnet value is derived from the number of addresses

Q Suppose an organisation is given the block 17.12.40.0/26 which contains 64 addresses. The organisation has 3 offices and needs to ~~avoid th.~~ divide the addresses into 3 subblocks of 32, 16 and 16 addresses. what are the subnet addresses and range of addresses for each subnet?

→ There are $2^{32-26} = 2^6 = 64$ addresses in this block. The first addresses in the block is 17.12.40.0/26 and the last address is 17.12.40.63/26.

Number of addresses (Requirement)	Number of addresses (Allocated)	Subnet Mask length	First address	Last address
32	32	27	17.12.40.0/27	17.12.40.31/27
16	16	28	17.12.40.32/28	17.12.40.47/28
16	16	28	17.12.40.48/28	17.12.40.63/27

Q An organization is granted a block of addresses with the beginning address 14.24.74.0/24. The organisations need 3 subblocks of address to use in this 3 subnets: one subblock of 10 addresses, one subblock of 60 addresses and one Subblock of 120 addresses. Design the subblocks?

→ There $2^{32-24} = 2^8 = 256$ addresses in this block. The first address is 14.24.74.0/24. The last address is 14.24.74.255/24.

Number of addresses (Requirement)	Number of addresses (Allocated)	Subnet mask length	First address	Last address
120	128	25	14.24.74.0/25	14.24.74.127/25
60	64	26	14.24.74.128/26	14.24.74.191/26
10	~~52~~ 16	28	14.24.74.192/28	14.24.74.207/28

48 address are left in reserve 1st address in this range is 14.24.74.208

Last address is 14.24.74.255

- Number of addresses(Allocated) -> Number of addresses rounded off to nearest 2^x
- Subnet mask length
  - Example number of addresses is 128
    - 2^x = 128
    - x=7 -> 2^7 = 128
    - Subnet mask length = 32 - x = 32 - 7 = 25
- First address
  - Start with the given address
- Last Address
  - Add the Number of addresses to the last piece of the address

- Here 0+128 -> Last address is 127, Next coming address is 128
- If the last piece exceeds 255, the second last piece is incremented

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Q Illustrate the subnetting concept. A company is granted the site address 181.56.0.0 The company needs 1000 subnets. Find the number of subnet possible and host which can be connected in each subnet.

= The company needs 1000 subnets.

Given site address : 181.56.0.0

then mask address is : 255.255.0.0

The company needs 1000 subnets. This is not a power of 2
The next number that is a power of 2 is 1024 (2^{10})
we need 10 more 1s in the subnet mask

$\therefore$ subnet mask = 255.255.255.192

i.e the no. of subnets possible = $\underline{\underline{2^{10} = 1024}}$

(The total no. of 0's is 6 (32-26))

$\therefore$ The no. of host which can be connected in each subnet = $2^6 - 2$ = $\underline{\underline{62 \text{ host}}}$

- Based on the IP we get the Subnet mask
  - 255.255.0.0
- 1000 Subnets are needed
  - Round off it to 1024, 1024 subnets are possible
  - 2^x = 1024
  - here x = 10
- Add 10 1's to the subnet mask

- Count number of zeroes in the new subnet mask
- 2^6 - 2 = hosts connected