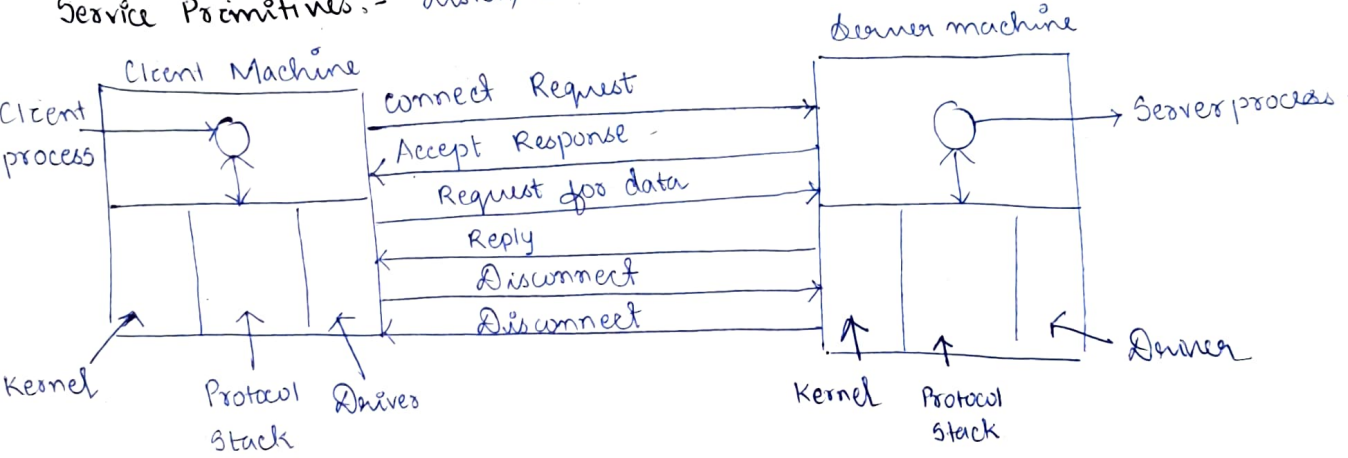
1. a) Computer Network:- Interconnected collection of autonomous computers.
Uses :- Business application, Home application and mobile users.

b) Connection-oriented
→ " service is related to telephone system
→ Feasible
→ Congestion Not possible
Eg- TCP

Connectionless - service.
→ related to postal system.
→ Not feasible
→ Congestion is possible
→ Eg UDP

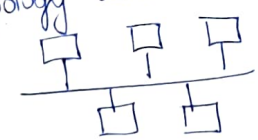
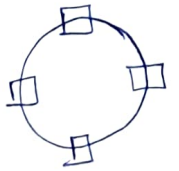
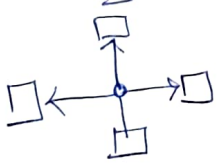
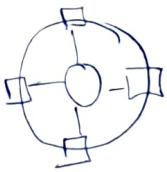
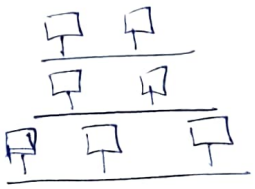
Service Primitives:- Listen, Connect, Accept, Receive, Send, disconnect.



c) 100ms of CT to generate
To inspect all of them it would take 1024 × 100ms.
or 102400ms.

2) a) Network Topology- A network topology is the physical and logical arrangement of nodes and connections in a network.

Different types of topology are:-
① Bus →
② Ring →
③ Star →
④ Mesh →
⑤ Tree

Comparision:-

OSI	TCP/IP
→ Open System Interconnection	→ Transfer Control Protocol / Internet Protocol
→ 91 has 7 layers (Please Don't Take Sauce PizzaAway)	→ 91 has 4 layers (Appln, Transport, N/W Access, Internet)
→ Low in usage	→ Mostly used
→ Replacement of tools and changes can be done easily	→ Not easily done.

Similarity → OSI and TCP/IP models both describe how info. is transmitted between 2 devices across a network.

Lan: 802.11

7	1	6	6	2	0-1500	0-46	4
Preamble	SOF	Destn add	source addr	Length	Data	Pad	check Sum

1. Frame Control - Contains info. about the type and control of the frame including protocol version, frame type and sub-types.
2. Duration/ID: Specifies the duration the medium will be taken for frame transmission and include an association ID.
3. Address Fields:- Receiver Add - Mac Add of receipient
   " " " server.
   " " representing the BSS.
4. Sequence Control - Manages order of frame transmission and reception.
5. Frame body - Contains actual data load or info being transmitted.
6. Frame Check Sequence - CRC for error detection.

3a. Fourier Series - it's a way to represent a periodic function as the sum of sine and cosine function.

$$f(x) = a_0 + \sum_{n=1}^{\infty} \left[a_n \cos\left(\frac{2\pi n x}{T}\right) + b_n \sin\left(\frac{2\pi n x}{T}\right) \right]$$

Limiting the bw in com^n systems reduces the range of frequencies used. According to Nyquist, the max^m data rate is twice the bw.

3) BW → refers to the range of frequencies a transmission medium can support. For a voice channel it's the difference b/w the highest and lowest frequencies.

Total BW ⇒ (No. of channels × Channel BW) + (No. of Guard Bands × Guard Bandwidth)

= (15 × 4KHz) + (15 × 0.5)KHz = —

c) Binary signal over:- 4KHz ; SNR is 20dB., max ^{m}gR

$C = B \cdot \log_2(1 + SNR)$

4) a) Guided Transmission Medias in CN are:-

i) Twisted pair cable:-
- consists of pairs of insulated Cu wires twisted together with 1mm thickness each.

2) Coaxial Cable - Contains a central conductor surrounded by insulating material and metalic sheild and outer insulating layer.
Commonly used for cable TV

3) Fibre-Optics Cables - Transmits data using light signals through thin strands of glass or plastic fibers.
High BW, low attenuation;
Used for high speed internet and long distance comm^{n}.

4) Waveguides - Hollow metal tubes designed to carry microwaves.
5) Powerlines - deliver electrical power to houses and electrical wiring within houses

b) Circuit Switching
- Requires call set up
- Requires a dedicated physical path
- Each packet follows the same route.
- Fixed BW

Packet switching
- ×
- ×
- ×

dynamic bw.

5) a) Need of flow control – FC is crucial in data comm^n to manage the rate of data transmission b/w a sender and a receivers.

Primary need → i) Preventing Buffer Overflows
ii) Optimizing throughputs

Common approaches for flow control are:-

① Sliding Window → Allow multiple frames to transmit b/w sender and receiver. Provides better utilization of the comm^n link.

② Stop and Wait – The sender sends one frame and waits for the acknowledgement from the receiver b4 sending the next frame. Simple & effective for low error environments.

b) A B ESC C ESC FLAG FLAG D.

For byte stuffing :-

FLAG A B ESC ESC C ESC ESC ESC FLAG ESC FLAG D FLAG

ii) 0 1 1 1 1 0 1 1 1 1 1 0 1 1 1 1 1 1 0

Bit stuffing 0 1 1 1 1 0 1 1 1 1 1 0 0 1 1 1 1 1 0 1 0

6) b) Sliding protocol using Selective repeat:-

c)
```
        1 0 1 0 1 0 1 0 0 0 (1 0
1 1 0 1)1 1 0 1
        ---------
        0 1 1 1 1
          1 1 0 1
        ---------
        0 0 1 0 0
          0 0 0 0
        ---------
        0 1 0 0 1
          1 1 0 1
        ---------
        1 0 0 0 1
          1 1 0 1
        ---------
        1 0 1 0 0
          1 1 0 1
        ---------
        1 1 1 0 1
```

$1 \cdot x^3 + 1 \cdot x^2 + 0 \cdot x + 1$

```
1 1 0 1 1 0 1 | 0 1 1 1 0 1
1 1 0 1)1 0 1 0 1 0 1 0 0 0 0
        1 1 0 1
        -------
        0 1 1 1 1
          1 1 0 1
        -------
        0 0 1 0 0
          0 0 0 0
        -------
        0 1 0 0 1
          1 1 0 1
        -------
        1 0 0 0 1
          1 1 0 1
        -------
        1 0 1 0 0
          1 1 0 1
        -------
        1 1 1 0 1
          1 1 0 1
        -------
          0 1 1 0
          0 0 0 0
        -------
          1 1 0 0
          1 1 0 1
        -------
            0 0 1
```

b) Sliding window protocol using selective repeats

- Go-Back-N wastes a lot of BW on retransmitted frames.
- An alternative strategy for handling errors is to allow the receiver accept & buffer the frames following a damaged or lost one.
- In SRP only the erroneous or lost frames are retransmitted while correct ones are received and buffered.
- The receiver while keeping the track of sequence nos, buffers the frames in memory and sends -ve ACK for the frames which are missing.
- Sender sends packets for -ve ACK pkts is received.

c) Assignment -3

7) a) Contention-Systems - Multiple users shares a common channel in a way that can lead to conflicts are widely k/a contention systems.

a) How slotted ALOHA solves the problem of Channel Allocation.

In slotted Aloha, the shared channel is divided into fixed time interval called slots. So, that if a stn wants to send a frame to the shared channel, it can only send at the beginning of the slot and only 1 frm allowed to send to each slot.

b) Carrier Sense Multiple Access with Collission Resolution.

Use: In n/w where the collin resoln is preffered.

Opn: Nodes continue transmitting after collision, adjusting power levels to resolve collisions efficiently than CSMA/CD.

CSMA/CD: ——

CSMA/CA A3

c) If a group of N stations share a 56-kbps, pure aloha channel. Each stn outputs a 1000 bit frame on an avg of once every 100 sec. even, if the previous has not been sent. What is max value of N.

→ There are N stations sharing 56 kbps pure aloha.

We with pure aloha, BW = 0.184 * 56 kbps = 10.3 kbps

1 station outputs 1000 bits in every 100 sec.

In 1 sec one station output at rate :-

$$1000/100 = 10 \text{ bits/sec}$$

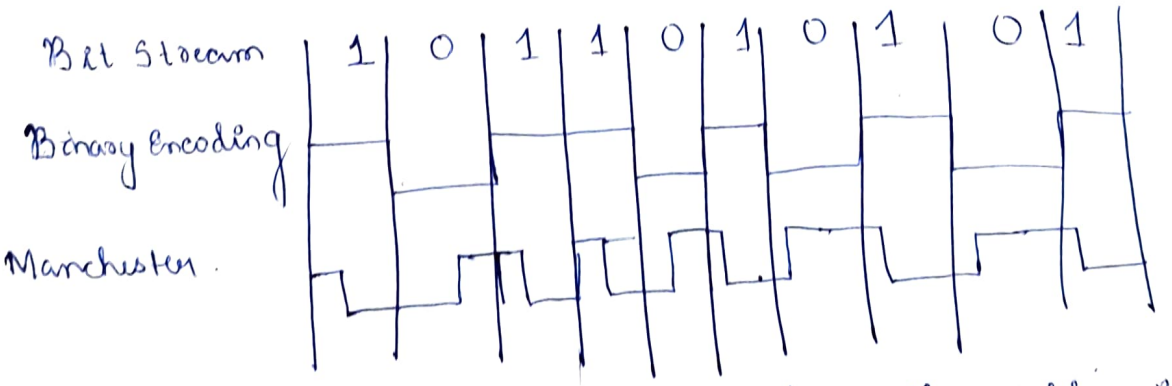
So, for N :-

$$N * 10 = 10300$$

$$N = \frac{10300}{10} = 1030$$

8) a) Manchester Encoding :-

1 0 1 1 0 1 0 1 0 1 :-



8) c) In flooding, a router forwards a packet to all neighbouring routers which in turn forwards it to their neighbours. The process continues until the pkt reaches the destination. While simple it may cause n/w congestion and redundant transmission. Loop prevention mechanisms like sequence nos are often employed.

9) c) DHCP - Dynamic Host Configuration Protocol

- Every computer or device on a network has an IP address for communication purposes.
- There are 2 ways in which a comp. can be assigned an IP addr:- Static IP or Dynamic IP.
- In dyn. IP is where the comp. gets an IP address automatically from the DHCP server.
- A DHCP server automatically assigns a computer an IP address.
- DHCP is based on the idea of a special server that assigns IP addresses to hosts asking for one. This server need not be on the same LAN as the requesting host.
- Since the DHCP server may not be reachable by broadcasting a DHCP relay agent is needed on each LAN.

b. For 255.255.240.0

Host addresses exist = $2^{12} = 4096$

For 255.255.255.0

Ethernets = $2^8 = 256$

Hosts = $2^8 = 256$.

10) a) UDP - The Internet protocol suite supports a connectionless transport protocol, UDP (User Datagram Protocol)

- UDP provides a way for applications to send encapsulated IP datagrams and send them without having a established connection.
- UDP transmits segments consisting of 8 byte header followed by a payload.

Source port	Dest^n port
UDP length	UDP Checksum

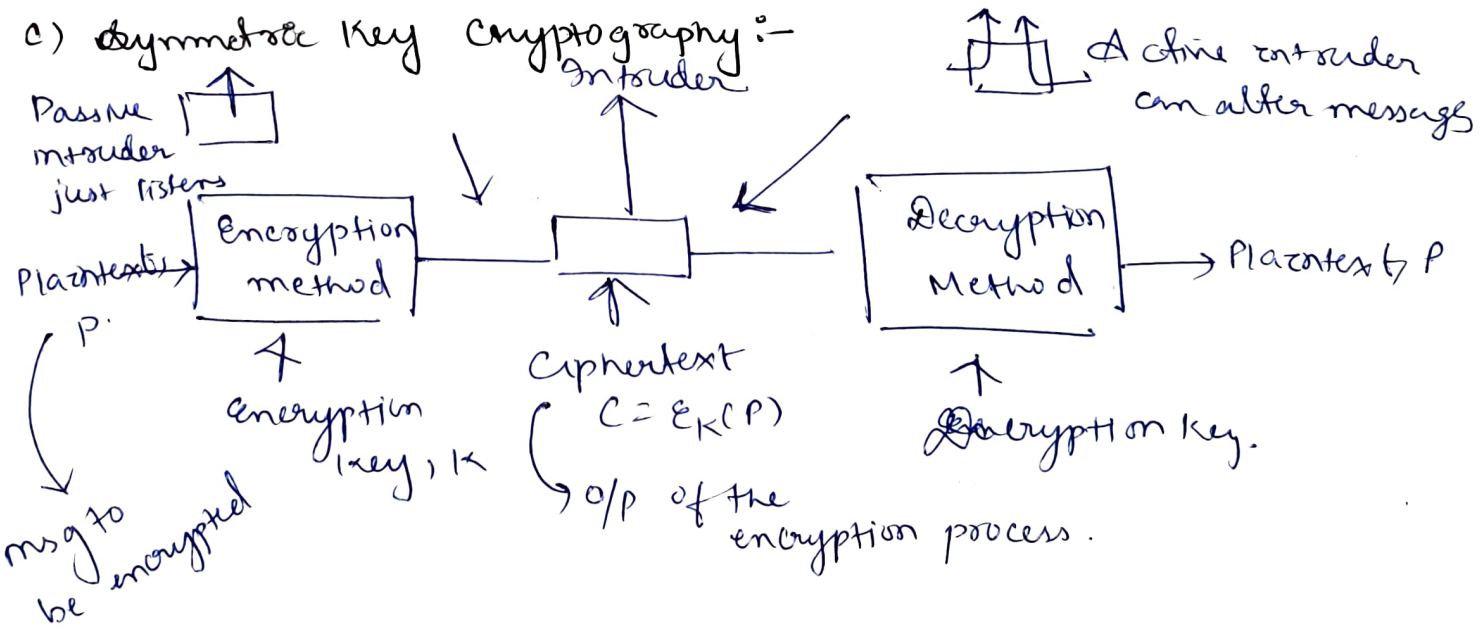
The main value of having UDP over just having IP address is the addition of the source and dest^n port

- It does not do flow control, error control.

b) Importance of DNS in application layer.

1. Name Resolution → DNS translates human readable domain names into IP addresses, enabling applns to locate and connect to servers on the Internet.
2. Load Balancing → DNS facilates load distribution across multiple servers improving appln performance and efficient resource utilization
3. Security – DNS plays crucial role in security by validating and authenticating domain names, to prevent DNS attacks and ensuring data integrity.
4. Redundancy & Failover – DNS provides redundancy allowing traffic to be rerouted in case of server failures, ensuring uninterrupted service.

c) Symmetric Key Cryptography :–



Redundancy → All encrypted msgs must contain some encrypted msgs must contain some redundancy, i.e info, not needed to understand the message.

Freshness → Measures must be taken to ensure that each msg received can be verified as being fresh, that is sent very recently.