

Section-A

- (Q.1) (i) — (a) attenuation distortion  
(ii) — (a)  $N_0 = kT$   
(iii) — (b) analog communication.  
(iv) — (a) voltage pulses  
(v) — (a) only in one direction.  
(vi) — (a) low to high voltage transition  
(vii) — (c) one error per 1000 bits  
(viii) — (c) 3  
(ix) — (a) File transfer protocol service  
(x) — (a) on-off keying (OOK)

Section-B

(Q.2) Switching technique — In its simplest form, data communication takes place between two devices that are connected directly by some transmission medium. However it is often impractical or uneconomical for two devices to be connected directly. Instead, communication between a source and destination nodes is achieved by transmitting data from source to destination through a network of intermediate nodes. These nodes provide switching facility that moves data from node to node until the destination is reached. Three different methods of establishing communication links between a sender

②

and receiver in a communication network are switching. Circuit switching, message switching, and packet switching, these methods are collectively known as switching techniques.

### Message switching —

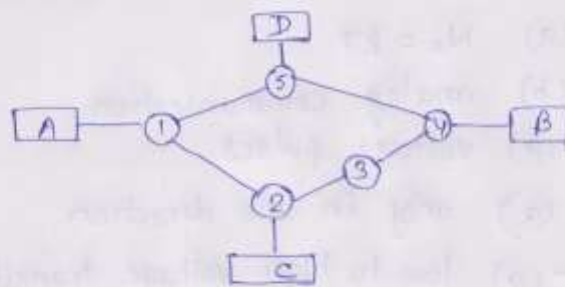


Figure 1 (Illustrating store-and-forward method of message switching)

In this method, when a node wants to send a message to another node, it first appends destination address to the message. It then transmits the message to its destination either by store-and-forward method or by broadcast method.

In store-and-forward method, a message is transmitted first from its source node to an intermediate node directly connected to it. The intermediate node stores the complete message temporarily, inspects it for errors, and transmits it to one of the nodes directly connected to it, based on an available free channel and its routing information.

In the broadcast method, a message is broadcast over a common medium known as broadcast channel. All nodes check the destination address attached to the message as it passes by, and ignore it if it is not addressed to it.

(3)

The destination code picks up the message when it reaches there. Routing delays inherent in store-and-forward method are eliminated in this method. However, this method requires that all nodes are connected to the broadcast channel simultaneously.

### Advantages —

- ① Unlike circuit switching, no physical connection is required between a source and destination nodes in message switching.
- ② It uses channels very effectively because channels are used only when messages are transmitted.

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(Q.3) Given,  $\phi_1(t) = \sqrt{\frac{2}{T}} \cos(2\pi f_c t)$   
and  $\phi_2(t) = \sqrt{\frac{2}{T}} \sin(2\pi f_c t)$   
for  $(k-1)T < t \leq kT$

where,  $k$  is an integer.

$$\therefore \int_{(k-1)T}^{kT} \phi_1(t) \cdot \phi_2(t) dt$$

$$= \int_{(k-1)T}^{kT} \left(\frac{2}{T}\right) \sin(2\pi f_c t) \cdot \cos(2\pi f_c t) dt$$

$$= 0$$

Hence,  $\phi_1(t)$  and  $\phi_2(t)$  are orthogonal in the interval  $(k-1)T < t \leq kT$ .



(4)

(Q.4) entropy  $H = -\sum_i P(i) \cdot \log_2 P(i)$  bit/symbol.

Given,  $P(1) = \frac{1}{2}$ ,  $P(2) = \frac{1}{4}$ ,  $P(3) = \frac{1}{8}$ ,

and  $P(4) = \frac{1}{8}$ .

$\therefore H = -\left[\frac{1}{2} \log_2 \left(\frac{1}{2}\right) + \left(\frac{1}{4}\right) \log_2 \left(\frac{1}{4}\right) + \left(\frac{1}{8}\right) \log_2 \left(\frac{1}{8}\right) + \left(\frac{1}{8}\right) \log_2 \left(\frac{1}{8}\right)\right]$

$= \left[\frac{1}{2} + \frac{1}{2} + \frac{3}{8} + \frac{3}{8}\right]$

$= \frac{7}{4}$  bit/symbol.

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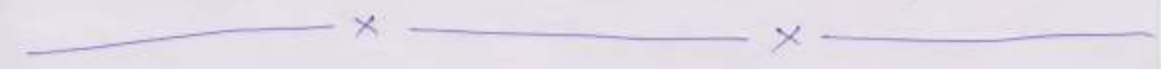
(Q.5) Bandwidth — It refers to data transfer rate of a communication system. It is measured in bits per second (bps).

Based on data transmission speeds, three basic categories of communication channels are,—

(a) Narrowband — Narrow band or sub-voice grade channels have speed in the range of 45 to 300 baud. They are used to handle low data volumes, and are adequate for low-speed devices. They are used mainly for telegraph lines and low speed terminals.

(b) Voice band — Voice band channels have speed upto 9600 baud. They are so called because their major application is in ordinary telephone voice communication. They are used also for data transmission from slow I/O devices to CPU or vice versa.

(c) Broad band — Broadband channels are used for transmission of large volumes of data at high speed. They have speed of 1 million baud or more. Broadband facility is used for high-speed computer-to-computer communication or for data transmission to several different devices simultaneously.



(Q.6) Answer —

$$\text{Baud} = \frac{f_b}{N} \quad \& \quad \text{Bandwidth} = \frac{f_b}{N}$$

where, N is the number of bits encoded into each signaling element

$$\therefore \text{Baud} = \frac{10,000}{1} = 10,000$$

$$\& \text{ Bandwidth} = \frac{10,000}{1} = 10,000$$



(Q.7) For an 8-PSK system,

M=8

∴ N = log<sub>2</sub> M = 3

∴ Baud =  $\frac{f_b}{N}$

=  $\frac{24 \text{ kbps}}{3}$

=  $\frac{24 \times 1000}{3}$

= 8000

(Q.8)

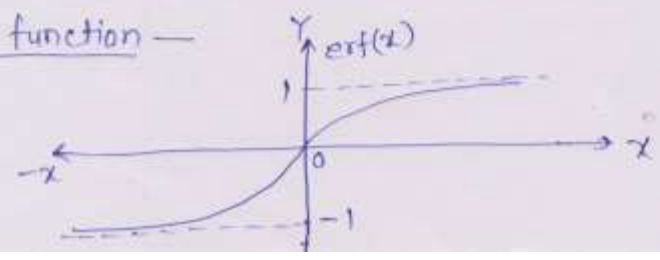
(i) Error function — It is defined as

$$\text{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2} dt$$

from this definition we may conclude that

$\text{erf}(\infty) = 1$  ,  $\text{erf}(0) = 0$  &  $\text{erf}(-\infty) = -1$ .

graph of error function —



properties of error function —

①  $\text{erf}(-x) = -\text{erf}(x)$

②  $\text{erf}(0) = 0$

(Q.8) (ii) LAN and WAN — Networks are classified broadly into two types LANs and WANs.

LAN — It is Local-area network. A LAN is restricted to a limited geographic coverage of a few kilometers, Ethernet is most widely used LAN technology because it is relatively fast and economical. The most common communication links used in LANs are twisted pair, coaxial cable, and ~~fiber~~ fiber optics. The cost of transmitting data in a LAN is ~~very~~ low.

WAN — It is wide-area network. WANs may operate nationwide or even worldwide. data transmission rates in WANs is lower than that of ~~WAN~~ LANs.

In WANs the communication cost may be very high because transmission media used are leased lines or public communication systems, such as telephone lines, microwave links, and satellite channels.

(Q.8) (iii) Electronic mail — Electronic mail service (known as e-mail in short) enables an internet user to send a mail (message) to another internet user in any part of the world in a near-real-time manner. An e-mail message takes



a few seconds to several minutes to reach its destination, because it travels from one network to another, until it reaches its destination. E-mail service delivers an already sent mail into its receiver's mailbox. Message in e-mail service can contain not only text ~~data~~ documents but also image, audio, and video data. Only restriction is that the data must be ~~digit~~ digitized, that is, converted to a computer-readable format.

As compared to paper mail, telephone and fax, many prefer e-mail because of its following advantages—

- (a) It is faster than paper mail
- (b) Unlike telephone, the persons communicating need not be available at the same time.
- (c) Unlike fax documents, e-mail documents can be stored in a computer, and can be edited easily using editing programs.

(8) (iv) Uses of the internet — The internet is a network of computers linking many different types of computers all over the world. It is a network of networks sharing a common mechanism for addressing computers, and a common set of communication protocols for communications between two computers on the network.



(9)

Basic services of the internet —

- (a) E-mail
- (b) File transfer protocol
- (c) Telnet
- (d) Usenet News