CMR INSTITUTE OF TECHNOLOGY

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Internal Assesment Test - III

Sub:	DATA COMMUNICATION NETWORK							Code:	10EE843
Date:	25 / 5 / 2017	Duration:	90 mins	Max Marks:	50	Sem:	VIII	Branch:	EEE

Answer Any FIVE FULL Questions

		Marks	OBE CO	OBE RBT
1 (a)	Explain the structural features of T1-TDM hierarchy	[5]	CO1	L4
(b)	Briefly explain the cellular telephony network.	[5]	CO1	L4
2 (a)	With neat diagram explain Bluetooth technology.	[6]	CO1	L4
(b)	Briefly explain about the spread spectrum. .	[4]	CO2	L4
3 (a)	Define SONET and with neat diagram explain the SONET frame structure.	[10]	CO2	L1
4 (a)	Explain analog to analog modulation techniques. .	[10]	CO2	L4
5 (a)	With a neat diagram, describe a) fiber optic cable b) coaxial cable	[6]	CO2	L1
(b)	Using Nyquist criterion, calculate the sampling frequency for the following a) Analog signal having bandwidth of 3000Hz b) Analog signal having fL = 3000Hz and fH = 7000Hz	[4]	CO2	L3
6 (a)	What is multiplexing? Explain the classification and features of multiplexing schemes used in data communication.	[10]	CO2	L4
7 (a)	Calculate the checksum byte and verify at the receiver for the following data bytes. m1= 10101101, m2=11101110, m3=11111011. .	[6]	CO2	L3
(b)	Calculate the CRC and check the same. Data: 100100; Divisor: 1101.	[4]	CO2	L3
8 (a)	With the help of neat diagram explain the ASK, FSK and PSK. Discuss the bandwidth in each case.	[10]	CO2	L4

Q) 8 (a)

Amplitude Shift Keying (ASK)

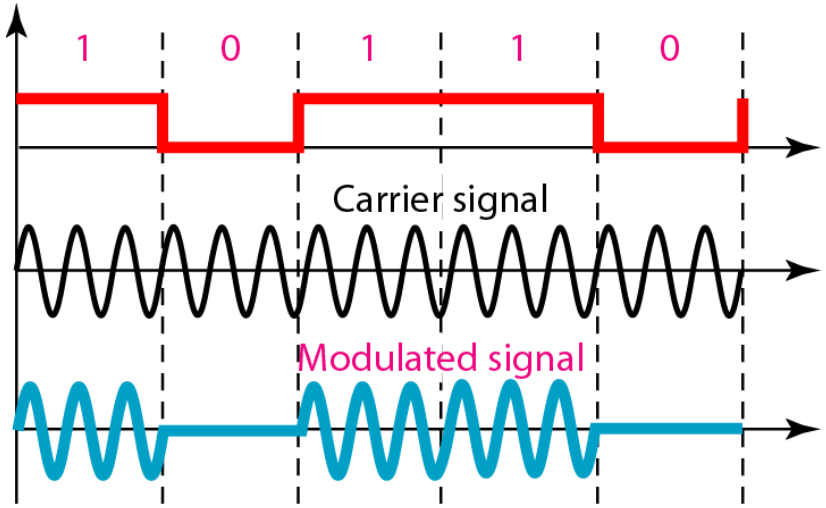
- ASK is implemented by changing the amplitude of a carrier signal to reflect amplitude levels in the digital signal.
- If the signal value is '1' then the carrier signal will be transmitted; If signal value is '0' no signal is transmitted.

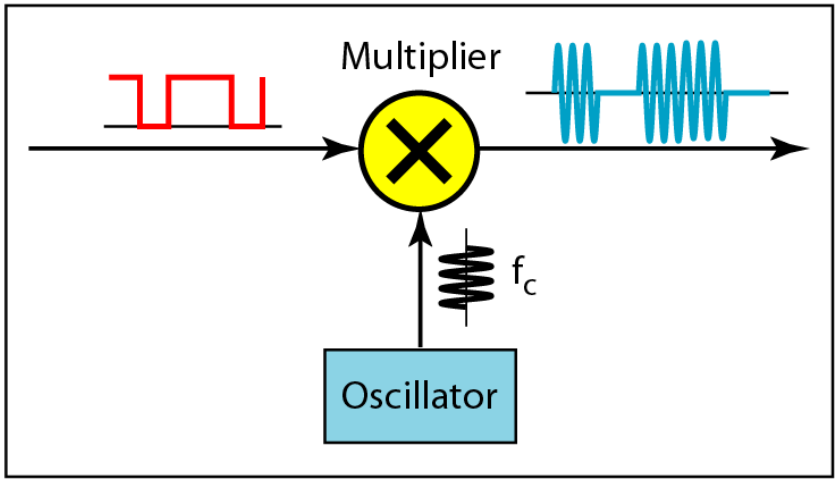
- The bandwidth B of ASK is proportional to the signal rate S.

$$B = (1+d)S$$

- "d" is due to modulation and filtering, lies between 0 and 1.

Implementation of binary ASK





Frequency Shift Keying

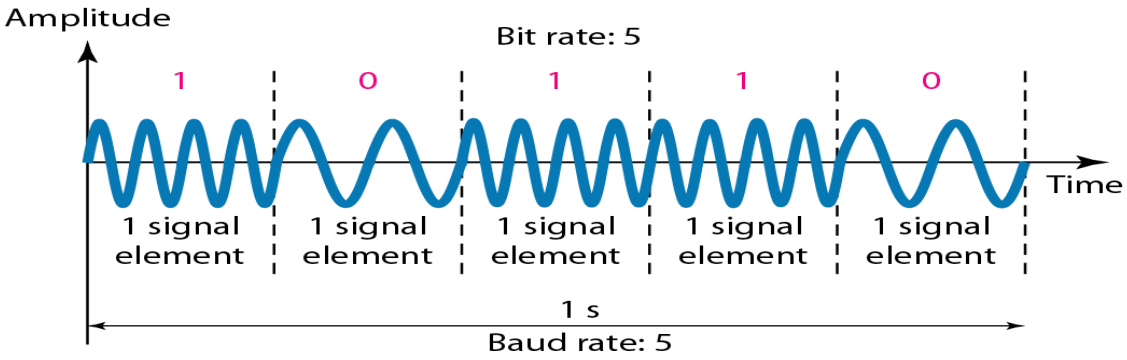
- **Frequency Shift Keying (FSK)** is the digital modulation technique in which the frequency of the carrier signal varies according to the digital signal changes. FSK is a scheme of frequency modulation.

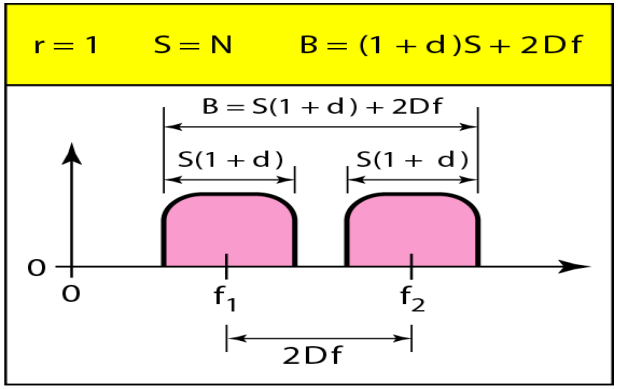
- For the digital signal having binary value '1', the output of a FSK modulated wave is high in frequency.

- For a digital signal having binary value '0', the output of FSK modulated wave is low in frequency.

- **1s** and **0s** are called Mark and Space frequencies.

For example: *Binary frequency shift keying*





If the difference between the two frequencies (f_1 and f_2) is $2\Delta f$, then the required BW B will be:

$$B = (1+d) \times S + 2\Delta f$$

Phase Shift Keying

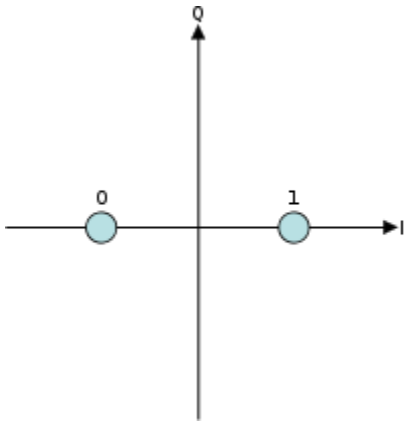
- We vary the phase shift of the carrier signal to represent digital data.
- The bandwidth requirement, B is:

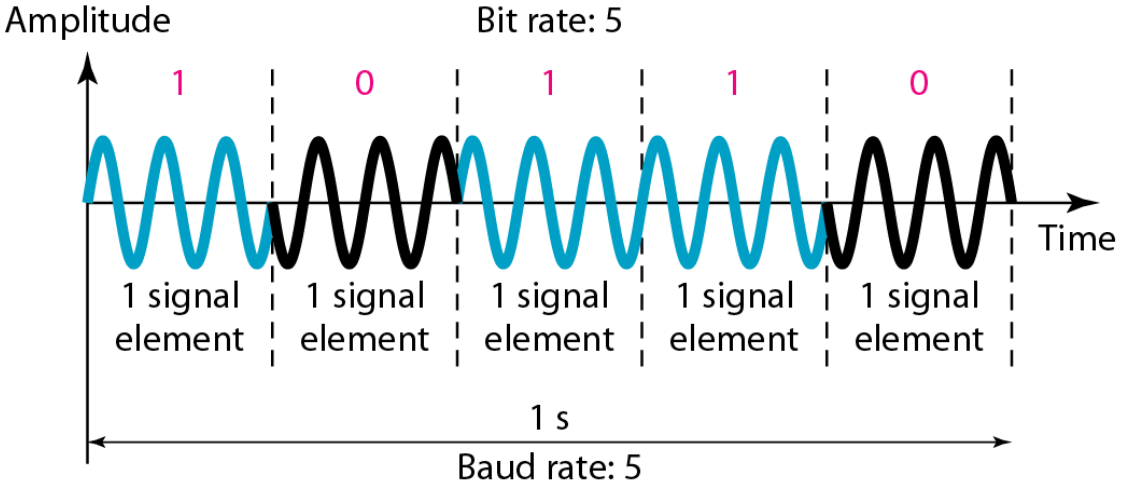
$$B = (1+d)xS$$

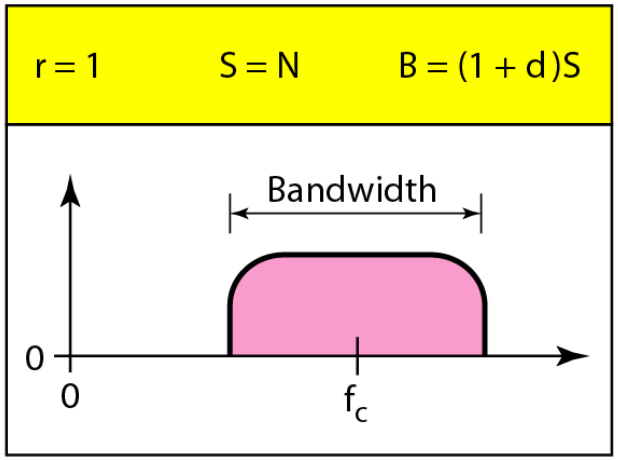
- PSK is much more robust than ASK as it is not that vulnerable to noise, which changes amplitude of the signal.

Binary phase shift keying

The phase shift of the carrier signal is varied by 180^0 to represent digital data.



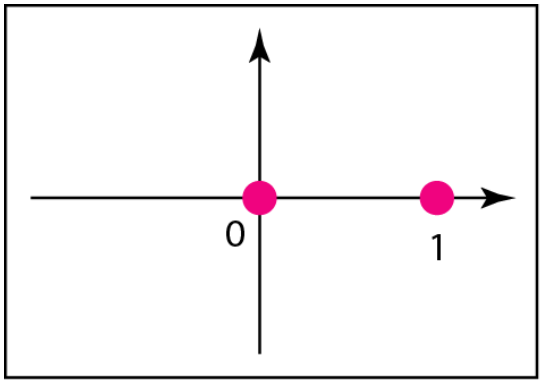




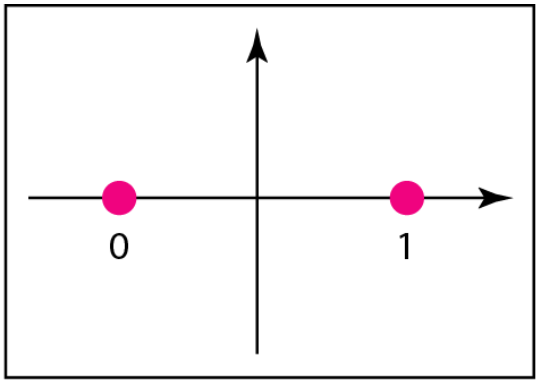
Quadrature PSK

- One carrier frequency is phase shifted 90^o from the other - in quadrature.
- Quadrature amplitude modulation is a combination of ASK and PSK

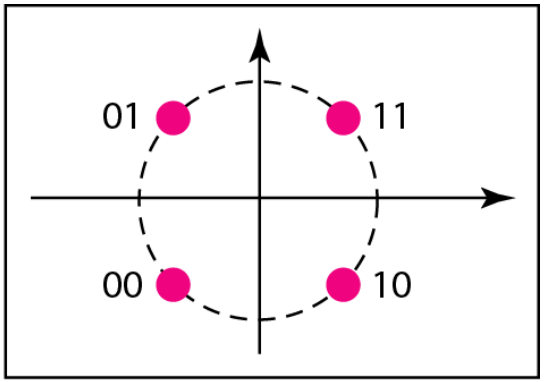
Three constellation diagrams



a. ASK (OOK)

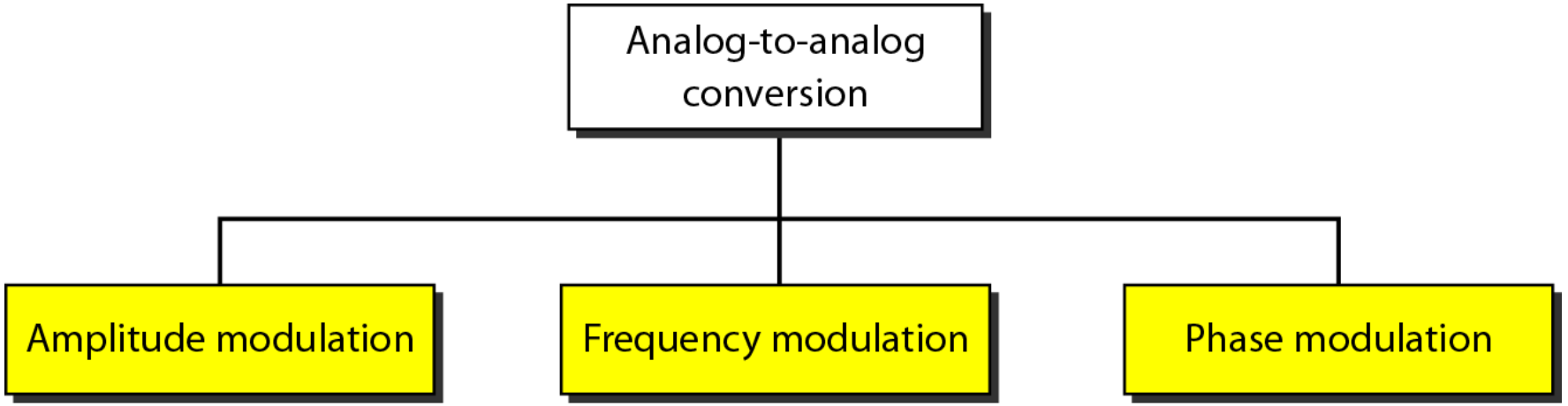


b. BPSK



c. QPSK

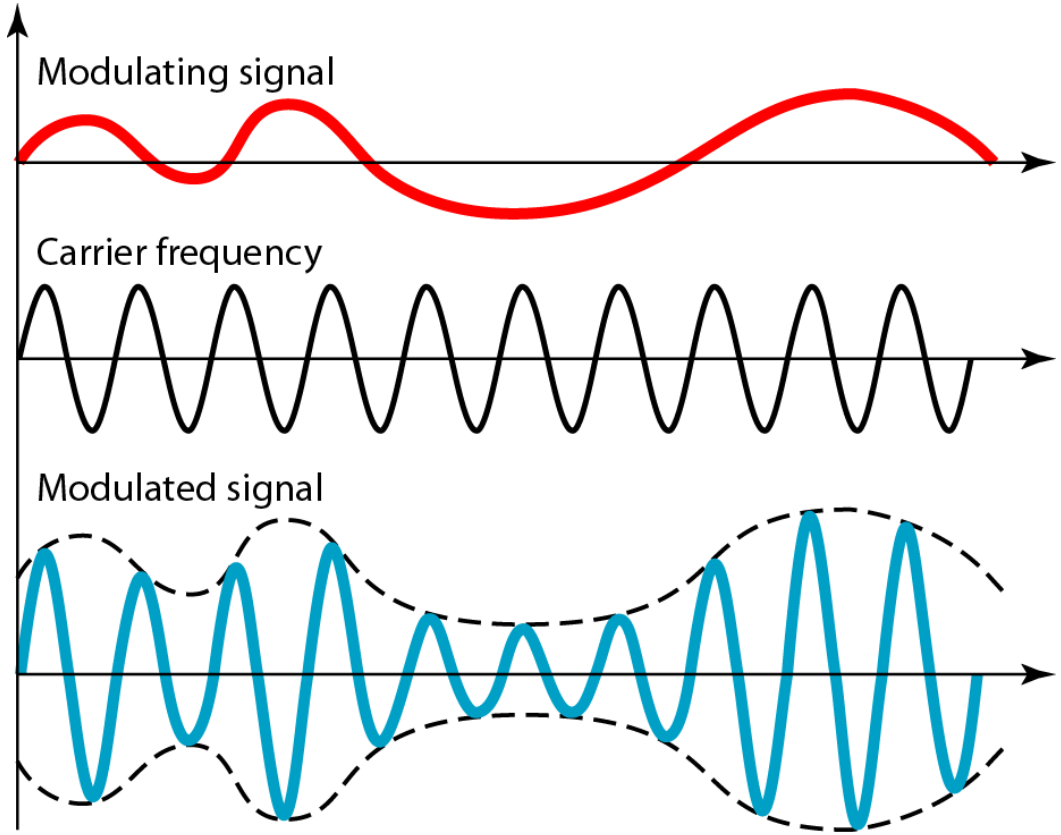
Q4) *Analog-to-analog modulation techniques*

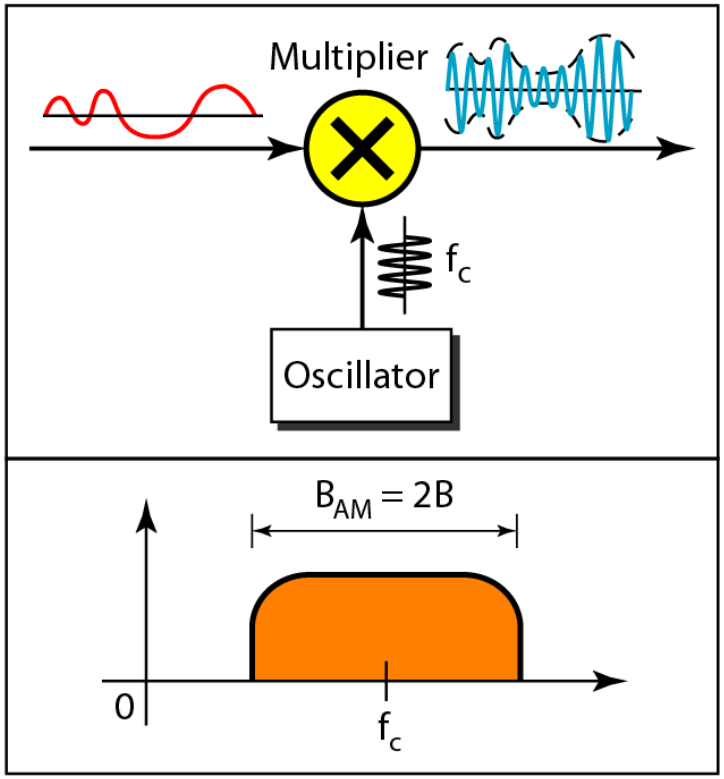


Amplitude Modulation

- The modulating signal changes the amplitude of carrier signal
- The required bandwidth is 2B, where B is the bandwidth of the modulating signal
- $B_{AM} = 2B$

Amplitude modulation

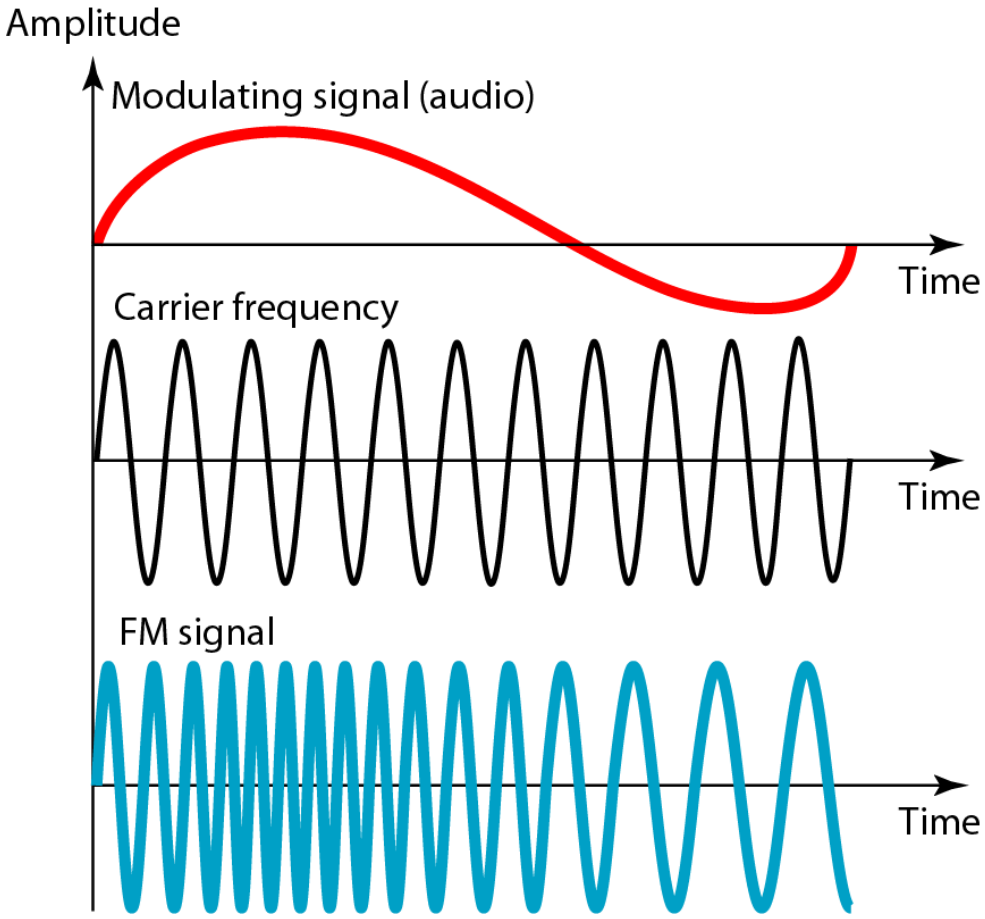


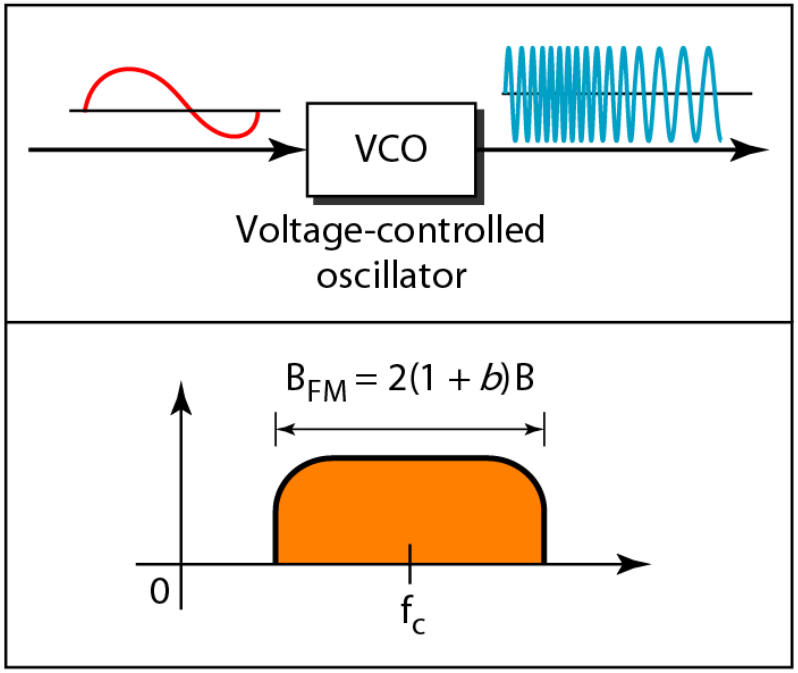


Frequency Modulation

- The modulating signal changes the freq. f_c of the carrier signal
- The bandwidth for FM is high
- It is approx. 10x the signal frequency
- $B_{FM} = 2(1 + \beta)B$. Where β is usually 4.

Frequency modulation

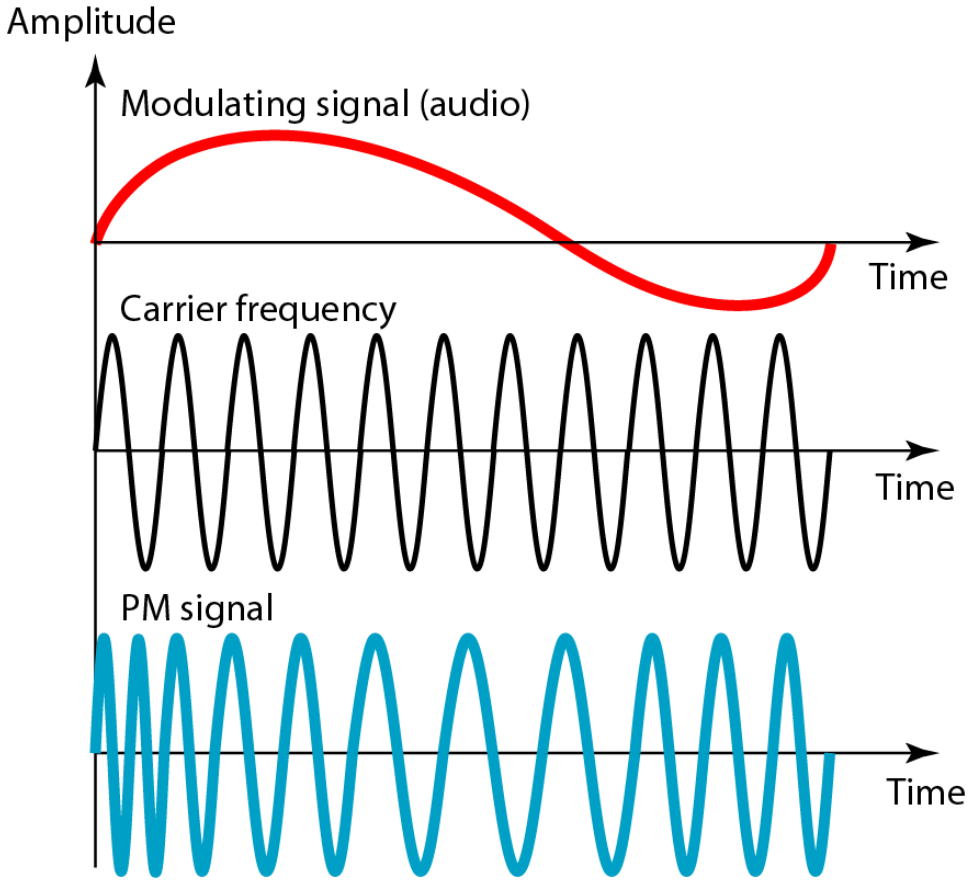


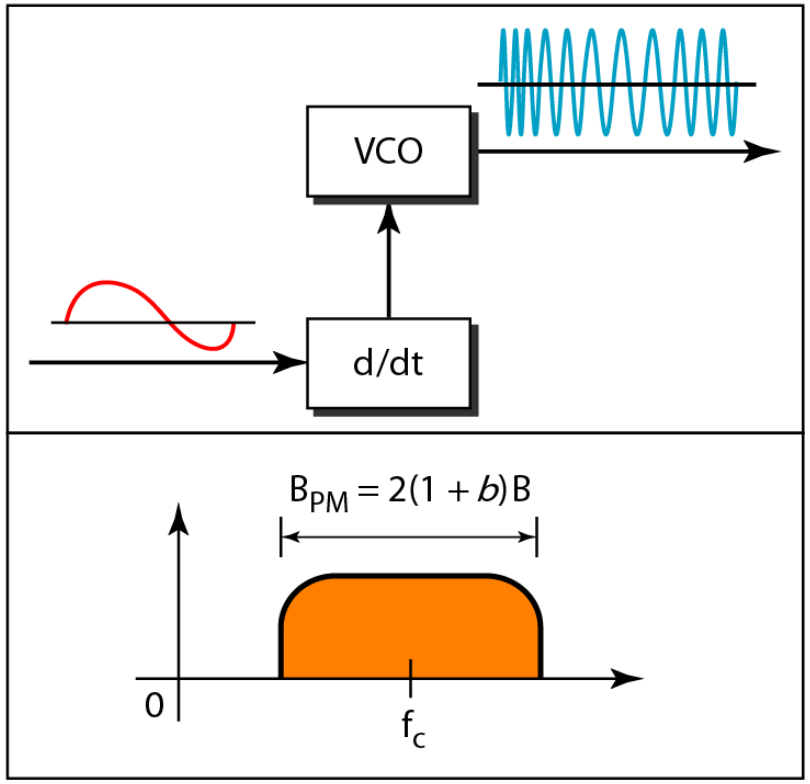


Phase Modulation (PM)

- The modulating signal only changes the phase of the carrier signal.
- The phase change manifests itself as a frequency change but the instantaneous frequency change is proportional to the derivative of the amplitude.
- The bandwidth is higher than for AM.
- $B_{PM} = 2(1 + \beta)B$.
- Where $\beta = 2$ most often.

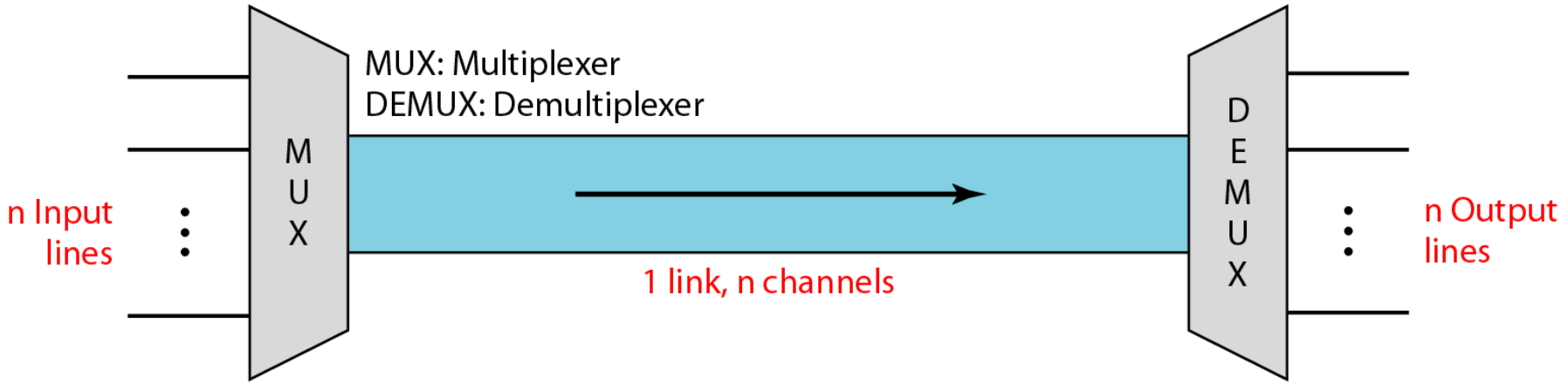
Phase modulation



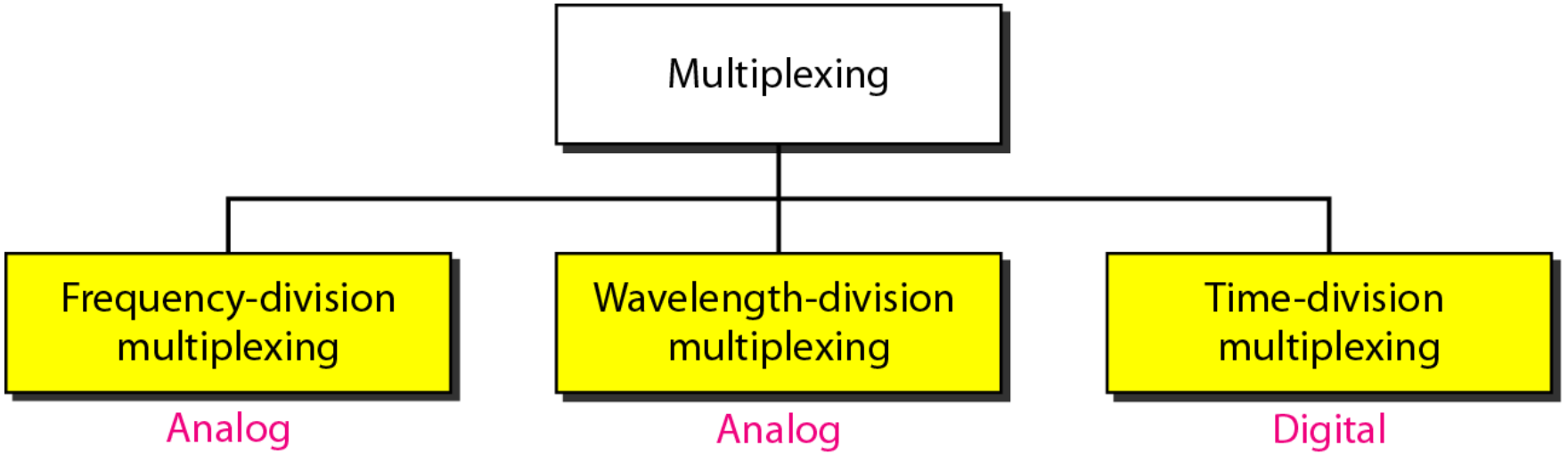


Q (6) MULTIPLEXING

Multiplexing is the set of techniques that allows the (simultaneous) transmission of multiple signals across a single data link.



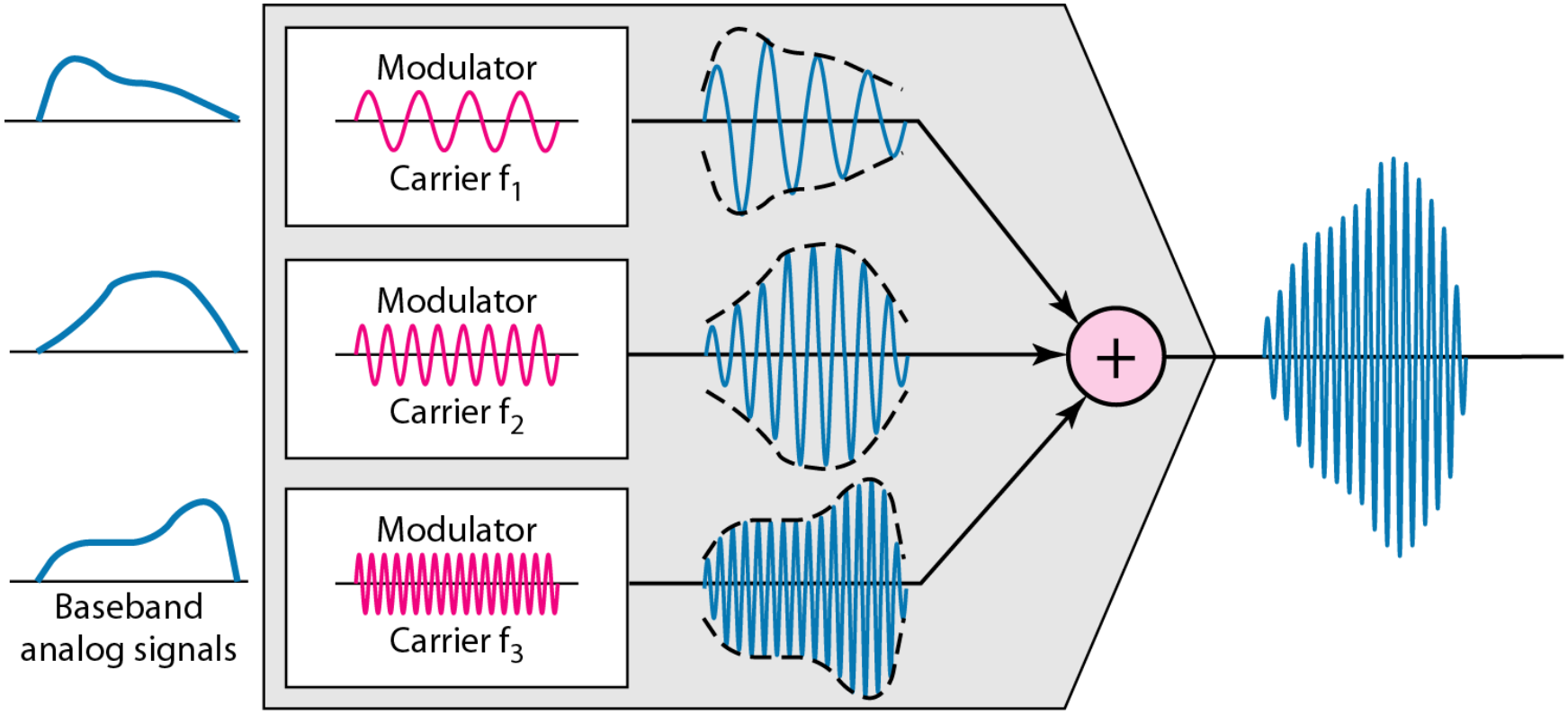
Categories of multiplexing



Frequency-division multiplexing (FDM)

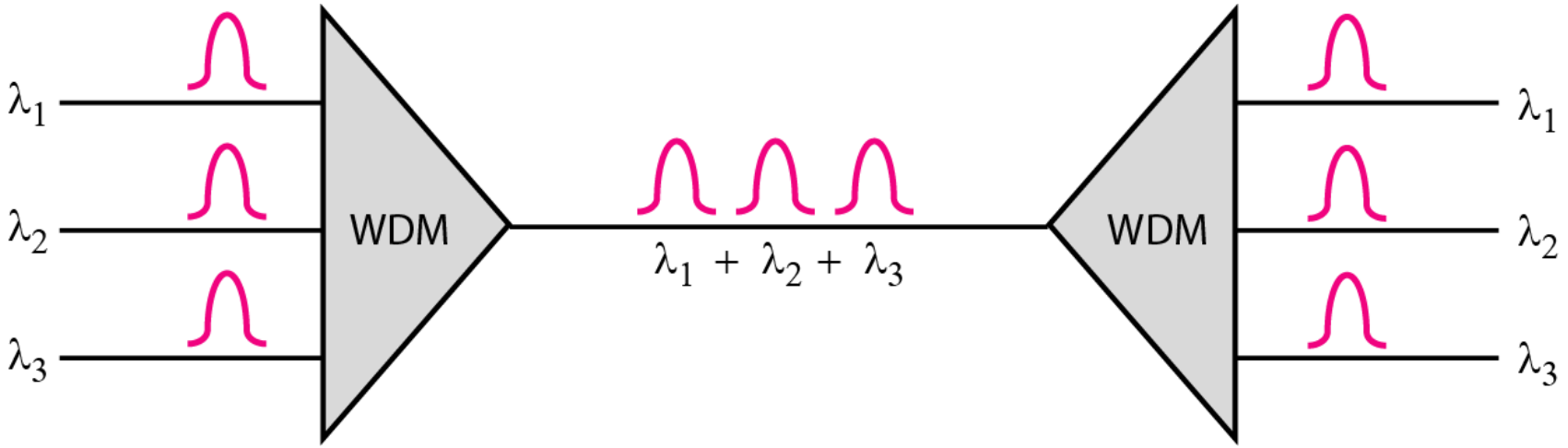
FDM is an analog multiplexing technique that combines analog signals

FDM process


Modulator
Carrier f_1
Modulator
Carrier f_2
Modulator
Carrier f_3
Baseband
analog signals
+

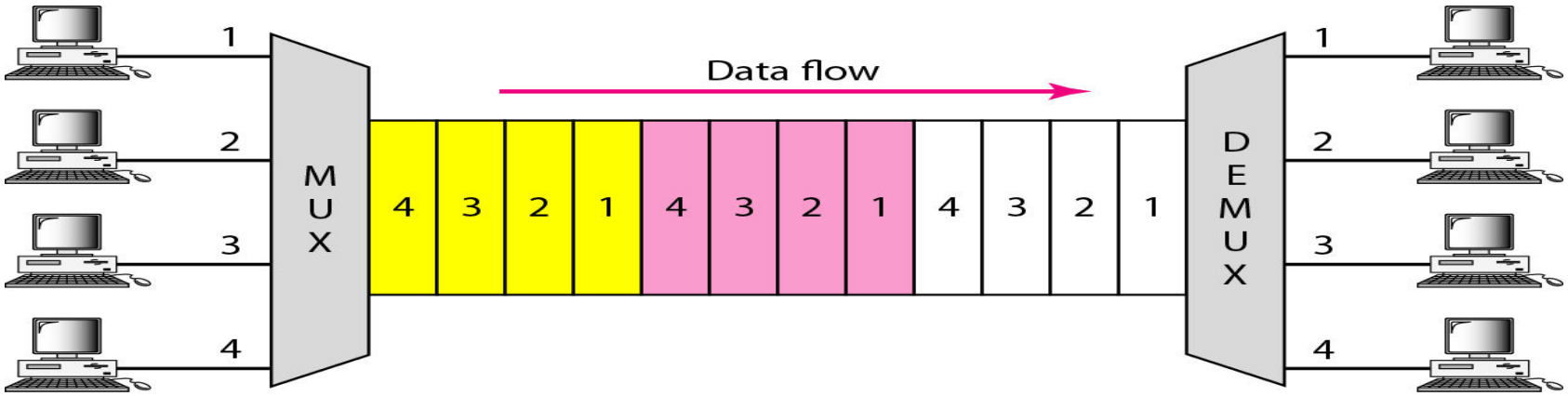
Wave length division multiplexing

- **WDM is an analog multiplexing technique to combine optical signals.**

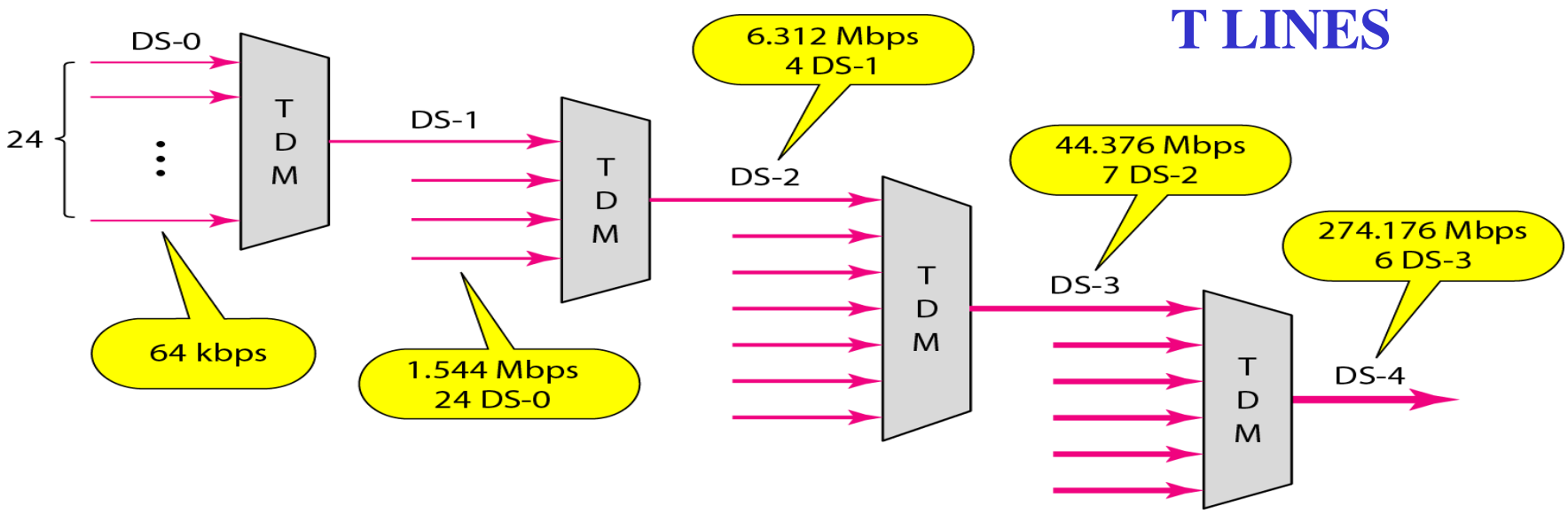


Time Division Multiplexing

- **TDM is a digital multiplexing technique for combining several low-rate digital channels into one high-rate one.**



Q) 1 (a)T1-TDM hierarchy



- ***DS0, DS1 and so on are the names of services.***
- ***To implement those services, the telephone companies uses T lines (T-1 to T-4) called T lines.***

T Lines for analog transmission.

- *T lines are digital lines designed for transmission of digital data, audio or video.*

- *They can be used for analog transmission (telephone connections), provided analog signal is first sampled, then time division multiplexed.*

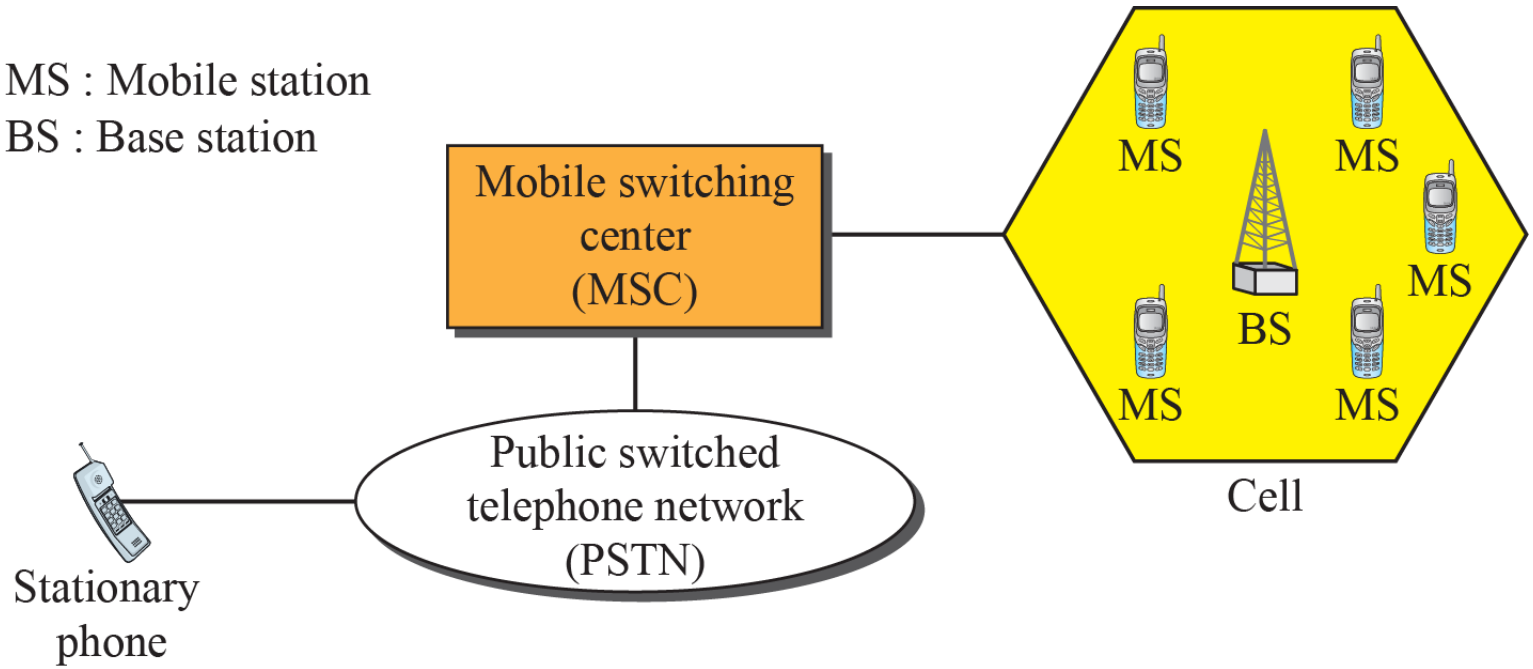
- *Earlier when an organization wanted 24 separate telephone lines, it needed to run 24 twisted pair from companies to central exchange.*

- *These days same organization can combine 24 lines to one T-1 line and run only one T-1 line o exchange.*

Q) 1 (b) Cellular telephony network

Cellular telephony is designed to provide communications between two moving units, called mobile stations (MSs), or between one mobile unit and one stationary unit, often called a land unit. A service provider must be able to locate and track a caller, assign a channel to the call, and transfer the channel from base station to base station as the caller moves out of range.

Cellular system



1st Generation:

Based on analog voice using frequency modulation

2nd Generation:

Digital techniques and time-division (TDMA) or code-division multiple access (CDMA)

3rd Generation:

Broadband access for personal communications services (PCS)

Q) 2 (a) Bluetooth technology:

:Bluetooth technology:

- Bluetooth is a wireless system that uses radio waves for communication. It has the ability to communicate with many different devices at once without interference.
- Bluetooth is an open standard for short-range transmission of digital voice and data that supports point-to-point and multipoint applications.

  Bluetooth is based on a low-cost, low power, short range radio link. Bluetooth cuts the cord that used to tie up digital devices. When two bluetooth devices come within 50 meters range of each other,they establish a connection together. It operates at 2.45 ghz which is available globally, although slight variation of location and width of band apply.

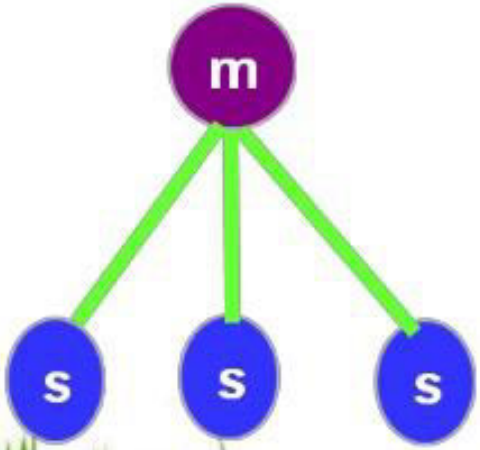
- The range is set at 10 to100 meters to optimize for target market of mobile and business user. The range can, however, be increased.

- Gross data rate is 1mbit/s, with second generation plans to increase to 2 mbit/sec.One-to-one connections allow maximum data transfer rate of 723 kbit/s. It has low power consumption, drawing only 0.3 ma in standby mode. This enables maximum performance longevity for battery powered devices.

- Bluetooth will support wireless point-to-point and point-to-multipoint (broadcast) between devices in a piconet.

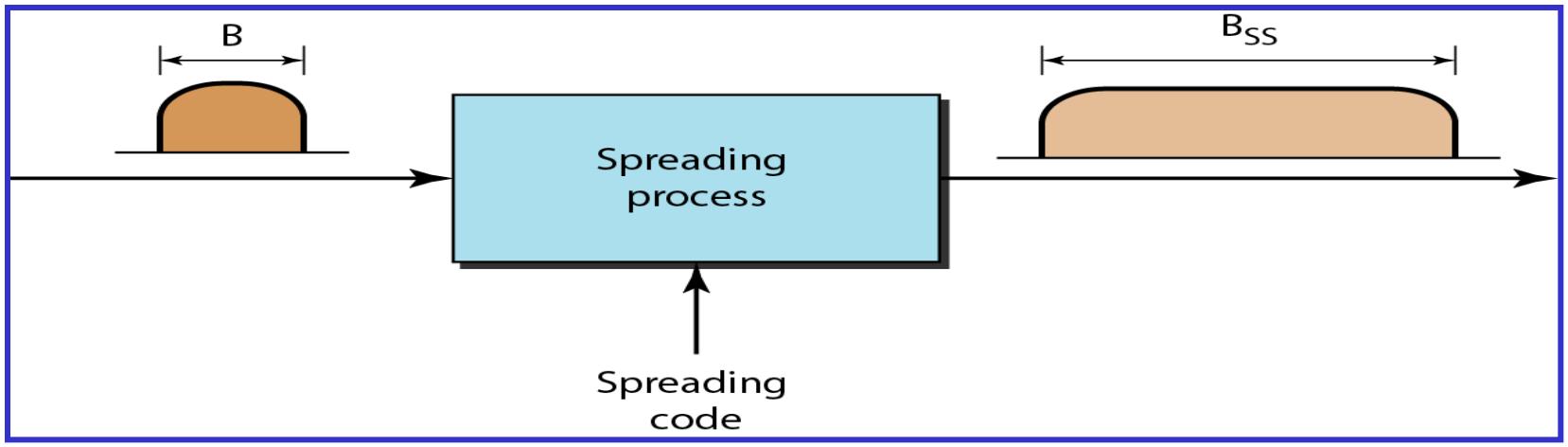
- Point to Point Link
  - Master - slave relationship
  - Bluetooth devices can function as masters or slaves

- Piconet
  - It is the network formed by a Master and one or more slaves (max 7)
  - Each piconet is defined by a different hopping channel to which users synchronize to
  - Each piconet has max capacity (1 Mbps)



Q) 2 (b) Spread spectrum

- Spread spectrum achieves its goals through two principles:
  1. The bandwidth allocated to each station needs to be, by far, larger than what is needed. This allows redundancy.
  2. The expanding of the original bandwidth B to the bandwidth Bss must be done by a process that is independent of the original signal. In other words, the spreading process occurs after the signal is created by the source.
  3. Spread signal to use larger bandwidth



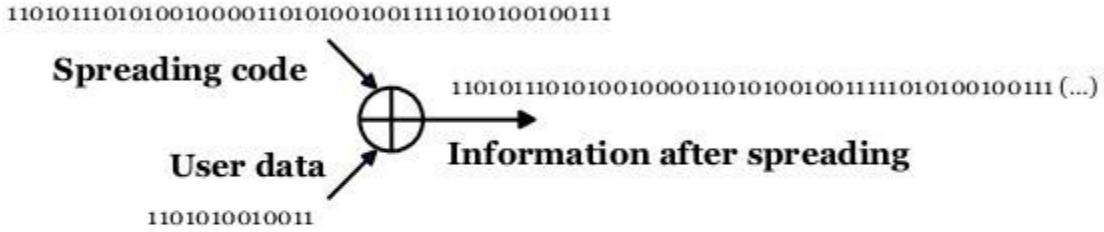
SPREAD SPECTRUM TECHNIQUES

- THE MAJOR SPREAD SPECTRUM TECHNIQUES ARE

- DSSS

- FHSS

Direct Sequence Spread Spectrum (DSSS)



- Data signal is multiplied by a spreading code, and resulting signal occupies a much higher frequency band
- Spreading code is a pseudo-random sequence

Frequency Hopping Spread Spectrum (FHSS)

- Data signal is modulated with a narrowband signal that *hops* from frequency band to frequency band, over time
- The transmission frequencies are determined by a spreading, or hopping code (a pseudo-random sequence)

Q) 3 SONET

SONET

- Synchronous optical network is a standard for optical telecommunication transport.
- We use it when we send data by optical fiber.

SONET SYSTEM

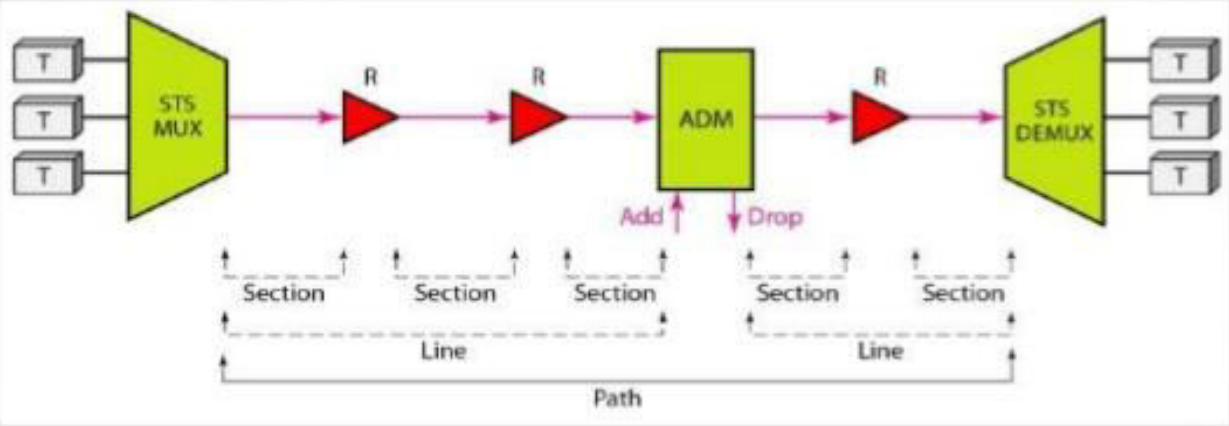
Signals:

- Electrical signaling levels called synchronous transport signals (STSs).
- The corresponding optical signals are called optical carriers (OCs).
- SDH specifies a similar system called a synchronous transport module (STM).

SONET SYSTEM

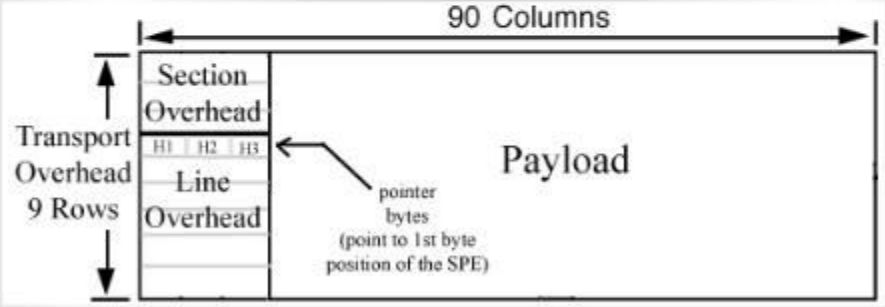
Connections:

- Sections(connecting two neighboring devices).
- Lines(two multiplexers).
- Paths(end-to-end portion).



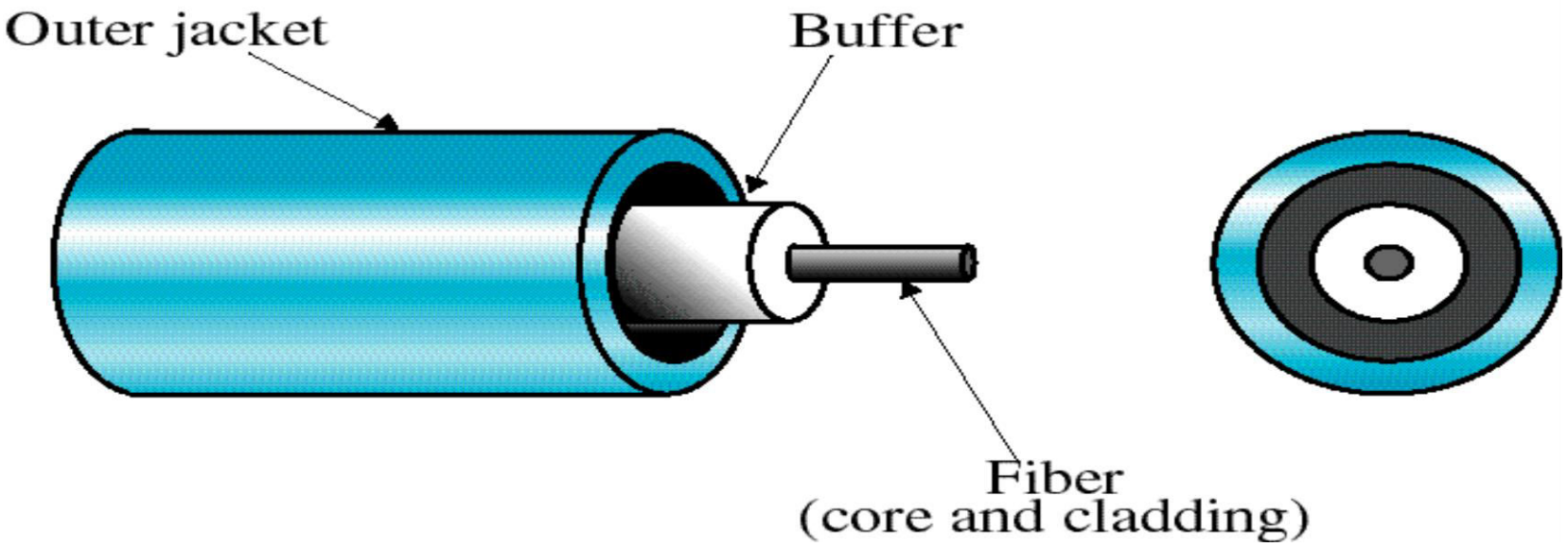
SONET FRAME

- Two-dimensional matrix of bytes
- 9 rows by 90 x n columns
- Each byte in a SONET frame can carry a digitized voice channel.



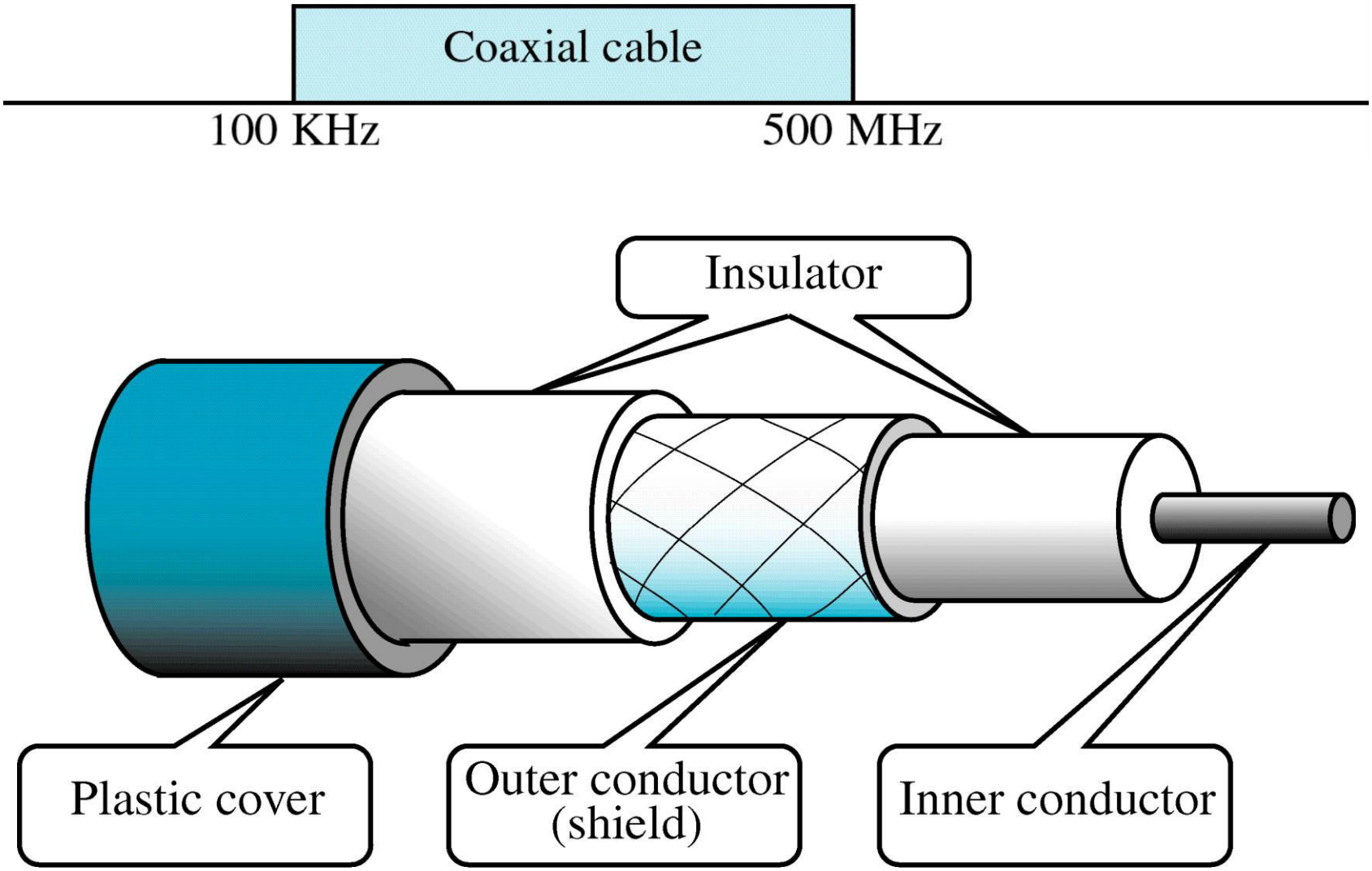
Q) 5 a) fiber optic cable b) coaxial cable

a) Fiber optic cable



- **Core** – central tube of very thin size made up of optically transparent dielectric medium and carries the light form transmitter to receiver. The core diameter can vary from about 5um to 100 um.
- **Cladding** – outer optical material surrounding the core having reflecting index lower than core. It helps to keep the light within the core throughout the phenomena of total internal reflection.
- **Buffer Coating** – plastic coating that protects the fiber made of silicon rubber. The typical diameter of fiber after coating is 250-300 um.

Coaxial Cable

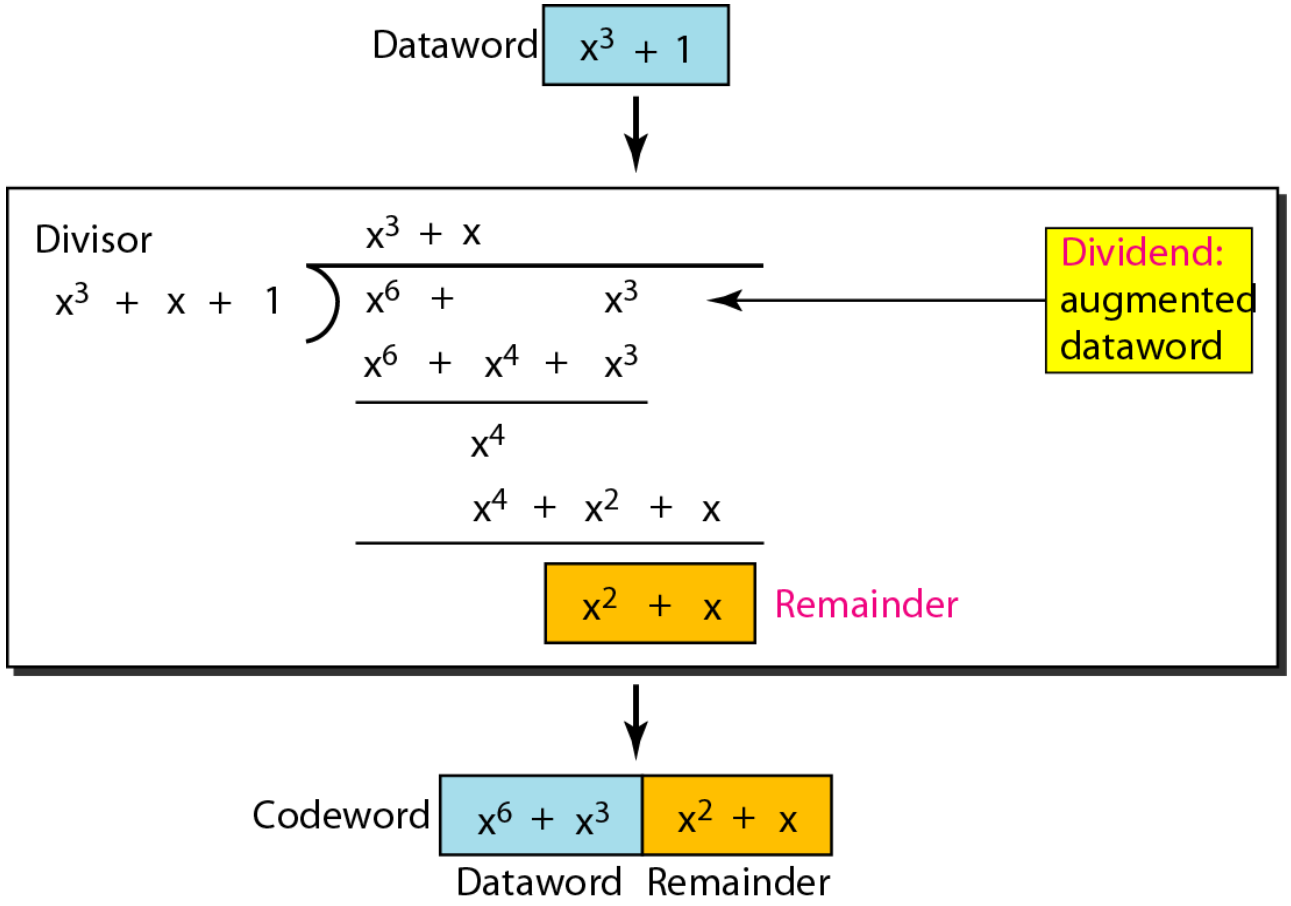


Q) 5 (b) Using Nyquist criterion, calculate the sampling frequency for the following

a)Analog signal having bandwidth of 3000Hz : As fH is not defined therefore bandwidth can't be calculated.

b) Analog signal having:
fL = 3000Hz and fH = 7000Hz
Bandwidth= fH – fL= 7000-3000= 4000Hz

Q) 7 (b)Calculate the CRC and check the same. Data: 100100; Divisor: 1101



7 (a) Assume the packet header is: 01 m1= 10101101, m2=11101110, m3=11111011

At transmitter:

m1= 10101101

= 1101 + 1010 = (carry)-> 1 0111

= 0111+ 1= 1000

= 1's complement =0111

At receiver: 1000+ 0111= 1111

= 1's complement = 0000

Similarly for m2 and m3