SECTION A 10 MARKS

1. D
2. A
3. A
4. D
5. B
6. B
7. A
8. D
9. D
10. A

One mark for each question

SECTION B 15 MARKS

1. True
2. True
3. True
4. False
5. False
6. False
7. True
8. False
9. True
10. True
11. True
12. False
13. False
14. True
15. True

One mark for each question

SECTION C 20 MARKS

1. Single
2. Multimode
3. Satellite, Microwave
4. Light, Current, Voltage
5. Wide, Communication
6. Dielectric
7. Wavelength
8. More
9. 16
10. 32
11. Amplitude, Frequency
12. Demodulator
13. Directivity
14. Antenna
15. PAM

One mark for each answer

SECTION D 55 MARKS

1.) TROPOSPHERE **(1 mark)**

Almost all weather phenomena take place in the troposphere. The temperature in this region decreases rapidly with altitude. Clouds form, and there may be a lot of turbulence because of variations in the temperature, pressure, and density. These conditions have a profound effect on the propagation of radio waves.

STRATOSPHERE **(1 mark)**

The stratosphere is located between the troposphere and the ionosphere. The temperature throughout this region is almost constant and there is little water vapor present. Because it is a relatively calm region with little or no temperature change, the stratosphere has almost no effect on radio waves.

IONOSPHERE **(1 mark)**

This is the most important region of the earth's atmosphere for long distance, point-to-point communications. Because the existence of the ionosphere is directly related to radiation emitted from the sun, the movement of the earth about the sun or changes in the sun's activity will result in variations in the ionosphere. These variations are of two general types:

a) Those that more or less occur in cycles and, therefore, can be predicted with reasonable accuracy.

b) Those that are irregular as a result of abnormal behavior of the sun and, therefore, cannot be predicted. Both regular and irregular variations have important effects on radio-wave propagation. Since irregular variations cannot be predicted, we will concentrate on regular variations.

2a) The ionization density of the layer **(1 mark)**

b) The frequency of the radio wave **(1 mark)**

c) The angle at which the radio wave enters the layer **(1 mark)**

3) **Types of transducers** **choose any three types with one example from each type (3 marks)**

Electromagnetic:

Antenna - converts electromagnetic waves into electric current and vice versa
Cathode ray tube (CRT) - converts electrical signals into visual form
Fluorescent lamp, light bulb - converts electrical power into visible light
Magnetic cartridge - converts motion into electrical form
Photo detector or Photo resistor (LDR) - converts changes in light levels into resistance changes
Tape head - converts changing magnetic fields into electrical form
Hall effect sensor - converts a magnetic field level into electrical form only.

Electrochemical:

pH probes
Electro-galvanic fuel cell
Electromechanical (electromechanical output devices are generically called actuators):
Electro active polymers
Galvanometer
MEMS
Rotary motor, linear motor
Vibration powered generator
Potentiometer when used for measuring position
Load cell converts force to mV/V electrical signal using strain gauge
Accelerometer
Strain gauge
String Potentiometer
Air flow sensor

Electro acoustic:

Geophone - convert a ground movement (displacement) into voltage
Gramophone pick-up
Hydrophone - converts changes in water pressure into an electrical form
Loudspeaker, earphone - converts changes in electrical signals into acoustic form
Microphone - converts changes in air pressure into an electrical signal
Piezoelectric crystal - converts pressure changes into electrical form
Tactile transducer

Photoelectric:

Laser diode, light-emitting diode - convert electrical power into forms of light
Photodiode, photo resistor, phototransistor, photomultiplier tube - converts changing light levels into electrical form

Electrostatic:

Electrometer

Thermoelectric:
RTD Resistance Temperature Detector
Thermocouple
Peltier cooler
Thermistor (includes PTC resistor and NTC resistor)

Radio acoustic:
Geiger-Müller tube used for measuring radioactivity.
Receiver (radio)

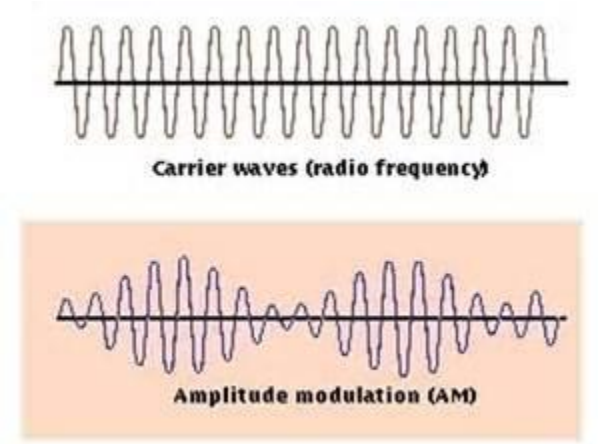
4a) **Bandwidth** is the difference between the upper and lower cutoff frequencies of, for example, a filter, a communication channel, or a signal spectrum, and is typically measured in hertz. In case of a baseband channel or signal, the bandwidth is equal to its upper cutoff frequency. Bandwidth in hertz is a central concept in many fields, including electronics, information theory, radio communications, signal processing, and spectroscopy. **(1 mark)**

b) **Transceiver** Basically a transceiver comes from two equipment; i.e. trans – being transmitter and ceiver – being receiver. Thus this equipment houses both the transmitter and receiver circuitries together with it's diplexer.
PTT or press-to-talk is activated when the caller talks into the transceiver and thus it's transmitter circuitry is switched to the antenna by the diplexer. When the PTT is released, the transceiver remains in the receiving circuitry and the antenna is switched back to the receiver circuit by the diplexer. **(1 mark)**

c) **Selectivity** is a measure of the performance of a radio receiver to respond only to the tuned transmission (such as a radio station) and reject other signals nearby, such as another broadcast on an adjacent channel. Selectivity is usually measured as a ratio in decibels (dBs), comparing the signal strength received against that of a similar signal on another frequency. **(1 mark)**

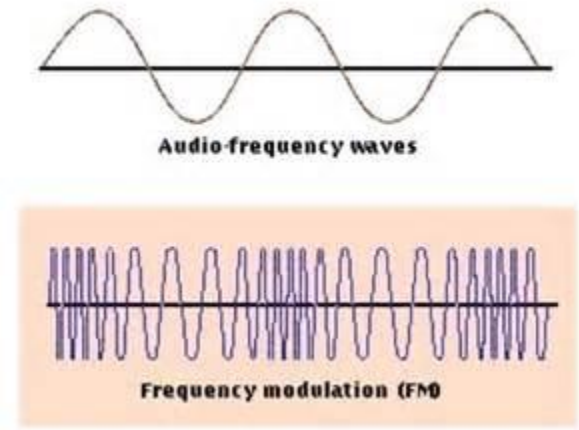
5a) Man-made interference from electrical and electronic devices of many kinds; **(1 mark)**
b) Terrestrial atmospheric noise from lightning storms; **(1 mark)**
c) Cosmic radiation from space. **(1 mark)**

6. Amplitude modulation (AM) is a modulation technique used in electronic communication, most commonly for transmitting information via a radio carrier wave. AM works by varying the strength (amplitude) of the carrier in proportion to the waveform being sent. That waveform may, for instance, correspond to the sounds to be reproduced by a loudspeaker, or the light intensity of television pixels.



(3 marks)

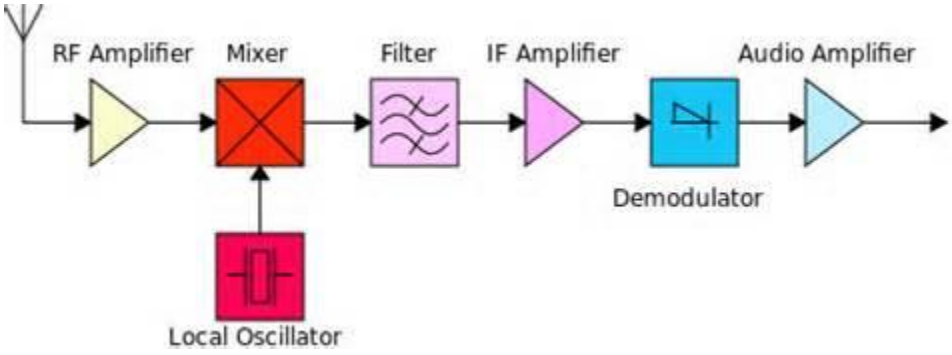
Frequency modulation (FM) is the encoding of information in a carrier wave by varying the instantaneous frequency of the wave. Frequency modulation is used in radio, telemetry, radar, seismic prospecting, and monitoring newborns for seizures. FM is widely used for broadcasting music and speech, two-way radio systems, magnetic tape-recording systems and some video-transmission systems.



(3 marks)

7) Topography **(1 mark)**
Population **(1 mark)**
Traffic **(1 mark)**

8)



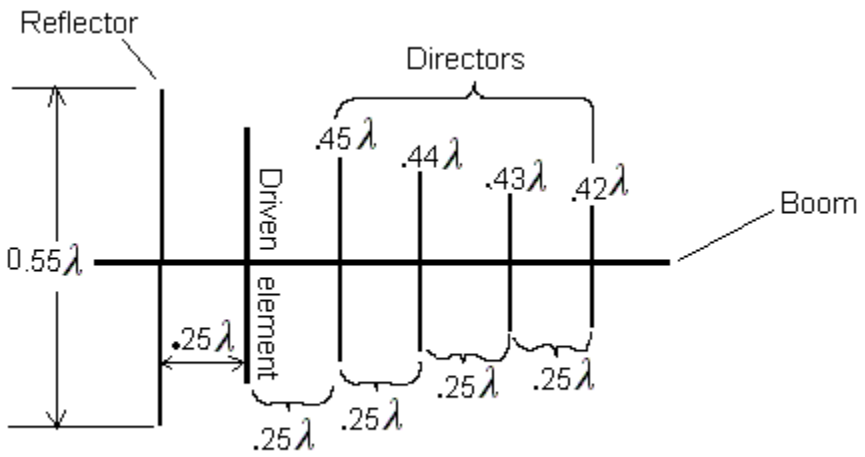
Half mark for each block with name **(4 marks)**

9) A private automatic branch exchange (PABX) is an automatic telephone switching system within a private enterprise. Originally, such systems - called private branch exchanges (PBX) - required the use of a live operator. Since almost all private branch exchanges today are automatic, the abbreviation "PBX" usually implies a "PABX." **(2 marks)**

10) Analog: continuous display of the information; it is an analog to the real information. The process of recording, storing or displaying analog information is in general mechanical. Digital: discrete display of the information: the information is represented by a series of numbers; the value of the numbers can be very close together but there are no intermediate values. It is not continuous. The process of recording, storing or displaying digital information involves numbers.

(2 marks)

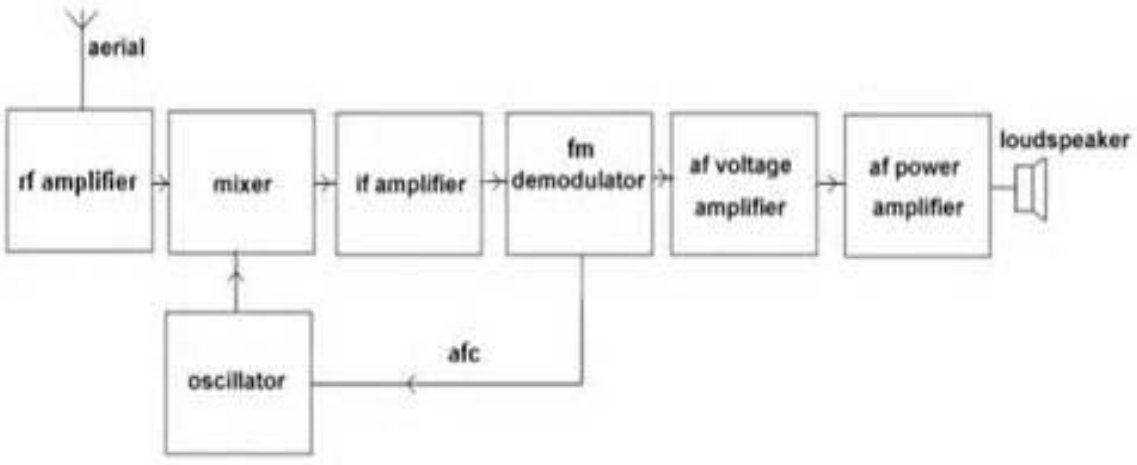
11)



(4 marks)

12) Lambda = v/f = 300 x 10^6 / 98.0 x 10^6 = 3.061 meters, therefore the Dipole length is 1.53 meters **(2 marks)**

13)



9 marks for block with name

14)
a) All elements are driven
b) It is fed at the front
c) Distance between elements varies
d) Input impedance is 75⦸
e) It is directional
f) Has high gain
(Choose any three) 0.5 mark each (1.5 marks)

15)
a) A Source **(0.5 mark)**
b) A destination **(0.5 mark)**
c) Devices that introduce various amounts of loss or gain to the signal as it propagates through the system **(0.5 mark)**

16) Depending on the type of antenna, the length of the antenna is directional proportion to it's wavelength. **(2 marks)**

17) Bit rate – is how many data bits are transmitted per second. **(1.5 marks)**
Baud rate – is the measurement of the number of times per second a signal in a communication channel varies. **(1.5 marks)**