SCIENCE ACADEMY (R.)

(A UNIQUE CENTRE FOR PU CLASSES)

Unit I : ELECTRIC CHARGES AND FIELDS

1. Mention any two methods of charging

1. Charging by friction
2. Charging by conduction and
3. Charging by induction.

2. Write any two Properties of electric charges

1) Charges possessed additive property.
2) Charges are quantized.
3) Charges are conserved

3. State and explain Coulomb's law of electrostatics

This law states that 'The force of attraction or repulsion between two point stationary charges is directly proportional to the product of the magnitude of charges and inversely proportional to square of the distance between them.

$$F \propto \frac{Q_1Q_2}{d^2}$$

$$F = K\frac{Q_1Q_2}{d^2}$$

For air medium

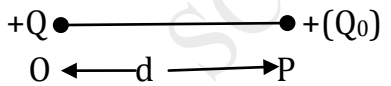
$$\therefore \quad \boxed{F = \frac{1}{4\pi\varepsilon_0} \times \frac{Q_1Q_2}{d^2}}$$

4. Write Coulomb's law in Vector form

$$\vec{F}_{12} = \frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{d^2}\hat{r}_{21} \; And \quad \vec{F}_{21,} = \frac{1}{4\pi\varepsilon_0}\frac{Q_1Q_2}{d^2}\hat{r}_{12}$$

$\vec{F}_{12} = -\vec{F}_{21}$ and $\hat{r}_{12} = -\hat{r}_{21}$. where $\hat{r}_{12}$ and $\hat{r}_{21}$ are unit vectors.

5. Obtain an expression for Electric intensity at a point due to a point charge



The force acting on unit +ve charge (Q_0) at 'P' due to charge Q is given by coulomb's law.

$$F = \frac{1}{4\pi\varepsilon_0}\frac{Q\,Q_0}{d^2}$$

$$F/Q_0 = \frac{1}{4\pi\varepsilon_0} \times \frac{Q}{d^2} \quad , \qquad \text{By def: } F/Q_0 = E$$

$$\boxed{\therefore \; E = \frac{1}{4\pi\varepsilon_0}\frac{Q}{d^2}}$$

6. Write any two Properties of electric lines of force or field lines.

1. Lines of force are always starts from +ve charge and ends at –ve charge.
2. Lines of force never intersects each other.
3. Lines of force will not form a closed path.
4. Lines of force do not pass through a conductor.

7. Write the differences between polar and non polar molecules.

POLAR MOLECULES: In some molecules centres of positive and negative charge concentration are separated by very small distance, they behave like dipoles they possess permanent dipole moment. Such molecules are called **polar molecules**.

Ex: H_2O, CO , N_2O , NH_3 etc.

NON POLAR MOLECULES:

In some molecules centres of positive and negative charge concentration lie at the same point. They do not behave like dipoles. Their dipole moment is zero, such molecules are called **non-polar molecules**.

Ex: CO_2, N_2 , O_2, H_2 etc.

8. Define the following:

1) **Linear charge density (λ)** : The charge distributed uniformly per unit length of the conductor is called as linear charge density.

2) **Surface charge density [σ]**:

Charge distributed uniformly per unit area of the surface of the conductor is called as surface charge density.

3) Volume charge density [ρ] :

Change distributed uniformly per unit volume of the surface of the conductor is called as volume charge density

9. State and explain Gauss theorem

This theorem states that "***the total electric flux over a closed surface enclosing charges is equal to $\frac{1}{\varepsilon_0}$ times the total charge enclosed by the surface***".

$$\Phi = \frac{1}{\varepsilon_0}[Q]$$

Let q_1, q_2 , q_3 ------ be the charges enclosed by a surface.

The total charge enclosed by the surface in $Q = q_1 + q_2 + q_3 + - - - - - -$

$$\text{i.e. } \Phi = \frac{1}{\varepsilon_0}(Q)$$

10. Write the Comparison of variation of electric potential with the distance, between a point charge and an electric dipole

	Point charge	Electric – dipole
1	$V \propto \frac{1}{r}$	$V \propto \frac{1}{r^2}$
2	It does not depend on the angle	It is directly proportional to cosine of the angle, $V \propto \cos\theta$

11. Mention the expression for capacitance of parallel plate capacitor and explain the terms used.

$$C = \frac{\varepsilon_0 A}{d}$$

where, A = Area of cross section , d = distance between the plates

ε_0 = permittivity.

12. Write any two Properties of equipotential surfaces.

1. No work is done in moving a test charge over an equipotential surface.
2. The equipotential surfaces gives the direction of the electric – field.
3. No two equipotential surfaces can intersect each other.

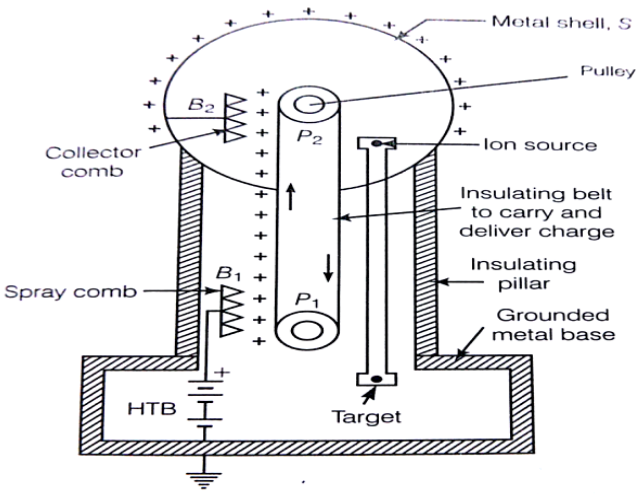
13. Expression for electric potential energy of a system of two point charges.

$$\therefore \quad \boxed{U = \frac{1}{4\pi\varepsilon_0} \times \frac{Q_1 Q_2}{d}}$$

For a system of three charges .

$$U = \frac{1}{4\pi\varepsilon_0} \times \left(\frac{Q_1 Q_2}{d_1} + \frac{Q_2 Q_3}{d_2} + \frac{Q_3 Q_1}{d_3}\right)$$

14. Draw a neat labeled diagram of Van-de Graff generator.



van de Graaff generator

15. Write any two uses of capacitors.

1) used to store electric charges
2) used to block unwanted DC voltage
3) used to avoid sparking in gaps.

16. Write the expression for Electric current in a conductor and explain the terms used.

$$\boxed{I = nAeV_d}$$

Where

n- electron density of conductor , A – Area of cross section of conductor
e – charge of electron of conductor, V_d drift velocity of electrons.

17. What is Current density? Mention the SI unit for it.

The ratio of current in a conductor to the area of cross section is called as current density. it is expressed as A/M^2.

18. State and explain Ohm's law.

This law states that, ***the current flowing through a conductor is directly proportional to the potential difference between the ends of the conductor. Provided temperature and other physical conditions of the conductor remaining constant***"

$I \propto V$

$I = \frac{1}{R} V$

$\boldsymbol{V = IR}$

19. Define the following: a) drift velocity b) Mobility

Drift velocity: The average velocity with which free electrons get drifted towards the positive end of conductor (or opposite to the electric field) under the influence of an external electric field is called drift velocity.

Mobility: It is defined as the ratio of magnitude of drift velocity per unit electric field.

$$\mu = \frac{|v_d|}{E}$$

20. Write the Limitations of Ohm's law

1) Potential difference may vary non-linearly with current
2) The relation between potential difference and current is non unique.
3) Ohm's law is not applicable for semiconductors.

21. What is Terminal potential difference? Mention an expression for it.

The potential difference across the terminals of the cell is called as terminal potential difference.

V = E - I ɤ, E – EMF of cell ɤ is internal resistance of the

V = E when cell is in open circuit.

22. State Kirchhoff's laws (or rules).

Junction rule: In any electrical network, the algebraic sum of the currents at a junction is zero. **i.e.** $\sum$ **I = O.**

Kirchhoff's I law is nothing but **law of conservation of charge.**

Loop rule: In any closed loop, the algebraic sum of the e.m.f is equal to the algebraic sum of product of currents and resistances in that mesh.

$\sum$ **E** = $\sum$ **IR.**

Kirchhoff's II law is nothing but '**law of conservation of energy**'.

23. Write any two Applications of Potentiometer:

1) It is used to verify the emf of the two different cells
2) It is used to find the internal resistance of the given cell.

24. What is Lorentz force? Give an expression for it.

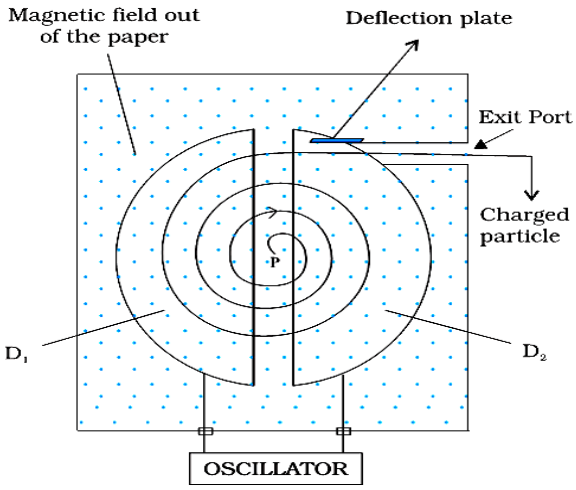
The total force experienced by a charge (q) moving in both electric and magnetic field is called ***Lorentz force***.

$$\vec{F_2} = q\left(\vec{E} + (\vec{V} \times \vec{B})\right)$$

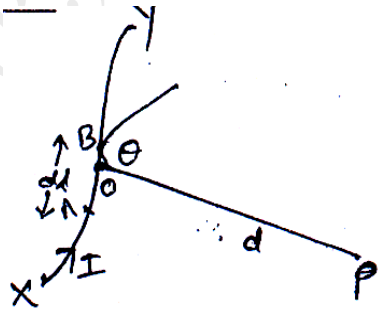
25. Write any two Uses of cyclotron

1) It is used to accelerate proton's , deuterons and ∝- particles which are used in nuclear reaction.
2) It is used to produce radio isotopes which are used is medical diagnosis and treatment.

26. Draw a neat labeled diagram of cyclotron and write any two applications of Cyclotron.



27. State and explain Biot savart's law (or Laplace law).



Magnetic field produced at P due to current I in the element AB is

1) directly proportional to strength of the current (dB α I)
2) directly proportional to length of the element (dB α dl)
3) directly proportional to sin θ (dB α sin θ) and
4) inversely proportional to square of the distance of point P from the mid point (dB α 1 / d^2)

Mathematically, **dB α (I d *l* sin θ) / d^2**

$$dB = k.\,(I\,d\,l \sin\theta) / d^2$$

$$k = \mu_0 / 4\pi$$

$$dB = \frac{\mu_0}{4\pi} \cdot \frac{I\,d\,l \sin\theta}{d^2}$$

28. Write any two Properties of Magnetic field lines:

1. No two magnetic field lines can intersect each other.
2. The magnetic field lines will be parallel and equidistant in a uniform magnetic field.
3. The magnetic field lines will be more crowded where the strength of the field is more.

29. Distinguish between Ammeter and Voltmeter

AMMETER	VOLTMETER
1. Ammeter is used to measure current in the circuit.	1. Voltmeter is used to measure p.d. b/w two points.
2. It is always connected in series.	2. It is always connected in parallel.
3. Its effective resistance is very low.	3. Its effective resistance is very high.
4. Resistance of ideal ammeter is zero.	4. Resistance of ideal voltmeter is infinity.

30. Define the earth's magnetic elements declination, dip.

Declination (δ): The angle between geographic meridian and magnetic meridian at the place is called declination at the place.

Dip (θ): The angle made by the direction of earth's magnetic field B with the horizontal along the magnetic meridian at the place is called 'dip' at the plane.

31. Write any two differences between Soft magnetic materials and hard Magnetic materials.

Soft Magnetic Materials	Hard Magnetic materials
1. They have low coercivity	1. They have high coercivity
2. Hysteresis loss is less	2. Hysteresis loss is high.
3. Eddy current loss is less.	3. Eddy current loss is high.

32. Write any two uses of Electromagnets.

1. They are used in electric bells.
2. They are used in loud speakers.
3. They are used in lifting Cranes.

33. State Faraday's laws of EMI:

I law: This law states that whenever magnetic flux linking round a close circuit changes an instantaneous emf and hence current produced in the circuit and this emf exists as long as the change takes place.

II law: this law states that the magnitude of the induced emf is directly proportional to the rate of change of magnetic flux.

34. State and explain Lenz's law.

This law states that the direction of induced emf and hence current is such that it tends to oppose the change that produces it.

$$e = -L\frac{dI}{dt}$$

35. What are eddy currents? Write any two applications of eddy currents.

The current induced in metal plate when placed in changing magnetic field is called 'eddy currents'.

Eddy currents are used in i) Speedometer,
ii) induction furnace
iii) electric breaks.

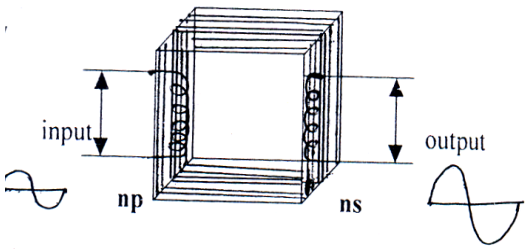
36. On what factors mutual inductance depends?

1) Number of turns on either coil
2) Shape and size of coils
3) Separation between the coils

37. What is a transformer on what principle it works?

Transformer is a device used to step up or step down alternating voltages.
It works on the principle of mutual induction.

38. Draw a neat labeled diagram of a Transformer



39. Mention the Sources of Energy losses in Transformer.

1) Magnetic flux leakage loss
2) Eddy current loss
3) Hysteresis loss

40. State Ampere's Circuital Law.

" The line integral of magnetic field $\vec{B}$ around any closed path is equal to μ_o times the total current threading the closed path"

i.e. $\oint \vec{B} \cdot \vec{dl} = \mu_o I$

41. What is displacement current? What is the need for displacement current?

" The current which comes into play in the region in which the electric field and the electric flux is changing with time".

Need for Displacement Current:

(i) To know about the Apparent Violation of Kirchhoff's Junction Law
(ii) To study the Violation of Ampere's Circuital law.

42. Write any two applications of gamma rays.

i) They are used in the treatment of cancer.
ii) They are used to produce nuclear reaction.

43. Write any two applications of UV rays.

i) They are used for purification of air and water.
ii) They are used in the synthesis of vitamin D.

44. Write any two applications of IR-rays.

i) They are used for long distance photography.
ii) They are used in the treatment of muscular sprain.

45. Write any two applications of X-rays.

i) They are used to detect foreign bodies inside human body.
ii) They are used to detect fracture in bones.
iii) They are used in the treatment of skin cancer.

46. Write any two applications of Microwaves

i) They are used in microwave ovens for heating
ii) They are used in RADAR system for aircraft navigation

47. State Laws of refraction:

I law: This law states that the incident ray, the refracted ray and the normal at the point of incidence are all lie in same plane.

II law (Snell's law) : This law states that the ratio of sine of angle of incidence and sine of angle of refraction is always a constant for given pair of media and for a colour ray of light.

$$\frac{\sin i}{\sin r} = \text{constant} = n$$

48. Write the Conditions of TIR

1) The ray should go from denser medium to rarer medium.
2) The angle of incidence in the denser medium must be greater than critical angle.

49. Write the Illustrations of TIR

1) Sparkling of diamond is due to total internal reflection.
2) Appearance of mirages is due to TIR.
3) Appearance of rainbow is due to dispersion and TIR.

50. Write any two applications of TIR.

1) Artificial diamonds are made to sparkle using TIR.
2) Using TIR messages are sent from one place to the other through the optical fibre.

51. Write any two Applications of Optical Fibre.

1) It is used to diminish or enlarge optical images.
2) It is used to measure blood flow in heart.
3) It is used to measure pressure and temperature.

52. What is Myopia? How to correct it?

Myopia is the defect of eye in which a person can see only nearby objects, but fails to see the far away objects distinctly.

Remedy : Using concave lens.

53. What is Hypermetropia? How to correct it?

Hypermetropia is the defect of eye in which a person can see only farther objects but fails to see nearer objects distinctly.

Remedy : Using convex lens

54. What is Presbyopia? How to correct it?

It is the defect of an eye which is unable to see the nearby as well as far away objects.

Remedy: Using Bifocal lens

55. Write any two conditions for sustained interference.

1) The two sources must be coherent
2) Two sources must be very narrow

56. Write Conditions for constructive interference interms of phase difference and path difference.

Phase difference : $\delta = 2n\pi$ where n = 0,1, 2,3,……

Path difference : $x = n\lambda$. n = 0, 1 , 2 , ……..

57. Write the Conditions for destructive Interference in terms of phase difference and path difference.

Phase difference $\delta = (2n + 1)\pi$ where n = 0,1,2,3,……

Path difference : $x = (2n + 1) . (\lambda/2)$ where n = 0,1,2,3,……..

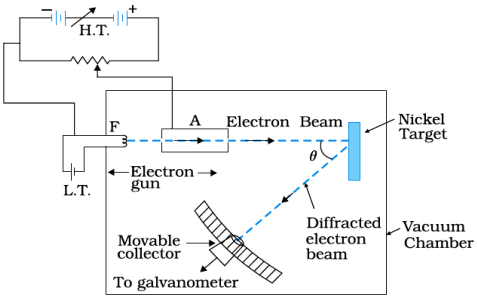
58. Write any two Applications of Polaroids.

1) They are used as sun glasses.
2) They are used as polarizers.
3) They are used as analyser.

59. Mention any two types of electron emission.

1. Photoelectric emission 2. Thermionic emission
3. Field emission

60. Draw a neat labeled diagram for Davisson – Germer experiment.



61. <u>Expression for wavelength of matter waves or de Broglie wavelength</u>.

The energy of the photon is given by

$$E = h\upsilon = hc / \lambda \quad \ldots\ldots\ldots\ldots\ldots \text{(I)}$$

According to Einstein's mass energy relation, energy of the photon is given by

$$E = mc^2 \quad \ldots\ldots\ldots\ldots\ldots\ldots \text{(II)}$$

From (I) and (II) , we get

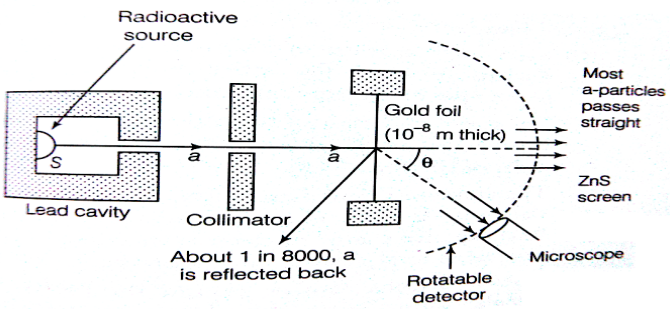
$$hc / \lambda = mc^2$$

$$\boldsymbol{\lambda = h / mc = h / p}$$

where **p = mc**, is the momentum of photon.

$$\boxed{\boldsymbol{\lambda = h / mv}}$$

62. Draw a neat labeled diagram for Geiger-Marsden experiment.
OR Rutherford's alpha scattering experiment.



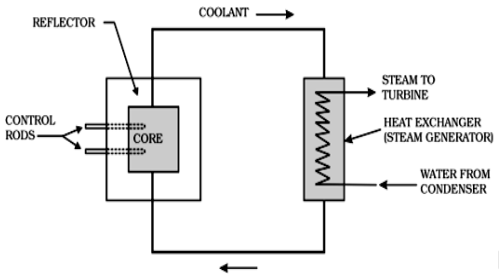
63. Write Drawbacks of Rutherford Model of atom.

i) It could not explain the stability of atoms.
ii) It could not explain the line spectrum

64. Write any two limitations of Bohr's atom model.

1) Bohr' theory is not applicable to atoms having more than one electron.
2) Bohr's theory fails to explain fine structure of spectral line.
3) This theory does not account for the wave nature of electrons.

65. Draw a neat labeled diagram for Power Reactor (Nuclear Reactor).



66. What is Light emitting diode (LED)? Write any two applications of LED.

An LED is a p-n junction diode which converts electrical energy to light energy.

Applications of LED's:

1) They are used as optical fibre transmitter.
2) They are used for message display in railway station, bus stand, and airport.
3) In TV remote control.

67. What is Photo diode? Write any two applications of photodiode.

A Photo diode is a p-n junction diode which converts light energy to electrical energy.

Applications:

1) These photodiodes are used in computers and in films.
2) They are used in camera light meters and clock radios.

68. What is Solar Cell diode? Write any two applications of it.

A solar cell is a junction diode which converts solar energy into electrical energy.

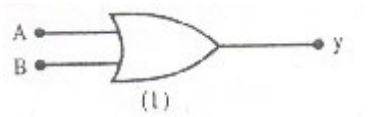
Applications:

1. They are used in Solar water heaters, solar power supplies.
2. Solar cells are used in satellites to recharge their batteries.

69. Distinguish between npn and pnp Transistor.

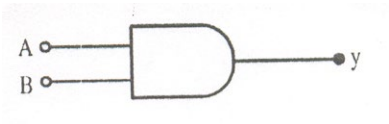
n p n transistor	**p n p transistor**
1. Here 1 p – type semiconductor is sandwiched between two n-type semiconductors.	1. Here 1 n – type semiconductor is sandwiched between two p-type semiconductors.
2. Conductivity is mainly due to electrons	2. Conductivity is mainly due to holes.
3. Conventional current flows from collector to emitter through the base	3. Conventional current flows from emitter to the collector through the base.

70. Write the circuit symbol and truth table for OR gate.



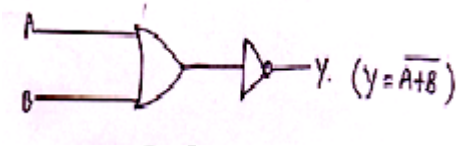
A	B	y = A + B
0	0	0
1	0	1
0	1	1
1	1	1

71. Write the circuit symbol and truth table for AND gate.



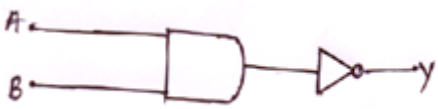
A	B	y = A . B
0	0	0
1	0	0
0	1	0
1	1	1

72. Write the circuit symbol and truth table for NOR gate.



A	B	y ($\overline{A + B}$ = y)
0	0	1
1	0	0
0	1	0
1	1	0

73. Write the circuit symbol and truth table for NAND gate.



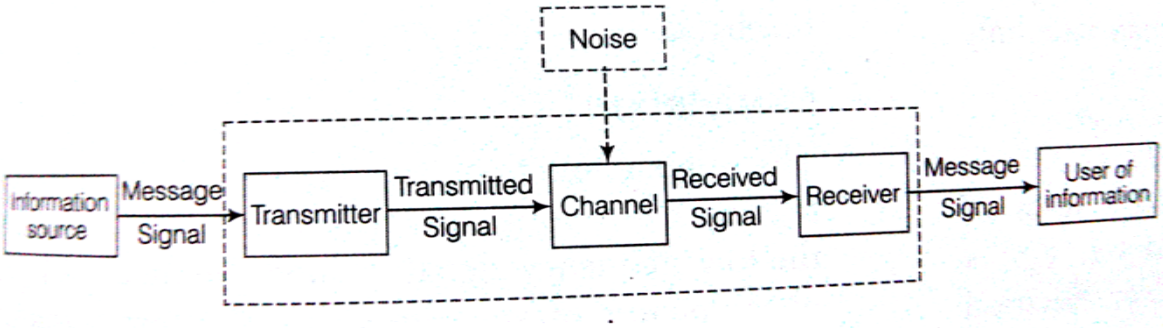
A	B	y (y = $\overline{A.B}$)
0	0	1
1	0	1
0	1	1
1	1	0

74. What is an integrated circuit? Name the widely used technology of IC.

The concept of fabricating *an entire circuit* on a small single block (or chip) of a semiconductor has revolutionised the electronics technology. Such a circuit is known as *Integrated Circuit* (IC).

The most widely used technology is the ***Monolithic Integrated Circuit.***

75. Write the generalised block diagram of communication system.



76. Define the following terms.

(i) ***Attenuation****:* The loss of strength of a signal while propagating through a medium is known as attenuation.

(ii) ***Range****:* It is the largest distance between a source and a destination up to which the signal is received with sufficient strength.

77. Define the following terms.

(i) ***Demodulation****:* The process of retrieval of information from the carrier wave at the receiver is termed demodulation. This is the reverse process of modulation.

(ii) ***Repeater****:* A repeater is a combination of a receiver and a transmitter used to extend the range of a communication system

(iii) Transducer: A device which converts message signals into suitable electrical signals is called transducer.

78. What is the Bandwidth of Speech signals?

Ans: 2800 Hz

79. What is the Bandwidth of TV signals?

Ans: 6 MHz

80. What is the bandwidth range for FM?

Ans: 88 to 108 MHz.

81. Mentio the different modes of Propagation of electromagnetic Waves

The electromagnetic waves can be transmitted through three processes,

(i) Ground wave propagation
(ii) Sky wave propagation
(iii) Space wave propagation

82. Mention the types of transmission media.

Ans: i) Co-axial cables ii) Free space iii) Optical fibres

83. What is modulation? What is the need for modulation?

The process of superposing audible frequency waves on carrier wave is called modulation. The superposed wave is called the modulated wave.

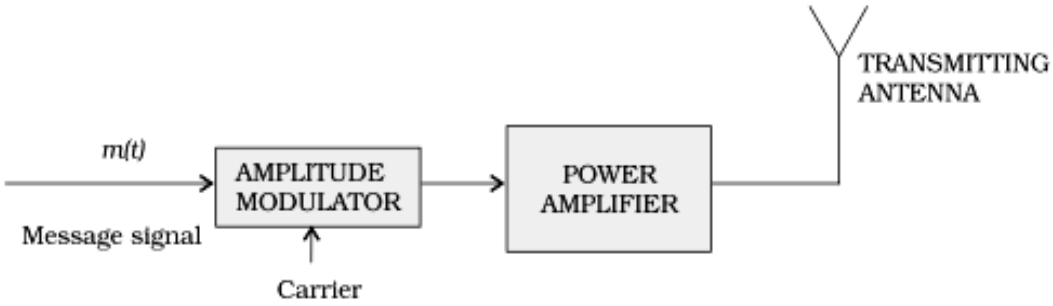
Need for modulation.

(i) To avoid the use of long impracticable antenna. (**λ / 4**.)

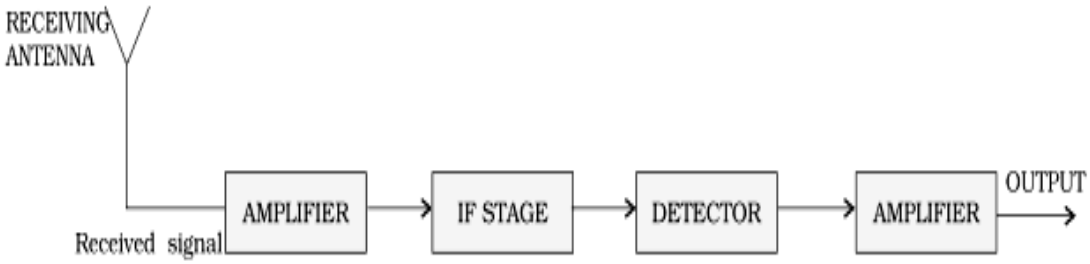
(ii) To provide proper power during transmission of signals [$P \alpha (1/\lambda)^2$]

(iii) To avoid mixing up of signals from the other transmitters

84. Draw a Block diagram of AM transmitter



85. Draw a Block diagram of AM Receiver.



86. Write any two differences between AM and FM.

AM (Amplitude Modulation)	FM (Frequency Modulation)
1. It handles un even power	1. It handles even power
2. It is less efficient	2. It is more efficient