Chapter # 16
Electomagnetic Waves & Electrons

Q.1. Under what circumstances does a charge radiate electromagnetic waves?
Ans: A charge radiates e.m. waves when it is accelerated.

Q.2. In an electromagnetic wave, what is the relationship, if any, between the variation in the magnetic and electric fields?
Ans: In an electromagnetic wave, the transverse sinusoidal oscillating electric field and magnetic field are propagated at right angles to each other and to the direction of motion.

Q.3. A radio transmitter has a vertical antenna. Does it matter whether the receiving antenna is vertical or horizontal?
Ans: A receiving antenna should be vertical just like a transmitting antenna. A horizontal receiving antenna will intercept much less radio frequency signals.

Q.4. Explain why are light waves able to travel through a vacuum, whereas sound waves cannot?
Ans: Light waves are electro-magnetic waves (of wavelength 400 nm to 760 nm). Sound waves are produced due to the vibration of the molecules of a medium. Hence sound waves require a material medium, whereas light waves do not require medium for their propagation.

Q.5. Explain the condition under which radiation of electromagnetic waves takes place from a certain source?
Ans: When a transmitting antenna is couples with an alternating source of potential (known as oscillator), charges (electrons) are accelerated up and down the antenna. This creates a fluctuating electric flux, which generates a magnetic flux. Hence the waves propagated from an antenna are e.m. waves.

Q.6. Can a diode be used for amplifying a weak signal?
Ans: Normally, a diode cannot be used for amplifying a weak signal. But specially constructed diode (e.g. tunnel diode) can be used as amplifier and oscillator for microwave frequencies.

Q.7. Are radio waves form of light?
Ans: Since both radio waves and visible light are electromagnetic in nature, hence we can say that radio waves are a form of light (of frequency 4×10^{14} H_z), having frequencies much lower (30 kH_z to 300 MH_z) than light.

Q.8. Can e.m. waves be propagated through a piped vacuum?
Ans: Yes.

Q.9. Why does a semi conductor act as an insulator at OK and why does its conductivity increase with increase of temperature? – OR – discuss the effect of temperature on semi conductors?
Ans: In a semiconductor, at OK, the valence band is completely filled and the conduction band is totally empty. The semiconductor, therefore, behaves like a perfect insulator. At room temperature, some of the electrons in the valence band gain energy from thermal agitation

of the lattice atoms and move up into the conduction band, leaving holes in the valence band. If the temperature is increased, due to further thermal agitation, more electrons occupy conduction band. Thus conductivity of semiconductor increases with increase of temperature.

Q.10. Explain the role of forbidden band in solids?

Ans:

1. In conductors, the conduction band and valence bands are overlapping and hence no forbidden band exists.
2. In insulators, the conduction and valence bands are separated by a large for bidden band.
3. In semiconductors, the conduction and valence bands are separated by a small forbidden energy gap.

Q.11. Why is light not seen in ordinary diode but an LED emits light?

Ans: Silicon is opaque to light. So ordinary silicon diode does not emit light but an LED is a junction diode made from gallium arsenide phosphate crystal. When it is forward biased, electron hole recombination takes place which results in the release of light.