SECTION B — (5 × 6 = 30 marks)

Answer in Short (about 100 words)

21. (a) What are polar and non-polar molecules? Give some examples.

Or

(b) State Biot-Savart law and relate it to Ampere's law.

22. (a) Show that Hertz potential $\vec{\pi}$ for an electric dipole of moment p is given by $\vec{\pi} = \frac{1}{4\pi\epsilon_0}\frac{[p]}{r}$.

Or

(b) Derive expression for electric and magnetic field due to an oscillating dipole.

23. (a) What must be the width of a rectangular guide, such that the energy of electromagnetic radiations whose free space wavelength is 3 cm. travels down the guide at 95% of the speed of light, in principal mode.

Or

(b) A plane electromagnetic wave travels through a uniform plasma. Calculating the poynting vector, show that it vanishes if the frequency of the wave is equal to the plasma frequency.

24. (a) Show that the scattering cross-section, when plane monochromatic waves are incident on free electron is $\sigma_T = \frac{8\pi}{3} r_0^2$.

Or

(b) Explain the following :

(i) The clear sky appears to be blue. Why?

(ii) The rising or setting sun appears red. Why?

25. (a) Prove that the space interval $x^2 + y^2 + z^2$ is not invariant under Lorentz transformation while the space-time interval $x^2 + y^2 + z^2 - c^2t^2$ is invariant.

Or

(b) Show that the self product of electromagnetic field Tensor is given by $F_{\mu\nu}^2 = 2\left(B^2 - \frac{E^2}{c^2}\right)$.

SECTION C — (5 × 10 = 50 marks)

Answer in detail.

26. (a) Using Coulomb's law obtain the results $div\ E = \left(\frac{\rho}{E_0}\right)$ and $curl\ E = 0$ for the electric field E due to volume charge distribution of density ρ.

Or