15. (a) Prove the E.B. is invariant under Lorentz transformation.

Or

(b) Show that the self product of electromagnetic field tensor is given by

$$F_{\mu\nu}, = 2\left(B^2 - \frac{E^2}{C^2}\right).$$

SECTION C — (5 × 8 = 40 marks)

16. (a) Show that the field inside a uniformly polarised sphere is constant every where and $\left(\frac{1}{3\epsilon_0}\right)$ times the density of polarisation and is directed opposite to the direction of polarisation.

Or

(b) Deduce Debye relation of study of molecular structure.

17. (a) Starting from Maxwell's equation, prove the Coulomb's law and Continuity equation.

Or

(b) Express the Lorentz force formula in terms of electromagnetic potentials.

18. (a) Derive the equations of Telegraphy.

Or

(b) Derive a standard wave equation representing unattenuated wave travelling at a speed v.

19. (a) Derive an expression for the classical radius of the electron.

Or

(b) What is normal and anomalous dispersion? Derive Sellmeier's equation for the refractive index of a dielectric medium.

20. (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) Writing Maxwell's equations in 4–vector form, prove that they are invariant under Lorentz transformation.