

B.Sc. (Honours) Examination 2019

Semester-IV

Physics (Honours)

Course: BPC-42

(Electricity & Magnetism-II)

Time: Three Hours

Full Marks: 40

Questions are of value as indicated in the margin.

Answer *any four* questions.

1. (a) What is displacement current? Briefly discuss. Obtain an expression for it considering modification of Ampere's law by Maxwell. 3+2
(b) Starting with Maxwell's equations in free space, show that the propagation of an electromagnetic wave is transverse. 5
2. (a) Show that the d'Alembertian operator $\square^2$ is Lorentz invariant. 4
(b) Derive expressions for $\mathbf{E}$ and $\mathbf{B}$ in terms of scalar and vector potentials V and $\mathbf{A}$. Show that under suitable gauge conditions, $\square^2 V = -\rho/\epsilon_0$; $\square^2 \mathbf{A} = -\mu_0 \mathbf{J}$. 3+3
3. (a) Considering the propagation of an electromagnetic wave through the boundary of two different dielectric media at normal incidence, show that $R+T=1$ 5
(b) If $\mathbf{B}$ is uniform, show that $\mathbf{A}(\mathbf{r}) = -(\mathbf{r} \times \mathbf{B})/2$ is valid. 3
(c) What is Brewster's angle? Discuss 2
4. (a) State and prove Poynting's theorem. 5
(b) Obtain an expression for 'skin depth' for a poor conductor. 5
5. (a) Write down the basic postulates of special theory of relativity. 1
(b) Discuss i) length contraction, ii) time dilation and iii) velocity addition law. 3+3+3
6. (a) State the laws of thermoelectric effects. 4
(b) For a Cu-Fe thermocouple with junctions at temperatures $(T + dT)$ and T respectively, show that $\Pi = T (dE/dT)$ and $\sigma_{Cu} - \sigma_{Fe} = -T (d^2E/dT^2)$ 3+3
7. (a) A sinusoidal emf is applied to an AC circuit i) with a resistor and an inductor in series and ii) with a resistor and a capacitor in series separately. Find the current flowing in the circuit in the above two cases. 3+3
(b) Briefly discuss the design and operation of a transformer. 4

(Symbols have their usual meanings in all questions above)