

5/PHY-300 Syllabus-2023

2 0 2 5

(Nov-Dec)

FYUP : 5th Semester Examination

MAJOR

PHYSICS

(Electromagnetic Theory)

PHY-300

Marks : 75

Time : 3 hours

*The figures in the margin indicate full marks
for the questions*

Answer any **ten** questions

1. (a) State and prove the uniqueness theorem in electrostatic field. 1+5=6
(b) What is an electrical image? 1½
2. Find the boundary condition satisfied by the electric field vector $\vec{E}$ and displacement vector $\vec{D}$ at the interface between two homogeneous dielectric media. 7½

(2)

3. What are polarization and polarization vector? Obtain the relation among electric field intensity $\vec{E}$, polarization $\vec{P}$ and electric displacement $\vec{D}$ in a dielectric medium.
 $1\frac{1}{2}+1+5=7\frac{1}{2}$
4. Consider a dielectric sphere in a uniform electric field $\vec{E}_0$. Calculate the potential and electric field intensity at a point inside the sphere.
 $7\frac{1}{2}$
5. What are polar and non-polar molecules? Give an example of each. Derive the Clausius- Mosotti relation.
 $1\frac{1}{2}+1\frac{1}{2}+4\frac{1}{2}=7\frac{1}{2}$
6. What do you mean by gauge transformation? Define scalar and vector potentials as occurred in electromagnetic theory. How do these potentials change under gauge transformation?
 $2+3+2\frac{1}{2}=7\frac{1}{2}$
7. State and prove Poynting's theorem. $2+5\frac{1}{2}=7\frac{1}{2}$
8. What is displacement current? Write down Maxwell's equations for electromagnetic fields in a dielectric medium. Explain the physical significance of the said equation.
 $1\frac{1}{2}+2+4=7\frac{1}{2}$

(3)

9. Discuss the propagation of plane electromagnetic waves in an isotropic dielectric medium. Show that electric and magnetic field vectors $\vec{E}$ and $\vec{H}$ are mutually perpendicular. $5+2\frac{1}{2}=7\frac{1}{2}$
10. Discuss the propagation of plane electromagnetic waves in a conducting medium. $7\frac{1}{2}$
11. (a) Obtain the relation among electric field $\vec{E}$, magnetic field $\vec{B}$ and propagation vector $\vec{k}$ in free space. $4\frac{1}{2}$
- (b) Describe circular and elliptical polarization using vector representation of the electric field. 3
12. Obtain the boundary conditions satisfied by the electromagnetic field vectors $\vec{E}$, $\vec{D}$, $\vec{B}$ and $\vec{H}$ on the plane interface between two media. $7\frac{1}{2}$
13. Find an expression for reflection and transmission coefficients for an electromagnetic wave incident normally on the boundary between two dielectrics. $7\frac{1}{2}$

(4)

14. Derive Fresnel's equation for non-conducting media when vector $\vec{E}$ is perpendicular to the plane of incidence. $7\frac{1}{2}$

15. What is an optical fibre? Explain the light propagation in an optical fibre using ray theory. What is acceptance angle?
 $1\frac{1}{2}+4\frac{1}{2}+1\frac{1}{2}=7\frac{1}{2}$

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