

**ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE - 27**  
**B.Sc. PHYSICS – III SEMESTER**  
**SEMESTER EXAMINATION – NOVEMBER 2020**  
**PH 318: ELECTROMAGNETISM, SOUND AND PHYSICAL OPTICS**

TIME 2 ½ Hrs

MAX. MARKS:70

This question paper has **TWO** printed pages and **THREE** parts

**PART- A**

Answer any **FOUR** of the following:

(10x4=40)

- 1.a) Obtain an expression for the force exerted on the surface of a charged conductor.  
 b) Derive an expression for the electric potential at any point due to an electric dipole. (5+5)
- 2.a) State and prove Ampere circuital law.  
 b) Obtain an expression for the magnetic field due to current along the axis of the solenoid. (4+6)
- 3.a) Give the theory of interference of light at an air wedge.  
 b) Define dispersive power of a grating and deduce an expression for the same. (7+3)
- 4.a) Derive an expression for the velocity of longitudinal waves in a rod.  
 b) Give any three differences between Fresnel and Fraunhofer Diffraction. (7+3)
- 5.a) Using Maxwell's field equation, obtain the velocity of electromagnetic waves in free space.  
 b) What is Poynting vector. What does it signify? (8+2)
- 6 a) What are Quarter wave plate and half wave plate? Obtain the expression for thickness of wave plate in each case.  
 b) Give the differences between positive and negative crystals with examples (6+4)

**PART – B**

Solve any **FOUR** of the following

(5x4=20)

7. A parallel beam of sodium light of wavelength  $5890\text{\AA}$  strikes a film of oil floating on water. When it is viewed at an angle  $i = 35^\circ$  from the normal,  $10^{\text{th}}$  dark band is seen. Determine the thickness of a film. Refractive index of oil = 1.5
8. A zone plate is illuminated with a source of sodium light ( $\lambda = 5896\text{\AA}$ ) placed at a distance of 1 m. If the image of the point source is obtained at a distance of 2m on the other side, what will be the power of the equivalent lens which may replace the zone plate. Also calculate the radius of the third zone of the plate.
9. A brass rod of length 3m is clamped at its centre. It is made to vibrate longitudinally. Find the Young's modulus of the brass if the density of the brass is  $8200 \text{ kgm}^{-3}$  and the frequency of the note produced is 600Hz.

10. An electron circulates around the nucleus in a path of radius  $5.1 \times 10^{-11} \text{ m}$  at a frequency of  $6.8 \times 10^{15}$  revolution per second. What is the value of B set up at the centre of the orbit? What is the equivalent dipole moment?
11. A solenoid has a length of 1m. The number of turns per cm is 500. Calculate the self-inductance of the coil if its diameter is 0.05m. Find the magnetic flux when a current of 2A passes through it.
12. Consider a vector field  $\vec{A} = x^2\hat{i} + y^2\hat{j} + z^2\hat{k}$ . (i) Is the field solenoidal?  
(ii) Is the field irrotational?

### PART – C

Answer any **FIVE** of the following: (5x2=10)

- 13.a) Is it possible to apply both Poisson's and Laplace at the same point in an electric field? Explain.
- b) It is easier to observe the phenomenon of diffraction in sound than light. Why?
- c) Sometimes, when a switch is turned off, a spark is produced. Justify.
- d) How does the fringe width change, when Young's Double slit experiment is conducted in a liquid? Explain.
- e) Give the physical significance of equation of continuity.
- f) Can longitudinal waves be polarised? Explain.