ST. JOSEPH'S COLLEGE (AUTONOMOUS), BENGALURU-27
B.Sc. PHYSICS - III SEMESTER
SEMESTER EXAMINATION: FEBRUARY 2022
PH 318 – ELECTROMAGNETISM, SOUND AND PHYSICAL OPTICS

Time- 2 ½ hrs   Max Marks-70

This question paper contains **two** printed pages and **three** parts

Part A

Answer any **FOUR** questions: (4 x 10 =40)

1. a) Obtain an expression for the mechanical force exerted on a unit area of
       a charged conductor.

    b) Derive $\vec{E} = -\nabla V$.   (7+3)

2. a) State and explain Biot - Savart's law.

    b) Obtain an expression for the magnetic field due to a current carrying straight
       conductor of finite length.   (4+6)

3. a) Give the conditions for sustained interference.

    b) Describe Kundt's tube experiment to find the velocity of sound in a rod. (3+7)

4. a) Explaining the theory of zone plate, derive a formula for its focal length.

    b) Give any three differences between Fresnel and Fraunhoffer diffraction (7+3)

5. a) State Maxwell's Equations and give its physical significance.

    b) Explain Poynting theorem.   (8+2)

6. a) What are quarter wave plate and half wave plate? Obtain an 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: (4 x 5 =20)

7. A narrow slit is illuminated by monochromatic light of wavelength 6×10^{-7} m ,which
    is placed at a distance of 0.1m from a straight edge. If measurements are carried
    out at a distance equal to 1m from the edge, what is the distance between the
    first and second dark bands.

8. A parallel beam of light of wavelength 6×10^{-7} m is incident on a thin transparent film
   of refractive index 1.5 such that angle of refraction is 45^0 in the film. Calculate the
   smallest thickness of the film which will appear dark by reflection.

9. Sugar solution of concentration 100 kg m^{-3} is kept in a polarimeter tube of length 0.22 m.If the specific rotation of the sugar is $0.75^0 \, kg^{-1}m^2$ .Calculate the rotation of linearly polarised light.

10. An electric dipole has a moment of $2\text{x}10^{-7}$Cm. Find the electric intensity at a point 0.1m from its midpoint in a direction inclined at 60^0 to the axis.

11. Calculate the self-inductance of a solenoid of 200 turns and length 25cm radius 5 cm having an air core. Calculate the magnetic flux produced when a current of 2A flows through it.

12. If $\vec{A} = xz^3\hat{\imath} - 2x^2yz\hat{\jmath} + 2yz^4\hat{k}$ find $\nabla \cdot \vec{A}$ at the point (1, -1, 1).

PART – C

Answer any **FIVE** of the following: (5 x 2 =10)

13. a) Can interference fringes be produced by using two identical bulbs? Explain.

b) Why do radio waves diffract around buildings while visible light do not?

c) Eddy current is sometime disadvantageous. Why? How can it be minimised?

d) Work done by a charge in a magnetic field is zero. Justify.

e) Displacement current is as real as conduction current. Explain.

f) What happens to the fringe width, when Young's Double Slit apparatus is immersed in water? Explain.