BACHELOR OF SCIENCE EXAMINATION, 2018 (OLD)

(1st Year, 2nd Semester)

PHYSICS (HONOURS)

Paper : OPTICS

Paper : HO - 4

Time : Two hours Full Marks : 50

Use separate Answer Script for each group

GROUP - A (25 marks)

Answer any *five* questions. 5x5=25

1. Derive the system matrix for a system of two thin lenses separated by a distance in air. Hence find the equivalent focal length of the system.
2. Define and explain the terms 'Cardinal points' of a system of coaxial lens system.
3. (a) Why is an extended source of light necessary for Newton's ring experiment?

(b) Suppose Newton's rings are formed in an experiment with a plano-covex lens placed on a plane glass plate in air. What would be the nature of Newton's rings when observed with reflected white light?

4. (a) Write down the conditions for sustained interference pattern.

(b) In Young's experiment interference bands are produced on the screen placed at 1.5 m from the plane of two slits which are separated by a distance of 0.15 mm and illuminated by a light of wavelength 450 nm. Find the change in fringe width when the screen is brought nearer to the slit by 50 cm.

5. (a) Write down an expression for the intensity pattern for diffraction of light due to a single slit.

(b) A screen is placed 50 cm from a single slit which is illuminated with 6000 Å light. If the distance between the first and third minima in the diffraction pattern is 3 mm, what is the width of the slit?

6. (a) Write down an expression for the intensity of Fraunhofer diffraction pattern due to a plane diffraction grating. Explain the symbols involved.

(b) How many orders would be visible if the wavelength of incident light is 589 nm and the number of lines in the grating is 700 per mm.

7. (a) A light of wavelength 546 nm gets plane polarized on reflection from a glass plate at an angle of incidence 60°. Find the refractive index of glass.

(b) A thin Polaroid, placed between a pair of crossed polaroids, is made to rotate at a rate ω about their common central axis. If an unpolarised light of intensity I_0 is incident on the first Polaroid what would be the intensity of the transmitted light?

8. (a) How can you experimentally distinguish between a circularly polarized and an unpolarised light?

(b) What is polaroid? Mention a few applications of polaroids.

BACHELOR OF SCIENCE EXAMINATION, 2018 (OLD)

(1st Year, 2nd Semester)

PHYSICS (HONOURS)

Paper : Electricity and Magnetism - I

Paper : HO - 4

Time : Two hours Full Marks : 50

Use separate Answer Script for each group

GROUP - B (25 marks)

Answer any *five* questions. 5x5=25

1. (a) Define electric field $\vec{E}$. Using superposition principle, extend your definition to consider discrete charge distributions.

   (b) How do you visualize electrostatic field graphically? Sketch with examples and explain the characteristics of this vector field.

   (c) An imaginary closed spherical surface S of radius R is centered on the origin. A charge $+q$ is placed on the origin and the flux through S is ϕ_E. Three additional charges are now added along the x-axis: $-3q$ at $x = -\frac{R}{2}$, $+5q$ at $x = \frac{R}{2}$ and $+q$ at $x = \frac{3R}{2}$. What is the flux through S now?

   $[1\frac{1}{2} + 2 + 1\frac{1}{2}]$

2. (a) Write down Gauss's law in integral form.

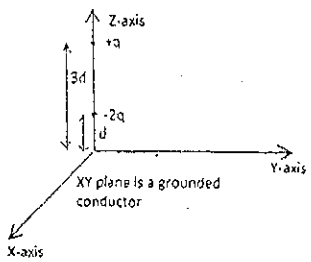
   (b) An amount of charge Q is distributed uniformly inside a sphere of radius R. Use Gauss's law to calculate electric field $\vec{E}$ at any internal and external points.

   (c) Show graphically the variation of electric field with distance, measured from the centre of the sphere.

   $[1 + (1\frac{1}{2} + 1\frac{1}{2}) + 1]$

3. (a) What is an electrical image? State its usefulness in solving electrostatic problems.

   (b) Two point charges are placed as shown in the figure. Find the force on the charge $+q$.



   $[2 + 3]$

4. (a) Explain the necessity to have a system of conductors to form a capacitor.

   (b) A system of conductors consists of two parallel plates, each of area A, and separated by a distance d. One plate is kept at potential V while the outer one is grounded. Use Laplace equation to find the potential function for this system. Find also an expression for the capacitance of this capacitor.

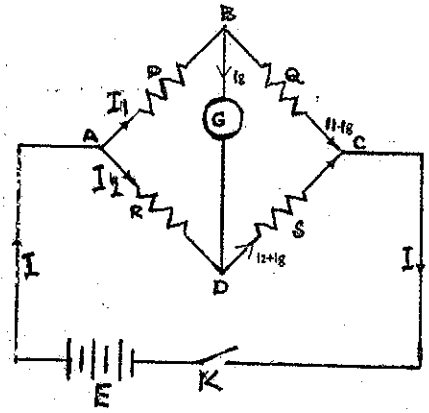
   $[1 + (2 + 2)]$

5. What type of motion would you expect when a point charge $+q$ of mass m is released from rest into a region of crossed uniform electric and magnetic fields? Sketch the path of the charged particle. Set up, without derivations, the necessary equations in support of your claim.

[1 + 1 + 3]

6. (a) State and explain Kirchhoff's laws for the distribution of currents and voltages in a network.

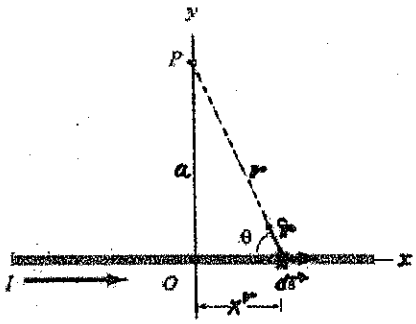
(b) Figure shows a Wheatstone bridge where resistances in the four arms are given as P, Q, R and S ohms. Take galvanometer resistance as G ohms. If the switch K is put to on position, write down equations for I_1, I_2 and I_g (solution for currents in different branches are not required).



[2 + 3]

7. (a) State and explain Biot-Savart law in vector form.

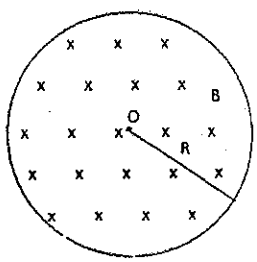
(b) A thin straight wire carrying a current I is placed along the $x-$ axis, as shown in the figure. Find magnetic field $d\vec{B}$ at point P due to current element $I\vec{ds}$.



[2 + 3]

8. (a) State and explain Faraday's laws of electromagnetic induction.

(b) Figure shows a uniform magnetic field of induction B at right angles to the plane of the paper. Assuming that B is increasing at a constant rate $\frac{dB}{dt}$ at every point in the circular region of radius R, find magnitude of the electric field E at a distance (i) $r < R$ and (ii) $r > R$ from the centre O.



[2 + 3]