

Dhanamanjuri University
B.Sc. 2nd Semester Examination 2021 (June)

PHYSICS HONOURS: CPH 105
Electricity and Magnetism

Answer all the questions.

1. Using Gauss's theorem calculate the electric field due to the uniform spherical shell of charge at a point (i) inside the shell and (ii) outside the shell.
Hence show that for points lying external to it, a uniformly charged spherical shell behaves as if the entire charge are concentrated at its centre and for points lying inside it the electric field is zero. 6+4 = 10
2. State and prove Poisson's equation regarding electric potential. Show that the potential function given by

$$\Phi(r) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho(r')}{|r-r'|} dv'$$

represents the solution of Poisson's equation. 5+5 = 10

3. What is an electrical image? A point charge is situated near an infinite plane earthed conductor. Applying the method of electrical image calculate (i) surface charge density induced on the plane, (ii) the force between the plane and the charge. 2+4+4 = 10
4. State and explain Biot and Savart's law in vector form in S.I. units. Applying Biot-Savart's law, determine the magnitude and direction of the magnetic field due to a steady current I in a long straight wire. 4=6 = 10
5. What is electromagnetic induction? State and explain Faraday's laws of electromagnetic induction.

A coil of 100 turns is pulled in 0.04 second from between the poles of a magnet where its area experiences a flux of 40×10^{-6} Wb. Calculate the induced e.m.f. in the coil.

6+4 = 10

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PHYSICS HONOURS: CPH 107
Waves and Optics

Answer all the questions.

1. Two SHMs act simultaneously on a particle at right angles to each other. Show that the path of the particle will be an ellipse when the two motions have the same period but different amplitude and phase.
What happens when the phase difference between the two motions is (i) zero and (ii) $\frac{\pi}{2}$ with same amplitude.

6+2+2 = 10
 2. Derive the mathematical expression of a plane progressive wave and hence deduce the differential wave equation. What are phase velocity and group velocity ?

4+4+2 = 10
 3. (a) Find the resultant of two SHM given by $x_1 = 0.03 \cos 10\pi t$ and $x_2 = 0.03 \cos 12\pi t$. Hence find the beat frequency and beat amplitude.

6

(b) Consider two strings of same length and same material. Tension in the strings are in the ratio 4:1 and diameters of the string are in the ratio 1:2. Compare the frequencies of the fundamental modes of vibration.

4
 4. Deduce the conditions for maxima and minima in the interference of light in a thin parallel film.

10
 5. Derive the theory of Newton's Rings. How can you measure the refractive index of a liquid by using Newton's Rings.

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PHYSICS DSC : DPH 103
Electricity and Magnetism

Answer all the questions.

1. (a) Define curl of a vector field. Show that the curl of the velocity vector of a particle in a rigid body is equal to twice the angular velocity of the rotating body. What is an irrotational rotation? 1+4+1 = 6

(b) Prove that (i) $\nabla \times (\nabla \Phi) = 0$

(ii) $\nabla \cdot (\nabla \times \vec{F}) = 0$ 2+2 = 4

2. (a) Evaluate $\iint_S \vec{A} \cdot \hat{n} \, ds$, where $\vec{A} = (x+y^2)\hat{i} + 2x\hat{j} + 2y\hat{k}$ and S is the surface of the plane $2x + y + 2z = 6$ in the first octant.

(b) If $\vec{F} = 2z\hat{i} - x\hat{j} + y\hat{k}$, evaluate $\iiint_V \vec{F} \, dv$, where V is the region bounded by the surface $x=0, y=0, x=2, y=4, z=x^2, z=2$.

5+5 = 10

3. State and prove Gauss's theorem in electrostatics. Using Gauss's theorem find the electric intensity at a point near an infinite plane sheet of charge. 5+5 = 10

4. (a) Define capacitance of a conductor. Obtain an expression for the capacitance of a parallel plate condenser.

(b) What is a dielectric? Define the term polarization and displacement vector for a medium. 5+5 = 10

5. (a) State Faraday's law of electromagnetic induction and prove that Faraday's law can be expressed as $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$, where \vec{E} and \vec{B} are the electric and magnetic field intensities respectively.

(b) Write down Maxwell's equations of electromagnetic waves.

6+4 = 10

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PHYSICS GE : GEP 003
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