

Bachelor of Engineering (Mechanical) Examination 2019(Old)
(First Year First Semester)
PHYSICS

Time: 3 hours

Full Marks: 100

Answer **any five** questions

1. (a) What do you mean by viscosity of liquid?

(b) Differentiate between streamline motion and turbulent motion of fluid?

(c) Deduce the velocity profile for the streamline flow of a liquid through a capillary tube of circular cross section (use Poiseuille's method).

(d) How do you determine the viscosity of a liquid by using Poiseuille's method?

3+3+8+6

2. a) Write down the equation of motion for a particle executing damped simple harmonic motion. Explain the physical origin of each term. Solve it for the case of small damping.

b) Why is damping usually taken to be proportional to instantaneous velocity?

c) A mass of 10 kg is acted upon by restoring force of 0.01 N/m and a resisting force of 0.002 N.s/m. Find out whether the motion is oscillatory or non-oscillatory. Also find the value of resisting force for the motion to be critically damped.

(3+3+6)+2+6

3. a) What do you mean by coherent sources? Give two practical examples.

b) Show that in case of superposition of waves from two incoherent sources the resultant intensity is the sum of individual intensities.

c) State and explain the conditions for the production of sustained interference fringes.

d) Consider two coherent sources of same frequency and of intensities I and $2I$. Find the ratio of maximum intensity to minimum intensity in their interference pattern.

5+5+5+5

Turn over

4. a) What do you mean by diffraction of light? Distinguish between diffraction and interference of light.

b) Derive an expression for the intensity of Fraunhofer diffraction pattern due to a single slit.

c) State Brewster's law. Light traveling in water of refractive index 1.33 is incident on a glass plate of refractive index 1.53. At what angle of incidence the reflected light is completely polarized?

6+8+6

5. a) State and prove Gauss's law of electrostatics. Show that electric field just outside a conductor is perpendicular to the surface and estimate the value of normal component of this field.

b) Determine the electric potential and field of an electric dipole at a large distance and its radius vector making an angle 60° with dipole axis.

10+10

6. a) State Biot Savart law and use it to calculate magnetic field at a point on the symmetry axis of a circular loop.

b) State Faraday's law of electromagnetic induction. Calculate self inductance per unit length of a long solenoid.

10+10

7. a) Write down Maxwell's equations of electromagnetic theory and show that they satisfy charge conservation principle.

b) Show that in a dielectric medium these equations become wave equations for electric and magnetic field.

c) Prove that plane wave solution of Maxwell's equations is transverse.

8+6+6

8. a) Write down time independent Schrodinger equation for a particle of mass m in one-dimensional infinite square well potential of width a . What will be the boundary conditions.

b) Calculate its energy eigenvalues and wave functions.

c) Estimate the probability of getting the particle in $0.25a < x < 0.50a$ for ground state.

5+8+7