Question Bank

B.Sc Part I

PaperI-Mechanics

1. Define Centre of mass.
2. Explain elastic and inelastic collisions.
3. State the principle of rocket.
4. Write Euler's equation for a rigid body motion.
5. Define radius of gyration of a rigid body.
6. What is rigid body?
7. Define inertial coefficient of a rigid body.
8. What is anharmonic oscillator?
9. What is damped simple harmonic oscillator?
10. Explain the potential well in potential energy curve.
11. Define quality factor of harmonic oscillator.
12. What do you understand by the resonance in parallel resonance circuit?
13. Define forced oscillator.
14. Calculate the logarithmic decrement for ballistic galvanometer.
15. Write the three main differences between series and parallel resonant circuit.
16. What do you understand by potential energy curve? Explain the cases of stable equilibrium and unstable equilibrium.
17. Find the displacement due to effect of Coriolis force on a body falling vertically downward on the earth.
18. Obtain the expression for the final speed of the rocket.
19. Discuss the path of particle under Central force and explain circular and elliptical orbit.
20. What is forced oscillator? Write a differential equation for this and prove that in condition of resonance its amplitude is given as

$$(X_0)_{Max} = F_0 \cdot \frac{Q}{W_0} \cdot \left(1 + \frac{1}{8Q^2}\right)$$

21. Prove that the observed acceleration due to gravity at a place is given by

$$g_\lambda = \sqrt{(g - w^2 R \cos^2 \lambda)^2 + (w^2 R \cos \lambda \sin \lambda)^2}$$

Where g is acceleration due to gravitational force, λ is attitude, and w is the angular velocity of earth of radius R. Derive the values of g_λ at poles and equator of earth.

22. Prove that the law of conservation of linear momentum remains valid in all inertial frames.
23. Discuss the over damping, critical damping and low damping for a damped simple harmonic oscillator.
24. What is anharmonic oscillator? Derive the expression for displacement and time period.
25. Prove that when any particle do the motion under the effect of central force, then
 a) Particle's angular momentum remains conserved.
 b) Particle's total energy remains conserved.

Paper II- Electromagnetism

1. Define the gradient of a scalar field.
2. Scalar field is represented by the following equation
$$V = 4yz^3 + 3xyz - z^2 + 2$$
   Calculate field at the point (0,-3, 1).
3. What is an electric dipole and dipole moment?
4. Define potential energy of a system.
5. What is Lorentz's force?
6. Prove that $\nabla r = r$
7. Define magnetic field. Write its dimension and properties?
8. Define Bohr magnetron. Find its value?
9. Define Biot Savart's law.
10. Define magnetic susceptibility and magnetic permeability and write down the relation between them.
11. Define orbital gyromagnetic ratio and prove that magnetic moment due to orbital motion of an electron must be an integer multiple of $eh/4\Pi m$. where symbols have usual meaning.
12. What is displacement current? Discuss its properties?
13. Write down Maxwell's equation in differentiation and integral form with their physical significance?
14. What do you mean by energy density of electromagnetism waves and give significance of pointing vector?
15. Define curl of a vector. Derive the expression of curl in Cartesian coordinate system. Discuss its physical significance.
16. (i) Deduce a relation for classical radius of an electron.
    (ii) Calculate the required amount of energy to build a sphere of radius $6.6* 10^{-15}$ m having 70 e charge on it.
17. (i) Determine the electric field inside a polarized dielectric and hence derive the Gauss's law.
    (ii) Determine the dielectric constant and susceptibility of diamond. Its permittivity is given by $1.416*10^{-10}$ $c^2 m^{-2} N^{-1}$.
18. Determine the magnetic induction inside and outside a long hollow thin current carrying cylinder. Plot magnetic field with distance from the axis of the cylinder.
19. (i) Derive an expression of Poynting vector and explain its physical significance.
    (ii) Laser rays of 50 W are concentrated with the help of a lens at 10^{-10} m^2 cross sectional area. Calculate the value of Poynting vector.
20. (a) State and prove Stoke's curl theorem?
(b) The electric potential in a field is given by the following formula
    $V = 343/r$ volt.
    Calculate the electric field at the position at r = (3i + 2j + 6k) meter?
21. (a) Derive formulae for essential energy required to build a sphere of uniform charge Q and radius R.
    (b) A dipole moment of HCl molecule is $3.4 *10^{-30}$ coloumb-m. Find the distance between H^+ and Cl^- ions.

22. Show that the potential at a distance R due to an arbitrary charge distribution can be an arbitrary charge can be expressed as

$V = 1/4\pi\varepsilon_0 \ (P_0/R + P_1/R^2 + P_2/R^3 + \ ....)$

23. (a) What do you understand by bound current and free current with regards to magnetic effect? Prove that the curl of magnetization field is equal to free surface current density?
    (b) Using above relation, establish the following.
       a. $B = \mu_0(H + M)$
       b. $\mu = \mu_0(1 + X)$

24. Write Maxwell's equation, use these equation to show the electromagnetic wave for non-conductor isotropic medium and to show that electric fields E is satisfy following wave equation.

$\nabla^2 E = \mu_0\varepsilon\partial^2 E/\partial t^2$

Obtain the formula of refractive index of the medium and also discuss validity of this formula?

25. Write Gauss's law in differential and integral form?

Paper III – Optics

1. Why the centre of Newton rings obtained by reflected light is perfectly dark?
2. What are fringes of equal inclination and Haidinger fringes?
3. What are half period zones?
4. Write down two main differences between Fresnel and Fraunhofer diffraction?
5. What do you mean by dispersion of grating? On which factors it depends?
6. What is Rayleigh criteria for just resolution?
7. Define specific rotation. Give its unit. On what factors does it depend?
8. What is the meaning of LASER? Write down necessary conditions for laser action.
9. Explain Einstein's A and B coefficients.
10. Draw energy level diagram of He-Ne laser. How population inversion is obtained in this laser.
11. Show that for free space EM waves radiation resistance is 377 ohm.
12. What do you mean by Poynting vector. Explain its physical importance?
13. Write Maxwell equation for EM Waves in free space.
14. Define the radiation pressure, energy and momentum of EM waves.
15. What is biquartz plate? Explain the properties with respect to half shaded plate.
16. Describe the formation of colors in thin film and show that with monochromatic light the interference patterns of reflected and transmitted light is complementary.
    (b) A thin flake of mica (refractive index u=1.5) is used to convert one slit of a double slit arrangement. The central point on the screen is occupied by what used to be the seventh bright fringe. If λ=5500 A^0 what is the thickness of mica sheet?
17. Discuss Fraunhofer diffraction due to a single slit. Derive the expression for the intensity and show that the intensities of first and second maxima are 1/22 and 1/61 of the intensity of the central maxima respectively.
18. Explain the Huygens's theory of double refraction in uniaxial crystals. Distinguish between positive and negative crystals.
19.   What is the basic concept of holography? How hologram of an object is obtained? What advantages does a hologram process over an ordinary photography.
20. (a) Derive an expression for velocity of longitudinal waves in gases and discuss Laplace correction.
    (b) The equation of motion of second waves along x-axis in air is given by $y = 10^{-5}\cos(400-x)$ calculate the displacement and volume strain at x=1/3 m and t=0.
21. What is Newton's Ring? Derive an expression for diameter of bright Newton's rings formed in reflected monochromatic light?
22. Describe the basic principle and working of a Michelson's Interferometer. Discuss localized fringes, their shapes and the condition under which they are formed?
23. Describe the Fraunhofer diffraction due to double slit and deduce the position of maxima and minima?
24. Describe the He-Ne laser. Draw the energy diagram for He-Ne laser. How the population inversion can be obtained in this laser?
25. What do you understand by free space of radiation resistance? Show that for free of radiation resistance for EM Waves its value is 377ohms?