

# QUESTION BANK OF PHYSICS DEPARTMENT

## +3 1st year Science

### Semester-I

#### Mathematical Physics I(Core 1)

##### Goup-A (Fill in the blank Question Carries 1 mark)

1. The equation  $y=ax^2 +bx+c=0$  represents the equation of \_\_\_\_\_.
2. The value of  $\text{div.grad } \phi$  is \_\_\_\_\_.
3. If  $xy+x^2 y^2 = \text{constant}$ , then  $\frac{dy}{dx}$  is \_\_\_\_\_.
4. Plot of equation  $x^2 = 4ay$  is symmetric about \_\_\_\_\_ axis.
5. The approximate value of  $\sqrt{25.2}$  is \_\_\_\_\_.
6. The solution of  $\sin 2x dy = y \cos 2x dx$  is \_\_\_\_\_.
7. If  $f(x,y,z) = e^x \sin y$  then  $\frac{\partial y}{\partial x} =$  \_\_\_\_\_.
8. If  $x = r \cos \theta$ ,  $y = r \sin \theta$  then  $\frac{\partial r}{\partial x} =$  \_\_\_\_\_.
9. The solution of  $\sin 2x dy = y \cos 2x dx$  is \_\_\_\_\_.
10. The function  $f(x) = [x]$  is \_\_\_\_\_ at all integers.
11. The scalar product of two perpendicular vectors is \_\_\_\_\_.
12. The vector product of two parallel vectors is \_\_\_\_\_.
13. The differential equation  $M(x,y) dx + N(x,y) dy$  is an exact differential equation for which the necessary condition is \_\_\_\_\_ + \_\_\_\_\_.
14. One of the integrating factors of the equation  $-ydx + xdy = 0$  is \_\_\_\_\_.
15. The equation  $\sin x \cos y dx + \cos x \sin y dy = 0$  is \_\_\_\_\_ differential equation.
16. The value equation of  $\hat{i} \cdot (\hat{j} \times \hat{k})$  is \_\_\_\_\_.
17. A unit vector perpendicular to both  $\vec{A}$  and  $\vec{B}$  is \_\_\_\_\_.
18. The scalar triple product of three vectors is \_\_\_\_\_ of a parallelepiped.

19. If the co ordinate surfaces are mutually perpendicular to each other, then they are called \_\_\_\_\_ system.
20. The expression for velocity in cylindrical coordinate is \_\_\_\_\_.
21. The expression for acceleration in cylindrical coordinate is \_\_\_\_\_.
22.  $\delta(-x) =$  \_\_\_\_\_.
23.  $\int_{-\infty}^{\infty} \delta(x) dx =$  \_\_\_\_\_ .
24. The value of  $\vec{A} \cdot (\vec{A} \times \vec{B})$  is \_\_\_\_\_.
25. The expression for arc length ds in terms of  $h_1$  ,  $h_2$  and  $h_3$  is given by  $ds^2 =$  \_\_\_\_\_ .
26. The cylindrical coordinates of point P in space are represented as \_\_\_\_\_
27. The spherical coordinates of point P in space are represented as \_\_\_\_\_ .
28. The plane polar coordinates of point P are represented as \_\_\_\_\_ .
29. The value of  $\vec{\nabla} \times \vec{r}$  is \_\_\_\_\_ .
30. The value of  $\vec{\nabla} \cdot \vec{r}$  is \_\_\_\_\_ .

(Answer in one word and each carries 1mark)

1. Is the plotting of  $\tan x$  against  $x$  continuous or not ?
2. Every polynomial is continuous at every point of the real line. True or false.
3. Write the approximate value of  $\sqrt{98}$  .
4. Write the solution of  $y'' + 4y = 0$
5. Write the solution of  $y'' + 6y' + 9y = 0$  .
6. What is the formula for Wronskian  $W ( y_1 , y_2 )$ ?
7. Does vector product of two vectors produce a vector?
8. Does scalar product of two vectors invariant under rotation?
9. The magnitude of a vector is independent of the rotation of the coordinate axes. Is it true or false?

10. Write the expression for the components  $\vec{A}$  if the coordinate axes are rotated about z-axis by an angle  $\theta$ .
11. Is  $x \cos 2y \, dx - \sin 2y \, dy$  an inexact differential?
12. Is flux of a vector field a scalar quantity?
13. Which theorem relates line integral with surface integral?
14. Which theorem relates surface integral with volume integral?
15. Write the mathematical form of Green's theorem in plane.
16. Find the value of  $\oint \vec{ds}$ .
17. Write Green's first identity.
18. What the value of  $\iiint_0^1 xyz \, dx \, dy \, dz$ ?
19. What the value of  $\text{grad}(1/r)$ ?
20. What is the value of  $\vec{\nabla} \times \phi \vec{A}$ .
21. Is the vector product of two vectors commutative?
22. Draw the graph of  $\delta(x)$  Vs  $x$ .
23. Write the expression for Dirac-Delta function in terms Gaussian function.
24. . Write the expression for Dirac-Delta function in terms rectangular function.
25. What is the area of the graph of  $\delta(x)$  versus  $x$ ?
26.  $\int_{-\infty}^{\infty} f(x)\delta(x)dx = f(0)$ . Is it correct?
27. What is the value of  $\int_{-1}^1 e^x \delta(x - 2)dx$ ?
28. Is scalar product commutative?
29. Write a physical quantity which is the scalar product of two vectors.
30. Torque is polar or axial vector?

Group B: Short question (each carries 1.5 mark)

1. Plot the graph of  $y = x^2$ .
2. What do you mean by continuity of a function?
3. What do you mean by discontinuity of a function?
4. What do you mean by differentiation of a function?
5. Find the approximate value of  $\sqrt{101}$  using differential calculus.
6. What do you mean by differential equation?
7. Define degree and order of a differential equation.
8. Write Bernoulli's equation in differential form.
9. Write Wronskian of a function.
10. State existence theorem.
11. State uniqueness theorem.
12. What do you mean by partial derivatives?
13. Write rotation matrix in two dimensions.
14. Write Euler's theorem.
15. What is integrating factor?
16. What is vector field? Give an example of vector field.
17. State Stoke's theorem.
18. State Gauss divergence theorem.
19. What do you mean by directional derivative?
20. Write Laplacian operator in spherical polar coordinates.
21. What do you mean by curl of a vector function?
22. What do you mean by gradient of scalar function?
23. What do you mean by divergence of vector function?
24. What do you mean by solenoidal vector?
25. What do you mean by rotational vector?

26. Prove that position vector is irrotational.

27. Find the value of curl grad  $\phi$ .

28. Solve  $\cos(x+y) dy = dx$ .

29. Explain the role integrating factor.

30. Find the approximate value of  $(1.001)^3$ .

Group C : Short question (each carries 2.5 mark)

1. Find the value of  $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x - 3}$ .

2. Show that  $\lim_{x \rightarrow 0} \sin\left(\frac{1}{x}\right)$  does not exist.

3. Find the Taylor series of  $\sin x$  at  $x=0$ .

4. Find the Taylor series of  $\cos x$  at  $x=0$ .

5. Prove that scalar product of two vectors is commutative.

6. Show that scalar product of two vectors is invariant under rotation.

7. If  $(x, y, z) = x^2 + y^2 + z^2$ , find  $\frac{d^2f}{dx^2}$ .

8. Find the value of  $\lim_{(x,y) \rightarrow (0,0)} \frac{xy}{y^2 - x^2}$ .

9. Find the first order partial derivatives of  $u = e^x \sin y$ .

10. If  $u = x\phi(y/x)$ , then prove that  $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = u$ .

11. Solve  $ydx - xdy = xy^3 dy$ .

12. Find the value of 'n' if  $\vec{A} = \hat{i} + n\hat{j} + 5\hat{k}$  is perpendicular to  $\vec{B} = 2\hat{i} + \hat{j} - \hat{k}$ .

13. Find the unit vector perpendicular to these vectors  $\vec{A} = 2\hat{i} - \hat{j} + \hat{k}$  and  $\vec{B} = 3\hat{i} + 4\hat{j} - \hat{k}$ .

14. If  $|\vec{A} + \vec{B}| = |\vec{A} - \vec{B}|$ , find the angle between  $\vec{A}$  and  $\vec{B}$ .

15. Find the value of  $\text{div curl } \vec{F}$  .
16. Find the value of  $\text{curl grad } \phi$  .
17. If  $\vec{A}$  and  $\vec{B}$  are irrotational , then prove that  $\vec{A} \times \vec{B}$  is solenoidal.
18. Prove that  $(k\vec{A}) = k \text{div} \vec{A}$  , where k is a constant.
19. Evaluate the integral  $\int_{x=0}^1 \int_{y=0}^2 xy dx dy$  .
20. Show that  $(\nabla \cdot \vec{A}) = \nabla \cdot \text{div} \vec{A} + \vec{A} \cdot \nabla$  .
21. Prove that  $\vec{\nabla} \cdot (\vec{A} \times \vec{B}) = \vec{B} \cdot (\vec{\nabla} \times \vec{A}) - \vec{A} \cdot (\vec{\nabla} \times \vec{B})$  .
22. Show that  $(\frac{\vec{r}}{r^3}) = 0$  .
23. Show that  $\text{JJ}^* = 1$  .
24. Show that the vector  $\vec{A} = x\hat{i} + y\hat{j} + z\hat{k}$  is irrotational .
25. Find integral  $\int_0^1 \int_0^{\sqrt{1-y^2}} dx dy$  .
26. Find the value integral  $\int_0^4 t^2 \delta(t - 5) dt$  .
27. Show that  $x\delta'(x) = -\delta(x)$  .
28. If  $\vec{a}$  is a constant vector, show that  $\vec{\nabla}(\vec{r} \cdot \vec{a}) = \vec{a}$  .
29. Prove that  $\nabla^2 (\frac{1}{r}) = 0$  .
30. Write the Laplacian operator in spherical polar and cylindrical coordinates.

Group D : Long questions

1. Plot the graphs of exponential function, Logarithmic function and trigonometric functions.
2. Plot the curve of the function  $y = x^3 - 12x - 16$  .
3. Find the Talyor series for  $f(x) = \sin x$  abot  $x=\pi/2$  .

4. Find approximate value of  $\sqrt{10}$  using Binomial series.
5. Plot the curve  $y = \frac{x^2}{x^2-9}$ .
6. Find  $\lim_{x \rightarrow a} \left( \frac{x^n - a^n}{x - a} \right)$ .
7. Solve the equation  $iR + L(di/dt) = E$ .
8. solve the equation  $(y+x)y' = y-x$
9. solve the equation  $(2x+4y-6)dy = (2x-5y+3)dx$ .
10. Derive the rotation matrix in 2-dimensional Cartesian co-ordinate system and show that it is an orthogonal matrix.
11. Show that volume of a parallelepiped is equal to the scalar triple product of three vectors.
12. Using Lagrangian multiplier, find the point on the plane  $ax+by+cz = p$  at which the function  $f(x,y,z) = x^2 + y^2 + z^2$  has a minimum value.
13. Show that the rectangular solid of maximum volume that can be inscribed in a sphere is a cube.
14. Explain Lagrange's method to solve partial differential equation.
15. Solve  $(1+xy)ydx + (1-xy)x dy = 0$
16. Find the extreme value of  $x^3 + 8y^3 + 64z^3$  when  $xyz=1$ .
17. Solve  $x(3ydx + 2xdy) + 8y^4 (ydx + 3xdy) = 0$ .
18. Derive scale factors in curvilinear co-ordinate system.
19. Derive gradient of a scalar function in curvilinear co-ordinate system.
20. Derive divergence of a vector function in curvilinear co-ordinate system.
21. Derive curl of a vector function in curvilinear co-ordinate system.

22. Derive Laplacian operator in orthonormal curvilinear system.
23. Derive gradient, divergence and curl in cylindrical co-ordinate system.
24. Derive gradient, divergence and curl in Spherical polar co-ordinate system.
25. Derive gradient, divergence and curl in rectangular co-ordinate system.
26. State and Prove Gauss divergence theorem.
27. State and prove Stoke's theorem.
28. Derive Green's theorem in plane.
29. Derive divergence of a vector function and give its physical significance.
30. Derive curl of a vector function and give its physical significance.

## **MECHANICS (CORE-2)**

### **Group A: fill in the blank ( question carries 1 mark)**

1. Angular momentum is a \_\_\_\_\_ quantity.
2. Torque is a \_\_\_\_\_ quantity.
3. Mathematical formula of M.I. of ring is \_\_\_\_\_ .
4. Mathematical formula of M.I. of circular disc is \_\_\_\_\_ .
5. Mathematical formula of M.I. of solid sphere is \_\_\_\_\_ .
6. The expression for coriolis force is \_\_\_\_\_ .
7. The expression for centripetal force is \_\_\_\_\_.
8. The formula of twisting torque on a wire is \_\_\_\_\_ .
9. The poiseuilles formula for liquid flow is \_\_\_\_\_ .
10. The dimensional formula of coefficient of viscosity is \_\_\_\_\_.
11. The unit of coefficient of viscosity is \_\_\_\_\_ .
12. The general formula of moment of inertia is \_\_\_\_\_ .

13. In S.H.M.  $a = \frac{v}{y}$ .

14. In damped harmonic motion resistance force proportional to  $v$ .

15. The value coriolis force at the equator is  $2v\omega \sin \theta$ .

16. The value of gravitational field intensity inside the spherical shell is  $0$ .

17. Clock paradox related with  $relativity$ .

18. The expression of gravitational potential of solid sphere outside it is  $-\frac{GM}{r}$ .

19. The expression of gravitational potential of solid sphere inside it is  $-\frac{GM}{2R} \left( 3 - \frac{r^2}{R^2} \right)$ .

20. The expression of gravitational potential of sphere shell outside it is  $-\frac{GM}{r}$ .

21. The expression of gravitational potential of spherical shell inside it is  $-\frac{GM}{R}$ .

22. Areal velocity of a planet is  $\frac{dA}{dt}$ .

23. The weight of a body on the surface of an artificial satellite is  $0$ .

24. The weight of a freely falling body is  $0$ .

25. The value of 'g' at the pole is  $g_p$  than 'g' at the equator.

26. The shape of orbit of a planet is  $ellipse$ .

27. The value of orbital time period of a geostationary satellite is  $24$  hours.

28. Relativistic mass is  $more$  than rest mass of a body.

29. Relativistic length is  $less$  than rest length of a rod.

30. Moving clock runs  $slow$ .

**(Answer in one word and each carries 1mark)**

1. Give an example of a body whose centre of mass outside the body.
2. What is the mathematical formula of moment of inertia?
3. Which are constant in elastic collision?
4. Which is constant in an inelastic collision?

5. What is the relation between torque and angular momentum?
6. Write the relation between acceleration and displacement in S.H.M. .
7. Give an example of centrifugal force.
8. Which is more elastic: steel or rubber ?
9. Write Einstein's mass-energy relation.
10. Write the dimensional formula of co-efficient of elasticity.
11. Elastic constants depend on nature of the material. (True or False).
12. The value of acceleration due gravity is greater at pole than equator. (True or False)
13. Which Kepler's law is based on areal velocity?
14. Write the relation between gravitational field and potential.
15. Write length contraction formula.
16. Write mass variation formula.
17. What is the rest mass of photon?
18. The viscosity of a liquid increases with rise in temperature. (correct the sentence)
19. Which property of liquid decreases with rise in temperature?
20. The rate of liquid flow is independent of its viscosity. (correct the sentence)
21. Write the range of Poisson's ratio.
22. What is the value of "g" at the centre of the earth?
23. How "g" varies with altitude from the surface of earth?
24. How "g" varies with depth of earth?
26. Write down the expression of excess pressure inside a soap bubble.
27. Write down the expression of excess pressure inside a liquid drop.
28. Write Mathematical form of Newton's law of gravitation.

29. Write an expression for total energy in S.H.M.

30. Give an example of fictitious force.

**Group B: Short questions (each carries 1.5 mark)**

1. Define radius of gyration.

2. Define torque.

3. Define angular momentum.

4. State the law of conservation of linear momentum.

5. State the law of conservation of angular momentum.

6. Define centripetal and centrifugal force.

7. Define frames of reference.

8. Define inertial and non-inertia frame of reference.

9. What is rotational K.E? Express it mathematically.

10. What is coriolis force?

11. What causes coriolis force?

12. What is the effect of coriolis force?

13. What do you mean by elasticity?

14. Define plasticity.

15. Define Young's modulus, Bulk modulus and Shear modulus of elasticity.

16. Define bending moment.

17. Define elastic limit.

18. State Hooke's law.

19. What is flexural rigidity?

20. What is the unit of flexural rigidity?

21. What is cantilever?

22. What is the purpose of a cantilever?
23. What do you mean by bending of beams?
24. Define surface tension of a liquid.
25. What is the effect of surface tension of a liquid with rise of temperature?
26. Explain why oil floats on water?
27. What is streamlined flow?
28. Define turbulent flow.
29. Define equation of continuity.
30. Define viscosity?
31. Define co-efficient of viscosity?
32. What is the S.I unit of coefficient of viscosity?
33. What do you mean by gravitational field?
34. Define gravitational field of intensity.
35. What do you mean by gravity?
36. What is acceleration due to gravity?
37. Define gravitational potential.
38. Define gravitational potential energy.
39. Define inertial mass.
40. Define central force.

**Group c: Short questions (each carries 2.5 mark)**

1. What is meant by the centre of mass of an object and how do you find the centre of mass?
2. What is moment of inertia and what is its mathematical formula?
3. By keeping moment of inertia of a body constant, if we double the time period, then what will be its angular momentum?
4. By increasing the angular velocity of an object by 10%, the kinetic energy has to be increased by what?

5. Explain why a dancer on ice spins faster when she folds her arms.
6. Why Coriolis force is zero at the equator?
7. If a solid sphere, disc and cylinder, are allowed to roll down an inclined plane from the same height then which will reach bottom first.
8. A wheel of mass 2kg having practically all the mass concentrated along the circumference of a circle of radius 20cm is rotating on its axis with an angular velocity of 100 rad/sec. What will be the rotational K.E of the wheel?
9. What is the moment of inertia of a uniform circular disc about the diameter?
10. Define angular acceleration and what is its unit?
11. If an object changes its angular velocity from 10rad/sec to 25rad/sec in 3sec, then calculate its angular acceleration.
12. Discuss the practical use of centrifugal force.
13. The modulus of rigidity and Poisson's ratio of the wire are  $2.87 \times 10^6 \text{N/m}^2$  and 0.379 respectively.
14. What is the value of Young's modulus of the material of the wire?
15. How the surface tension of a liquid varies with dissolving organic and inorganic solute?
16. What is the coefficient of viscosity with change of temperature?
17. What do you mean by kinetic viscosity?
18. Define gravity wave.
19. Define ripple.
20. What is the difference between bending moment and bending stress?
21. What do you mean by conservative field and conservative force?
22. Define Kepler's 3<sup>rd</sup> law of planetary motion.
23. What is GPS and how it works?
24. Discuss the use of GPS.
25. What is the principle of GPS?
26. How does GPS determine your position on earth?

27. How does the GPS help?
28. Does GPS work without internet?
29. What is the gravitational field at a point inside a spherical shell?
30. What is meant by geosynchronous orbit?
31. What is the value of universal gravitational constant "G"?
32. What do you mean by weightlessness?
33. What is the altitude of a geosynchronous orbit?
34. Calculate the potential energy of a body of mass 10k.g at a distance a 25m above the ground.
35. What is the dimensional formula of "G"?
36. What are the characteristics of geo-stationary satellite?
37. Write down any two applications of geo-stationary satellite?
38. Define escape velocity.
39. State Kepler's laws of planetary motion.
40. Write the expressions for four vector coordinates.

**Group D: Long Questions-**

1. Calculate gravitational field and potential due to a spherical shell.
2. Calculate gravitational field and potential due to solid sphere.
3. Derive the equation of two body problem and its reduction to one body problem.
4. Derive differential equation of motion with central force and its solution.
5. State and explain Kepler's law of planetary motion.
6. What is a geo-stationary satellite? Discuss about geo-synchronous orbits.
7. Discuss about basic idea about global positioning system.
8. Discuss about physiological effects on astronauts.
9. State and prove the law of conservation of angular momentum of a single particle and a system of particle.

10. State and prove perpendicular axis and parallel axis theorem of moment of inertia.
11. Derive the Euler's equation of motion for a rigid body.
12. Discuss the derivation of moment of inertia of a solid sphere.
13. Discuss the derivation of moment of inertia of a solid cylinder.
14. Explain about combined rotational and translational motions.
15. Discuss about the moment of inertia of a big wheel.
16. Explain motion in a non-inertial frame.
17. Explain about rotating co-ordinate system.
18. Discuss about Coriolis force and its application.
19. Derive the relation between elastic constants.
20. Discuss about twisting torque in a cylinder.
21. Derive the expression for bending moment.
22. Discuss about the bending beams.
23. Discuss about the theory of single cantilever.
24. Discuss about the theory of double cantilever.
25. Derive Poiseuille's equation for flow of liquid through a capillary tube.
26. Discuss about the corrections in the Poiseuille's formula.
27. Discuss about gravity wave and ripple.
28. Describe Michelson and Morley Experiment.
29. Derive Lorentz transformation equations.
30. Derive relativistic addition formulae for velocity.
31. Derive mass variation formula and mass energy relation.
32. Derive relativistic Doppler's effect.

## **Semester-II**

## Electricity and Magnetism(Core 3)

### Group A: fill in the blank ( question carries 1 mark)

1. Electric flux is \_\_\_\_\_ quantity.
2. The unit of electric flux is \_\_\_\_\_ .
- 3 Electric field lines represent the \_\_\_\_\_ of electric field intensity.
4. Electric potential is \_\_\_\_\_ quantity.
5. The S.I. unit of electric potential is \_\_\_\_\_ .
6. Electric flux is the \_\_\_\_\_ product of electric field intensity and area.
7. The S.I. unit of capacitance is \_\_\_\_\_ .
8. The capacity of a parallel capacitor varies \_\_\_\_\_ with distance between two plates.
9. The capacity of a parallel capacitor varies \_\_\_\_\_ with common area of two plates.
10. Magnetic field intensity on the axis of a current carrying conductor is \_\_\_\_\_ .
11. Magnetic field intensity at the centre of the current carrying circular coil is \_\_\_\_\_ to its plane.
12. Magnetic flux is the \_\_\_\_\_ product of magnetic field intensity and area.
13. The S.I. unit of magnetic flux is \_\_\_\_\_ .
14. The S.I. unit of magnetic field intensity is \_\_\_\_\_ .
15. The S.I. unit of electric flux is \_\_\_\_\_ .
16. Two field lines do not \_\_\_\_\_ each other.
17. The S.I. unit of magnetic moment is \_\_\_\_\_ .
18. The S.I. unit of electric dipole moment is \_\_\_\_\_ .
19.  $K = 1 +$  \_\_\_\_\_ .
20.  $\mu_r = 1 +$  \_\_\_\_\_ .
21. Lenz's law is based on \_\_\_\_\_ .

22. Faraday's second law gives the \_\_\_\_\_ of induced emf.
23. The dimensional formula of electric flux is \_\_\_\_\_ .
24. The dimensional formula of magnetic flux is \_\_\_\_\_ .
25. Magnetic moment = \_\_\_\_\_ x Area
26. The dimensional formula magnetic field intensity is \_\_\_\_\_ .
27. Polarization vector is numerically equal to \_\_\_\_\_ .
28. The susceptibility of a diamagnetic substance is \_\_\_\_\_ ?
29. *Electro magnets are made of \_\_\_\_\_ ?*
30. The resultant magnetic moment for \_\_\_\_\_ materials is zero in the absence of external magnetic field.

**(Answer in one word and each carries 1mark)**

1. What is the relation between volt and stat volt?
2. Write the expression for electrostatic energy density.
3. Write the expression for magnetostatic energy density.
4. Write the S.I. unit of mutual inductance.
5. Write the relation between polarization vector and electric susceptibility.
6. Write the relation between dielectric constant and electric susceptibility.
7. Write the relation between relative permeability and magnetic susceptibility.
8. Magnetic susceptibility is positive for diamagnetic substance. (correct the sentence)
9. Write Curie's law.
10. Write the expression for resonance frequency.
11. Write the relation between electric displacement vector and electric field intensity.
12. Write the expression for inductive reactance.
13. Write the expression for capacitive reactance.

14. Write the expression for torque on an electric dipole in a uniform electric field.
15. Write the expression for torque on a magnetic dipole in a uniform magnetic field.
16. What is the use dielectric in a capacitor?
17. Write the expression for energy stored in a capacitor.
18. What is the unit of permittivity?
19. Write the alternate name magnetic flux density.
20. Write the dimensional formula of magnetic flux density.
21. What is the angle between equipotential surface and electric line of force?
22. What is the shape of equipotential surface in the electric field of a point charge.
23. What is the intensity of electric field inside a charged spherical shell ?
24. What is the direction of electric dipole moment ?
25. Write the S.I. unit of self inductance.
26. What is the reactance of inductor to d.c. ?
27. What is the reactance of capacitor to d.c. ?
28. Write the force on a moving charge in a magnetic field.
29. Write the force on a current carrying conductor in a magnetic field.
30. Write the expression for capacitance of a spherical condenser.

**Group B: Short questions (each carries 1.5 mark)**

1. Define electric field intensity. Give its S. I. Unit ?
2. What is an electric lines of force ?
3. Why two electric lines of force cannot intersect each other ?
4. What do you understand by electric flux ?
5. Does the intensity of electric field due to an infinite plane sheet of charge depends upon the distance of observation from it ?
6. Define types of electric flux ?
7. Write dimensional formula and unit of electric flux ?
8. State Gauss law in electrostatics?
9. Write down Differential form of Gauss law ?

10. State Coulombs law in electrostatics ?
11. Calculate the number of electric lines of force originating from a charge of 10 coulomb ?
12. What do you mean by Gaussian Surface ?
13. What is the electric field at any point between two oppositely charge particle ?
14. Define electric potential and potential energy ?
15. What is an equipotential surface ?
16. How do the electric potential and electric field due to a dipole vary with distance ?
17. Write down Poissons and laplace equipotential ?
18. What is electric dipole moment what is its unit in S.I ?
19. What is the torque acting on electric dipole in an uniform electric field ?
20. What is the potential energy of dipole in a uniform electric field ?
21. What do you mean by magnetic effects of electric current ?
22. Define magnetic flux density ?
23. What is the force acting on a charge moving through a uniform magnetic field ?
24. State Fleming's left hand rule ?
25. What is the force acting on a current carrying conductor of length 'L' Placed in a uniform magnetic field 'B' ?
26. State Biot-Savert's law ?
27. State Ampere's circuital law ?
28. What is Lorntz's force ?
29. What is a Galvanometer ?
30. On What factors does the capacitance of a parallel plate capacitor depend ?

**Group C: Short questions (each carries 2.5 mark)**

1. The electric field near earth's surface is 600 v/m What is the surface charge density on earth's surface.
2. Write down the properties of electric lines of force ?
3. Electric field in a region is zero. Should the electric potential also be zero in the region ?
4. How much is the workdone in moving 0.0005 C Charge between two points on an equipotential surface ?
5. What is the relation between electric field intensity and potential gradient ?

6. When a charged particle moves in a magnetic field. Explain why its kinetic energy remains same ?
7. Why is phosphor benzene alloy preferred for the suspension wire of a ballistic galvanometer ?
8. What is a solenoidal field Give one example?
9. State the condition under which the magnetic scalar potential ?
10. What are the conditions for a moving coil galvanometer to be ballistic ?
11. What is the physical significance of a critical damping ratio ?
12. What are the conditions for a moving coil galvanometer to be dead beat ?
13. What is the use of logarithmic decrement ?
14. What is the physical significance of magnetic vector potential ?
15. A capacitor of capacitance 50 microfarad is charged to a potential of 1000v. Calculate the energy stored in the capacitor ?
16. What is the electric field between two plates 4cm apart and connected to 12v battery ?
17. What is a dielectric ? Define dielectric constant .
18. What is the difference between free charges and bound charges ?
19. Distinguish between polar and non polar dielectric ?
20. What is the differential form of Gauss law for dielectric ?
21. What is the relation between peak value & rms value of A.C ?
22. What is the relation between peak value & rms value of Emf ?
23. Why A.C are more dangerous than D.C for same voltage ?
24. What is the impedance of LCR series in A.C circuit ?
25. In series LCR A.C circuit what is the expression of quality factor ?
26. How the quality factor, Resonance and band width of LCR circuit are related ?
27. What is the resonance frequency of a parallel LCR circuit ?
28. Why a parallel LCR circuit is called resistor circuit. ?
29. Define the Thevenin resistance and define the Thevenin equivalent.
30. Define the Transistor current and define super position theorem .

### **Group D: Long Questions-**

1. State and prove Gauss law. Write down its differential form ?
2. Applying Gauss law calculate the intensity of electric field at a point due to a uniformly charged straight wire having charge density 'P' ?
3. Using Gauss Law, Calculate electric field inside a hollow spherical charge distribution ?

4. Using Gauss Law, Calculate electric field due to uniformly charged solid sphere ?
5. State Gauss Law in differential form Derive Poisson's equation and Laplace equation ?
6. State and prove uniqueness theorem ?
7. Derive the electrostatic potential energy of a charged sphere ?
8. Applying Biot-savart law find the magnetic field due to long straight current carrying conductor ?
9. Using Biot-savart law calculate the strength of magnetic field at the center of a circular coil carrying current ?
10. State and prove Ampere's circuital law and calculate its differential form ?
11. Define vector potential and derive an expression for the vector potential ?
12. What is a ballistic galvanometer. Explain the construction and theory of it ?
13. Explain :-
  - i) Electro magnetic damping
  - ii) Critical damping
  - iii) Logarithmic decrement
14. Derive the expression for capacitance of a parallel plate capacitor with
  - i) Air
  - ii) A dielectric slab
15. Find the expression for the capacitance of a parallel plate capacitor with a dielectric medium.
16. Calculate the capacitance of a spherical capacitor in a dielectric medium.
17. Calculate the electrostatic energy per unit volume in a dielectric.
18. Derive the differential and integral form of Gauss law in dielectric ?
19. Obtain an expression for electrostatic energy stored per unit volume in a dielectric medium.
20. Describe the formation and the significance of the hysteresis loop.
21. What is a hysteresis ? Derive an expression for the work done per unit volume during cycles of magnetization ?
22. Discuss the importance of hysteresis curve ?
23. Derive Maxwell's equation for electromagnetic waves ?
24. What is mutual induction. Derive the expression for the reciprocity theorem ?
25. What is an impedance of an electric circuit. Derive an expression for impedance of an A.C LCR series circuit ?
26. Find an expression for the current in an AC circuit containing resistance, inductance, capacitance in series calculate the condition of resonance .

27. What is meant by resonance in a parallel resonant circuit ? Why is the circuit known as resistor circuit ?
28. Calculate the frequency in series resonance LCR circuit and define Q-factor .
29. What do you understand by the resonance in an electrical circuit ? Discuss the characteristics of a series and parallel resonant circuits .
30. Describe Thevenin theorem, Norton theorem and Reciprocity theorem.

### **Waves and Optics (Core 4)**

#### **Group A: fill in the blank ( question carries 1 mark)**

1. Rainbows are formed by \_\_\_\_\_.
2. In Fresnel's biprism the central fringe is\_\_\_\_\_.
3. The condition for minimum spherical aberration for two thin lenses of focal lengths  $f_1$  and  $f_2$  separated by distance "d" is\_\_\_\_\_.
4. A pair of conjugate points on the axis of a lens having unit positive angular magnification is known as\_\_\_\_\_.
5. The achromatic condition for two lenses of focal lengths  $f_1$  and  $f_2$  separated by distance "d" is\_\_\_\_\_.
6. If the focal length of eye lens of Huygens's eye piece is 'f' then what the distance of separation between two lenses is\_\_\_\_\_.
7. Mechanical wave in a gas is \_\_\_\_\_.
8. Mechanical waves on the surface of a liquid are\_\_\_\_\_.
9. In a Fabry-Perot interferometer the circular fringes are formed at fringes of\_\_\_\_\_.
10. Fabry-Perot interferometer is based on the principle of interference by\_\_\_\_\_.

11. Fabry-Perot interferometer is based on the principle of interference by\_\_\_\_\_.
12. The fringes formed in Michelson's interferometer are localized \_\_\_\_\_.
13. In Fraunhofer diffraction from a slit the light wave front incident on the slit is \_\_\_\_\_.
14. In a single slit diffraction, for a slit of width 'd' and wave length  $\lambda$ , the angular separation between central maximum and 1<sup>st</sup> minimum is\_\_\_\_\_.
15. In single slit Fraunhofer diffraction, the width of the central maximum is greatest for \_\_\_\_\_ colour.
16. Resolving power and limit of resolution are \_\_\_\_\_ of each other.
17. The intensity of principal maximum in the spectrum of grating having N slits is proportional to\_\_\_\_\_.
18. To be able to see diffraction pattern, the size of obstacle must be \_\_\_\_\_ of the wave length of light.
19. In a transmission grating, the transparent and opaque strips are of equal width, the absent spectra are \_\_\_\_\_.
20. If the widths of transparent strips are double of the width of opaque strips then the absent orders are \_\_\_\_\_.
21. Diffraction phenomenon is usually divided into \_\_\_\_\_ classes.
22. In \_\_\_\_\_ type of diffraction, the screen and the source are kept at finite distance.
23. The spreading of waves into the regions of the geometrical shadow is called \_\_\_\_\_.
24. Crone's spiral is a \_\_\_\_\_.

25. A device that is based on the concept of Fresnel's half period zone is called \_\_\_\_\_.
26. zone plate is based on \_\_\_\_\_ phenomenon.
27. The shape of fringes in Newton's ring are \_\_\_\_\_.
28. The expression for central fringe width of single slit is \_\_\_\_\_ .
29. The unit of power of a lens is \_\_\_\_\_ .
30. In wave propagation \_\_\_\_\_ is transferred from one point to another point.

**(Answer in one word and each carries 1mark)**

1. Write the differential equation of a wave.
2. When a sound wave goes from one medium to another then which quantity remains unchanged.
3. In which type of wave energy is not transferred?
4. What is the ratio between group Velocity and phase velocity in a dispersive medium
5. What is the shape of wave front originating from a point source of light?
6. What is the shape of wave front for a liner source?
7. What is the expression of electromagnetic wave in medium?
8. What is the relation between coherence length and coherence time?
9. To which property of a medium will you relate to the potential energy of a wave?
10. Under which condition the group velocity is equal to phase velocity?
11. On reflection from a denser medium, what will be the path difference?
12. Give an example of phenomenon of the interference of division of amplitude.
13. Give an example of interference due to division of wave front.
14. Can we produce interference with white light?

15. Do interference effects occur for sound waves?
16. What is diffraction?
17. Define power of a lens.
18. What is the relation between path difference and phase difference?
19. What is the wave front?
20. What are the essential properties of a medium to have a wave motion through it.
21. What is optical path?
22. What is dispersion of light?
23. What is dispersive power of material of a prism?
24. What is an eye piece?
25. What are the cardinal points of an optical system?
26. What is a wave?
27. Write a relation between group velocity and phase velocity.
28. What is the differential equation of a simple harmonic oscillator?
29. Is sodium light really a coherent source?
30. Is multi-colour fringe possible in case of an oil film?

**Group B: Short questions (each carries 1.5 mark)**

1. State and explain Huygens's principle.
2. What is Fermat's Principle of least time?
3. What is Fermat's principle of stationary time?
4. Define Transverse and longitudinal wave.
5. Explain why wave velocity is also called phase velocity.
6. What is the difference between normal dispersion and anomalous dispersion?
7. Distinguish between wave velocity
8. Describe temporal and spatial coherence.
9. Define coherence length and coherence time.

10. Write down the properties of electromagnetic wave.
11. Define intensity of a wave. Write an expression for it.
12. What are the characteristics of Ramsden's eye piece?
13. What should be the thickness of an oil film on the water surface to see the colours in it?
14. State Stoke's law in terms of phase change on reflection.
15. What is an interferometer?
16. What is the working and principle of Michelson-Morley interferometer?
17. Why a compensating plate is used in Michelson's interferometer.
18. Name the fringes produced in Fabry-Perot interferometer.
19. What will happen when Young's double slit experiment is performed in water?
20. In Young's double slit experiment, fringes appear at straight line. Explain?
21. Compare the pattern of fringes formed in biprism and Lloyd's mirror.
22. How are Newton's ring formed?
23. Why is the centre of ring dark in Newton's ring set up?
24. What will happen to Newton's rings if a drop of water is inserted between the lens and the glass plate?
25. How coherent source of light waves are produced?
26. What is the condition of interference?
27. What happens when the width of the slit in Fresnel's biprism is increased?
28. Explain the necessity of broad source of light for observing colours in thin films.
29. What happens to the Newton's, when liquid is filled in the air?
30. What is Michelson's interferometer? Give its principle?

**Group C: Short questions (each carries 2.5 mark)**

1. Why do we get circular rings in the Michelson's interferometer?
2. Why Fabry Perot interferometer is very useful for resolving very small wavelength difference?

3. What are interference filters?
4. What do you mean by Finesse?
5. What are the main advantages of Fabry Perot interferometer than Michelson's?
6. How localised fringes are produced in the Michelson's interferometer?
7. Why does a Michelson interferometer produce fringes with an extended source but not with an extended source but not with a point source?
8. What is the use of Michelson interferometer?
9. What is the difference between Fresnel's and Fraunhofer's diffraction?
10. Define Fresnel's half period zone.
11. Why does a zone plate half multiple foci?
12. How is Fresnel's diffraction represented graphically?
13. What are Rayleigh's criteria of resolution?
14. What is the difference between the magnification and resolution?
15. How do we measure the half width of the nth order principal maximum of diffraction pattern of a grating?
16. Show that whether matrix  $\begin{pmatrix} 3 & 2 \\ 3 & 4 \end{pmatrix}$  is a system matrix of optical system.
17. The equivalent focal length of a Huygens's eye piece is 6 cm. Calculate focal length of the field lens.
18. The focal length of each lens of Ramsden's eye piece is 12 cm. Calculate the equivalent focal length of the eye piece.
19. Two thin Plano-convex lenses of the same material in a Huygens eye piece are 10 cm apart. Find the focal lengths of the eye piece.

20. A travelling wave has a rating of 440 Hz at 360 m/sec .How far will two position be from each other if the corresponding displacement differ in phase by  $\pi$  rad.
21. Ruby laser is operating at wave length  $6943 \text{ \AA}$  with emission band width of  $10^7$  Hz. Calculate the coherence length.
22. Find the coherence length for white light .The wave length of white light ranges from  $7 \times 10^{-7} \text{ m}$  to  $4 \times 10^{-7} \text{ m}$ .
23. Light of wave length 700 nm has coherence length  $14 \times 10^{-6}$ .Find coherence time.
24. Find the Q-factor of a laser beam having wave length  $8 \times 10^{-7}$  and coherence length 7m.
25. Comparison between Michelson's and Fabry-Perot interferometer.
26. Write down uses of Fabry-Perot interferometer.
27. When a movable mirror of Michelson interferometer is shifted through 0.006180mm then 22 fringes move across the field of view. Find the wavelength of light.
28. The mirror in Fabry-Perot interference has a reflection co-efficient of 0.089. Determine the co-efficient of fringes.
- 29.The movable mirror of Michelson's interferometer is moved through a distance of 0.03201mm. Find the number of rings shifted across the cross wire if the wave length of light is  $6000 \text{ \AA}$ .
30. What will happen to Newton's rings if monochromatic light is replaced by white light?
31. Explain colour produced in thin film.

32. In Young's double slit experiment, light of wave length  $5000\text{\AA}$  is used. The fringe width changes by  $2.5\text{mm}$  when

the screen move towards the slit by  $100\text{cm}$ . Find the distance between two slits.

33. Newton rings are observed in reflected light of wavelength  $6000\text{\AA}$ . The diameter of the  $10^{\text{th}}$  dark ring is  $0.5\text{cm}$ .

Find the radius of curvature and thickness of air film.

34. What would be the minimum number of lines drawn on diffraction grating so as to resolve the  $1^{\text{st}}$  order sodium

doublet having a difference of wave length  $6\text{\AA}$  at a wavelength  $5893\text{\AA}$ ?

35. Compare a zone plate and convex lens.

#### **Group D: Long Questions-**

1. Discuss Fermat's principle and prove laws of reflection and refraction.
2. Define system matrix of an optical system. Obtain the system matrix for a thick lens and derive the lens formula  
for thin lens from the system matrix.
3. Define cardinal points of a system of co-axial lenses. State their properties.
4. Describe the construction and working of a Ramsden's eyepiece. What are its merits and demerits?
5. Describe the construction and working of a Huygens eyepiece.
6. Discuss the comparison between Ramsden's and Huygens's eyepiece.
7. Derive an expression for pressure amplitude of a plane progressive wave and express the intensity of a wave in  
terms of pressure amplitude.
8. What do you mean by progressive wave? Derive the equation of a progressive wave.
9. State Huygens principle and using it prove laws of reflection.

10. State Huygens principle and using it prove laws of refraction.
11. Explain temporal coherence, spatial coherence, and coherence length and coherence time. Write the relation  
between coherence length and coherence time.
12. Describe Young's experiment for interference of light and find an expression for fringe width.
13. Describe the Fresnel's biprism method for determining the wavelength of light.
14. Explain how Newton's rings are formed and determination of wavelength of light.
15. Discuss the interference in thin films due to transmitted system of rays.
16. Describe the interference in thin films due to transmitted system of rays.
17. Describe the construction of Michelson interferometer and explain the formation of fringes in it.
18. Explain the principle of Fabry-Perot interferometer. Obtain an expression for the intensity of transmitted light  
and also explain the visibility and sharpness of the fringe.
19. Derive an expression for Fraunhofer diffraction pattern with a narrow slit and by a parallel beam of mono-chromatic light.
20. Describe Fraunhofer's diffraction at a double slit.
21. Describe Fraunhofer's diffraction due to a single slit.
22. Give the construction and theory of plane transmission grating and explain the spectra formed by it.
23. What is a zone plate? Describe the construction and theory of zone plate.
24. Give the mathematical treatment of Fresnel's diffraction at a straight edge.
25. Describe diffraction through multiple slit.

