

Sessional Examination - 2022

Class : B. Sc. 1st Semester

Subject : Physics (Honours)

Paper : PHY-HC-1016

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer *any six* questions, each carrying five marks: 5 x 6 = 30

1. Prove i) $(\vec{A} \times \vec{B})^2 = A^2 B^2 - (\vec{A} \cdot \vec{B})^2$

ii) $|\hat{a} - \hat{b}| = 2 \sin \frac{\theta}{2}$

Where θ is the angle between \hat{a} and \hat{b} . 5

2. Show that the vectors $\vec{a} = 5\hat{i} + 6\hat{j} + 7\hat{k}$, $\vec{b} = 7\hat{i} + 8\hat{j} + 9\hat{k}$ and $\vec{c} = 3\hat{i} + 20\hat{j} + 5\hat{k}$ are coplanar vectors.

3. Show that $\vec{a} \times (\vec{b} \times \vec{c}) = (\vec{a} \cdot \vec{c})\vec{b} - (\vec{a} \cdot \vec{b})\vec{c}$. 5

4. If $\vec{f} = xy^2\hat{i} + 2x^2yz\hat{j} - 3yy^2\hat{k}$, find divergence of \vec{f} at $(1, -1, 1)$. 5

5. Define Gradient of a scalar function. If $\phi = 3x^2y - y^3z^2$, find grad ϕ at the point $(1, -2, -1)$. 5

6. Define order and degree of a differential equation. Write the order and degree of the following: 5

a) $x \frac{d^2y}{dx} - xy = 0$

b) $x^2 \left(\frac{d^2y}{dx^2} \right)^3 + y \left(\frac{dy}{dx} \right)^4 + y^4 = 0$

7. If $y = A \cos x + B \sin x$, form the differential equation and also write the order of the differential equation. 4 + 1 = 5

(2)

8. Define a linear differential equation. Write its standard form.

Solve the linear differential equation :

$$1 + 1 + 3 = 5$$

$$(x + 1) \frac{dy}{dx} - y = e^x (x + 1)^2$$

9. What is exact differential equation. Solve the exact

differential equation :

$$2 + 3 = 5$$

$$(5x^4 + 3x^2y^2 - 2xy^3)dx + (2x^3y - 3x^2x^2 - 5y^4)dy = 0$$

10. What is Wornskian ? Check whether the following function

are linearly independent or not :

$$2 + 3 = 5$$

$$e^x \cos x, e^x \cos x$$

Or

$$\text{Solve: } \frac{d^2y}{dx^2} - 5 \frac{dy}{dx} + 6y = 0$$

Sessional Examination - 2022

Class : B. Sc. 1st Semester

Subject : Physics (Honours)

Paper : PHY-HC-1026 (Mechanics)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer *any six* questions of the following : 5 x 6 = 30

1. Distinguish between inertial and non-inertial frames of reference. 5
2. State Newton's 1st law and derive it from Newton's 2nd law. 5
3. Show that length is invariant under Galilean transformation. 5
4. Deduce the equation of Rocket motion. 5
5. Show that the path of a inclined projectile is parabolic. 5
6. What are conservative and non-conservative forces ?
Give example. 5
7. What is moment of inertia and find the moment of inertia of a uniform circular disc about an axis passing through its centre and perpendicular to its plane. 5
8. Show that $Y = 3K (1 - 2\sigma)$. 5
9. Show that force as a negative gradient of potential energy. 5
10. Find the gravitational potential and field due to a solid sphere at a point outside the sphere. 5

Sessional Examination - 2022

Class : B. Sc. 1st Semester

Subject : Physics (Generic)

Paper : PHY-HG-1016 (Mechanics)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer *any six* questions of the following : 5 x 6 = 30

1. Write the difference between scalar and vector product. 5
2. If $\vec{A} = 2\hat{i} + 3\hat{j} - 4\hat{k}$, $\vec{B} = 3\hat{i} - 2\hat{j} + \hat{k}$ then find
i) $\vec{A} \cdot \vec{B}$ ii) $\vec{A} \times \vec{B}$. 5
3. Define inertial and non-inertial frames of reference. 5
4. State Newton's 2nd law of motion and derive its mathematical form. 5
5. State Newton's 3rd law and derive it from Newton's 2nd law. 5
6. Deduce the differential equation of SHM. 5
7. Establish an expression of time period of a compound pendulum. 5
8. State Kepler's law in planetary motion. 5
9. Establish the relation $K = \frac{Y}{3(1-2\sigma)}$. 5
10. Find the expression for twisting couple on a cylinder. 5

Sessional Examination - 2022

Class : B. Sc. 3rd Semester

Subject : Physics (Honours)

Paper : PHY-HC-3016

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer six questions each carrying 5 marks :

6 x 5 = 30

1. Define Hermitian, symmetric and orthogonal matrix. Give the matrix representation of a matrix. 5
2. Find the complex conjugate of the matrix $\begin{pmatrix} 1 & 2 & 3i \\ 1-i & i & 2+3i \end{pmatrix}$. 5
3. Express a square matrix as the sum of an Hermitian and an anti-Hermitian matrix. 5
4. Find the inverse of the matrix $A = \begin{pmatrix} 3 & 2 & 1 \\ 1 & 1 & 1 \\ 5 & 1 & -1 \end{pmatrix}$. 5
5. Show that $A = \begin{pmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{pmatrix}$ is an orthogonal matrix. 5
6. Show that an orthogonal matrix is non-singular. 5
7. Prove that $(AB)^{-1} = B^{-1}A^{-1}$. 5
8. If $A = \begin{pmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 5 & 0 & 0 \end{pmatrix}$ then verify that $A^3 = 5I$. 5
9. Determine the rank of the matrix $\begin{pmatrix} 1 & 2 & 3 \\ 3 & 4 & 5 \\ 4 & 6 & 8 \end{pmatrix}$. 5
10. Show that $(AB)' = B'A'$. 5

Sessional Examination - 2022

Class : B. Sc. 3rd Semester

Subject : Physics (Honours)

Paper : PHY-HC-3026

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer *any six* questions of the following : 5 x 6 = 30

1. What are extensive and intensive thermodynamic variables ?
State Zeroth law of thermodynamics. 5
2. Establish the relation : 5
$$C_p - C_v = R$$
3. Calculate the workdone during an Isothermal process. 5
4. What are isothermal, adiabatic, reversible and irreversible process ? Give examples. 5
5. What are compressibility and expansion co-efficient. 5
6. Mention five postulates of kinetic theory of gases. 5
7. State the Maxwell-Boltzmann law of velocity distribution and write its mathematical expression. 5
8. What do you mean by degree of freedom? State numbers of degrees of freedom for monatomic, diatomic and polyatomic gases. 5
9. Find an expression for RMS speed. 5
10. State mean free path and law of equipartition of energy. 5

Sessional Examination - 2022

Class : B. Sc. 3rd Semester

Subject : Physics (Honours)

Paper : PHY-HC-3036

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any six :

5 x 6 = 30

1. Write the difference between analog signal and digital signal with example.
2. Write short notes :
 - a) Decimal number system
 - b) Binary number system
 - c) BCD
3. Convert Decimal to Binary number :
 - a) $(33)_{10}$
 - b) $(37.25)_{10}$
4. Convert Binary to Decimal system :
 - a) $(10111)_2$
 - b) $(11011.01)_2$
5. Find the 1's and 2's compliment
 - a) 10011
 - b) 10001
6. Find the result of Binary addition :
 - a) 101 and 110
 - b) 1011 and 1001
7. Find the result of Binary subtraction :
 - a) 10001 subtract from 10011 by using both general and 1's compliment method.
8. Convert Decimal to BCD :
 - a) $(234)_{10}$
 - b) $(358)_{10}$
9. Convert Octal to Decimal number :
 - a) $(645)_8$
 - b) $(211)_8$
10. Convert Hexagonal to Decimal number :
 - a) $(F8)_{16}$
 - b) $(15A)_{16}$

Sessional Examination - 2022

Class : B. Sc. 3rd Semester

Subject : Physics (Generic)

Paper : PHY-HG-3016

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer *any six* questions of the following : 5 x 6 = 30

1. State Zeroth law and first law of thermodynamics. 5
2. What are isothermal, adiabatic, isobaric, reversible and irreversible process ?
3. Calculate the workdone during an isothermal process. 5
4. Write the postulates of kinetic theory of gases (any five). 5
5. State and explain Maxwell's law of velocity distribution. 5
6. Write short notes : 5
 - a) Micro-state
 - b) Macro-state
7. Show that $S = K \log w$, where 5

$S =$ Entropy of the system.
 $K =$ Constant, $w =$ Thermodynamical Probability
8. Deduce Maxwell-Boltzmann distribution law. 5
9. Derive Plank's law of Blackbody radiation. 5
10. Deduce Wien's distribution law of Blackbody radiation. 5

Sessional Examination - 2022

Class : B. Sc. 5th Semester

Subject : Physics (Honours)

Paper : PHY-HC-5016

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer **any six** questions each carrying 5 marks : $6 \times 5 = 30$

1. Choose the correct options : 1×5

- i) The momentum of a photon of energy E is
 - a) EC
 - b) E^2C
 - c) E/C
 - d) E/C^2
- ii) The de Broglie wave are :
 - a) matter waves
 - b) mechanical waves
 - c) electromagnetic waves
 - d) standing waves
- iii) Which one of the following wave function is the best representation of a free particle along the positive x -axis ?
 - a) $A \sin(kx - \omega t)$
 - b) $A \cos(kx - \omega t)$
 - c) $A e^{i(ka - \omega t)}$
 - d) $A e^{-i(ka - \omega t)}$
- iv) The probability density $\psi^*(x, t) \psi(x, t)$ is always :
 - a) real
 - b) complex
 - c) zero
 - d) negative
- v) The Schrodinger equation contains :
 - a) 1st order time derivative
 - b) 1st order space derivative
 - c) 2nd order time derivative
 - d) 3rd order time derivative

2. What is a wave function ? Give Born's interpretation of a wave function. $2 + 3 = 5$

(2)

3. Why the wave function $\psi(x)$ be single-valued everywhere?
Is $\psi(x) = x^3$ and acceptable wave function? 5
4. Derive the time dependent Schrodinger's equation. 5
5. Write the Schrodinger's equation for a free particle.
What is the physical significance of the wave function? 5
6. Prove the relation $\frac{\partial p}{\partial t} + \vec{\nabla} \cdot \vec{S} = 0$, where P is the probability density and \vec{S} is the probability density constant. 5
7. Show that the probability density $\psi^*(x, t) \psi(x, t)$ is always real. 5
8. 'If ψ_1 and ψ_2 are two solutions of the Schrodinger's equation, then a linear combination $\psi = C_1\psi_1 + C_2\psi_2$ where C_1 and C_2 are constants is also a solution.' Prove the statement. 5
9. If $\psi(x) = Ae^{-\frac{\alpha^2 x^2}{2}} e^{ikx}$, find the normalization constant A.
10. Normalize the wave function $\psi(x) = Ae^{ikx}$ in the region $-a \leq x \leq a$. 5

Sessional Examination - 2022

Class : B. Sc. 5th Semester

Subject : Physics (Honours)

Paper : PHY-HC-5026

(Solid State Physics)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer *any six* :

5 x 6 = 30

1. Define Bravais lattice, primitive unit cell and basis.
2. Distinguish between crystalline and amorphous solids.
3. Draw the Miller planes :
 $(2\ 2\ 2)$, $(\bar{1}\ 0\ 0)$ & $(0\ 0\ 1)$
4. Define reciprocal lattice and Wigner Seitz cell.
5. Draw the lattices of tetragonal crystal system specifying lattice parameters.
6. Explain any two symmetry operators.
7. Deduce Bragg's law.
8. What do you mean by super-conductivity and super conductor ?
9. Explain Meissner effect.
10. Distinguish between type 1 and type 2 super conductors.

Sessional Examination - 2022

Class : B. Sc. 5th Semester

Subject : Physics (Honours)

Paper : PHY-HE-5016

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer *any six* :

5 x 6 = 30

1. Define the terms accuracy, error and precision.
2. State the three major categories (Gross, Systematic and Random) of error.
3. Define the following terms :
 - a) Arithmetic mean
 - b) Deviation
 - c) Standard deviation
4. Write the difference between periodic and aperiodic signals. State the properties of periodic signals.
5. Examine whether the signals periodic or non-periodic, if periodic determine the fundamental period :
 - a) $\sin 12 \pi t$
 - b) $e^{j4\pi t}$
 - c) $5 \cos 2 \pi t$
6. Explain S/N ratio and noise figure :
7. For the following given data, calculate -
 - i) Arithmetic mean
 - ii) Deviation of each value
 - iii) Algebraic sum of the deviationGiven, $x_1 = 49.7$, $x_2 = 50.1$, $x_3 = 50.2$, $x_4 = 49.6$, $x_5 = 49.7$,
8. Calculate the average deviation and standard deviation for the previous data (in question number 7).
9. Explain any three methods of safety grounding.
10. Write short notes :
 - a) Electrostatic Shielding
 - b) Electromagnetic Interference Shielding (EMI)

Sessional Examination - 2022

Class : B. Sc. 5th Semester

Subject : Physics (Honours)

Paper : PHY-HE-5056

(Nuclear and Particle Physics)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer *any six* questions of the following : 5 x 6 = 30

1. Derive Semi-empirical mass formula. 5
2. Write the similarities between nucleus and liquid drop. 5
3. What are electron emission, positron emission and electron capture ? 5
4. What is binary energy ? Write about nuclear forces. 5
5. Write about neutrino hypothesis. 5
6. Using semi-empirical mass formula find the binding energy of ${}_{20}\text{Ca}^{40}$. 5
7. What is nuclear reaction ? What are the different types of nuclear reactions ? 5
8. What are the conservation laws of nuclear reactions ? 5
9. What is strangeness quantum number ? Draw the Baryons and Mesons Octate. 5
10. What are elementary particles? What is antiparticle ?
What are Leptons and Hadrons ? 5
