

Sessional Examination - 2023

Class : B. Sc. 1st Semester

Subject : Physics

Paper : CORE

(Mathematical Physics & Mechanics)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries Five Marks): $6 \times 5 = 30$

1. Show that total energy of a particle in SHM is constant.
2. Deduce the differential equation of SHM.
3. Define Del operator. If $\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$ be the position vector field. Find divergence and curl of \vec{r} .
4. Define: (i) line integral (ii) surface integral and (iii) volume integral.
5. If $\vec{F} = 2z\hat{i} + x\hat{j} + y\hat{k}$. Evaluate $\iiint \vec{F} \cdot d\vec{v}$, where v is the region bounded by the surface $x = 0$, $y = 0$, $x = 2$, $y = 4$, $z = x^2$ and $z = 2$.
6. Define Dirac Delta function. Write its properties.
7. a) Distinguish between inertial and non-inertial frame of reference.
b) Can earth be considered as inertial frame?
8. Write the effect of centrifugal force on a body rotating about an axis.
9. Find the expression for position vector of centre of mass of a system of two particles.
10. Define impulse. Show that impulse is equal to change in momentum.

Sessional Examination - 2023

Class : B. Sc. 1st Semester

Subject : Physics

Paper : SEC

(Electronic Circuit Design)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries **Five** Marks): 6 x 5 = 30

1. What is Semiconductor? Write the difference between P-type and N-type semiconductor.
2. What are PN-junction and Zener diode? Draw the V-I characteristics curve for each.
3. Explain the working principle of Full wave rectifier.
4. Discuss Zener diode as a voltage regulator.
5. Write short note:
 - i) filter circuit
 - ii) OPAMP and its application.
6. Define amplification factor α and β . Find out the relation between them.
7. What are the different types of BJT? Explain the different configuration of BJT with diagram.
8. Explain in brief the working of pn junction diode in forward bias connection.
9. What is a resistor? Explain the different types of resistor.
10. Explain the working of transistor as an amplifier.

Sessional Examination - 2023

Class : B.A./B. Sc./B.Com. 1st Semester

Subject : Physics

Paper : MDC

(Natural and Physical Science)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries Five Marks): 6 x 5 = 30

1. Write short note:
 - i) Atoms
 - ii) Molecules
 - iii) Ions.
2. Explain Boyle's Law and Charles's Law a gas.
3. Explain covalent and Ionic bonding.
4. Define the terms Interference and diffraction.
5. Discuss the composition of world.
6. Explain the electrical and magnetic behavior.
7. What do you mean by friction? Give its applications
8. Write briefly the terms wave and oscillation.
9. What do you mean by osmosis? What is its importance?
10. What are the different kinds of forces? Explain them.

Sessional Examination - 2023

Class : B. Sc. 3rd Semester

Subject : Physics (Honours)

Paper : PHY-HC-3016 (Mathematical Physics-II)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries Five marks) $6 \times 5 = 30$

1. Define Hermitian and Skew-Hermitian matrices.

If A and B are Hermitian matrices, show that $AB + BA$ is Hermitian whereas $AB - BA$ is Skew-Hermitian.

2. What is adjoint of a matrix? Find the inverse of

$$A = \begin{bmatrix} 1 & 2 \\ 3 & -5 \end{bmatrix}.$$

3. Verify Cayley-Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$.

4. Define Gamma function. Prove that $\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}$

5. Show that $\Gamma(n+1) = n!$. Find the values of $\Gamma(2)$, $\Gamma(3)$.

6. Find the solution of $2 \frac{\partial u}{\partial x} + 5 \frac{\partial u}{\partial y} = 0$ using the method of separation of variables.

7. Solve Laplace equation in Cartesian coordinate.

8. Define rank of a matrix. Find the rank of the matrix

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 7 \\ 3 & 6 & 10 \end{bmatrix}$$

(2)

9. What is diagonalize matrix? Diagonalize the matrix

$$A = \begin{bmatrix} 1 & 0 & 1 \\ 1 & 1 & 0 \\ 1 & 0 & 1 \end{bmatrix}$$

10. Express the matrix $A = \begin{bmatrix} 2 & 1 & 0 \\ 1 & -1 & -2 \\ 4 & 2 & 0 \end{bmatrix}$ as a sum of symmetric and Skew-symmetric matrix.

Sessional Examination - 2023

Class : B. Sc. 3rd Semester

Subject : Physics (Honours)

Paper : PHY-HC-3026 (Thermal Physics)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries Five marks) $6 \times 5 = 30$

1. Write first law of thermodynamics and express it in differential form.
2. Derive an expression for work done during an adiabatic process.
3. State Zeroth law of thermodynamics and explain its physical significance.
4. What are reversible and irreversible processes? Give examples.
5. State Kelvin-Planck and Clausius statements. State Carnot's theorem.
6. Explain the Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas.
7. Describe Stern's Experiment and its significance in understanding Doppler broadening.
8. Define mean, RMS, and most probable speed of gas molecules.
9. Discuss the concept of degrees of freedom in the context of molecular motion in gases.
10. Define the mean free path of gas molecules and discuss factors that affect its value.

Sessional Examination - 2023

Class : B. Sc. 3rd Semester

Subject : Physics (Honours)

Paper : PHY-HC-3036 (Digital System & Applications)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries Five marks) $6 \times 5 = 30$

1. Explain Cathode Ray Oscilloscope (CRO).
2. Write the difference between Combinational circuit and Sequential circuit.
3. Write short note: (i) Active element (ii) Passive element.
4. Give the realization of NAND gate.
5. What is Integrated circuit (IC)? Explain SSI, MSI, LSI and VLSI.
6. State De Morgan's theorem and proof it.
7. Draw the basic circuit diagram of M/S JK flip flop.
8. Find 1's and 2's compliment of the binary number 10010.
Convert octal number $(358)_8$ into decimal number.
9. Write short notes: (i) Decoder (ii) Encoder.
10. Explain Serial-In-Parallel-Out (SIPO) shift register.

Sessional Examination - 2023

Class : B. Sc. 3rd Semester

Subject : Physics (Generic)

Paper : PHY-HG-3016 (Thermal Physics & Statistical Mechanics)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries Five marks) $6 \times 5 = 30$

1. State Zeroth Law of thermodynamics. Derive $C_p - C_v = R$.
2. Calculate the work done during an adiabatic process.
3. What are reversible and irreversible processes?
Give examples.
4. Define Enthalpy, Gibb's, Helmholtz and Internal Energy Functions.
5. Derive Clausius-Clapeyron equation using Maxwell's equations.
6. Derive Maxwell's law of Velocity distribution.
7. What is Blackbody radiation? Deduce Wein's distribution law.
8. Establish the relation between Entropy and Thermodynamical Probability.
9. Derive Bose-Einstein distribution law.
10. Derive Fermi-Dirac distribution law.

Sessional Examination - 2023

Class : B. Sc. 5th Semester

Subject : Physics (Honours)

Paper : PHY-HC-5016 (Quantum Mechanics and Applications)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries Five marks) $6 \times 5 = 30$

1. Define a wave function associated with a wave packet. Determine whether or not $\Psi(x) = e^x$ is an acceptable wave function.
2. Find the expression for the wave function associated with a free particle.
3. Establish the time dependent Schrodinger's equation.
4. Show that probability density $\Psi^*(x, t) \Psi(x, t)$ is always real.
5. What is probability current density? Find the expression for it.
6. Show that, $\hat{p}_x = i\hbar \frac{d}{d\phi}$ is a Hermitian operator.
7. Show that if $\Psi_1(\vec{r})$ and $\Psi_2(\vec{r})$ are two independent solutions of the Schrodinger equation, then $\Psi(\vec{r}) = a_1 \Psi_1(\vec{r}) + a_2 \Psi_2(\vec{r})$.
8. What are eigen values and eigen function associated with operator? Show that is an eigen function of the operator with eigen value -5 .
9. Find the angular momentum operators in Cartesian form.
10. Find the momentum and energy operator associated with the wave function

$$\Psi(x, t) = Ae^{-\frac{i(Et - px)}{\hbar}}$$

Sessional Examination - 2023

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 (Each question carries Five marks) $6 \times 5 = 30$

1. Define superconductivity and explain the experimental results that led to its discovery.
2. What is the critical temperature in superconductivity, and why is it a crucial parameter? How does it vary among different superconducting materials?
3. Explain the Meissner effect and its significance in superconductivity.
4. Differentiate between type I and type II superconductors. What are their key characteristics?
5. Describe London's Equation and its role in understanding the behaviour of superconductors in the presence of magnetic fields.
6. What is the penetration depth, and how is it related to London's Equation?
7. What is the isotope effect in superconductivity, and how does it provide insights into the underlying mechanisms of superconducting materials?
8. Provide an overview of the BCS (Bardeen-Cooper-Schrieffer) theory without going into mathematical derivations.
9. Explain the concept of Cooper pairs in the context of superconductivity. How do these pairs of electrons contribute to the superconducting state?
10. Discuss the practical applications and significance of superconductivity in various fields, such as energy transmission, medical imaging, and particle accelerators.

Sessional Examination - 2023

Class : B. Sc. 5th Semester

Subject : Physics (Honours)

Paper : PHY-HE-5016 (Experimental Technique)

Time : 1 Hour 20 Minutes

Full Marks : 30

Answer any Six (Each question carries Five marks) $6 \times 5 = 30$

1. Write short notes:

i) Errors

ii) Gross Error

iii) Significant figure.

2. Calculate standard deviation from the given data

2, 4, 6, 8, 10 and 12.

3. Define S/N ratio and Noise figure.

The voltage output from a transistor as a study value of 0.95 volt with function component of 0.35 volt rms. If the noise figure of the transistor is 1.3. What is the signal to noise ratio of the measure quantity?

4. Define Periodic and Non Periodic signal of a system. Examine the signal are periodic or non periodic (i) $\sin 2\pi t$ (ii) $e^{j\pi t}$.

5. Draw the block diagram of digital multimeter.

6. Write the difference between digital and analog instrument

7. Show that pumping speed, $S = \frac{V}{t_2 - t_1} \ln \frac{P_0}{P_1}$?

8. What is diffusion pump? Discuss the working principle of Diffusion pump.

9. What is EMI? Write the mechanism of EMI.

Sessional Examination - 2023

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 (Each question carries Five marks) $6 \times 5 = 30$

1. Write Semiempirical mass formula and explain its various terms.
2. What are the significant similarities between a drop of liquid and an atomic nucleus?
3. Discuss the success and failure of liquid drop model.
4. What are the characteristics of nuclear force?
5. What do you mean by Quarks? How many possible Quarks are there? Give the charge and quantum number associated with each quark.
6. What are the evidences of Shell model of nucleus?
7. What is Strangeness quantum number? Draw the Baryons and Mesons octate.
8. What is mass defect and packing fraction? Why neutron number exceeds proton number in the medium and heavy nucleus?
9. What is binding energy? Write the significance of Binding energy curve.
10. What are the structures of neutron and proton in terms of Quarks? What are Leptons? How many Leptons are there? Write their names.
