



A Charutar Vidya Mandal's Institution
V.P. & R.P.T.P. SCIENCE COLLEGE
(AUTONOMOUS) (Grant-in-Aid)
Affiliated to Sardar Patel University
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Bachelor of Science (Semester IV) External Examination - 2026
US04MAPHY02

Classical, Quantum and Solid State Physics

Date: 25-03-2026, Wednesday
Time: 01:45 PM to 04:15 PM

Total marks :50

Q-1

Multiple Choice Question

10

Two bodies are separated by distance r . If the distance becomes $2r$, the gravitational force between them becomes

1. (a) $\frac{F}{2}$ (c) $\frac{F}{3}$
(b) $\frac{F}{4}$ (d) $2F$



Central force always acts

- 2 (a) perpendicular to radius (c) opposite to velocity
(b) tangent to orbit (d) along the radius vector

Turning points occur when

- 3 (a) Radial velocity is zero (c) Potential energy is zero
(b) Acceleration is zero (d) Velocity is maximum

A narrower wave packet corresponds to

- 4 (a) smaller uncertainty in momentum (c) zero uncertainty in momentum
(b) larger uncertainty in momentum (d) constant momentum always

Conservation of probability means that

- 5 (a) wave function is always real (c) momentum always decreases
(b) particle energy always increases (d) total probability remains constant with time

The Force which holds atom together is _____

- 6 (a) Gravitational Force (c) Cohesive Force
(b) Electrostatic Force (d) Magnetic Force

Which bond is formed by sharing of electrons between atoms?

- 7 (a) Ionic (c) Metallic
(b) Hydrogen (d) Covalent

Number of atoms per unit cell in a BCC is _____.

- 8 (a) 3 (c) 2
(b) 4 (d) 1

Total number of Bravais Lattice is _____.

- 9 (a) 32 (c) 7
(b) 41 (d) 14

Which structure has lowest Atomic packing factor?

- 10 (a) SC (c) FCC
(b) BCC (d) HCP



Long Questions:

Derive the expression for gravitational field intensity and gravitational

- Q-2 (a) potential due to a continuous mass distribution, and establish the relation [06]
between field and potential.

Distinguish carefully between gravitational constant (G) and acceleration due

- (b) to gravity (g). Why does one remain constant while the other changes from [04]
place to place?

OR

Reduce the two-body problem to an equivalent one-body problem and derive

- Q-2 (a) the expression for reduced mass, and explain why apple falls toward the earth [06]
and not the earth towards the apple?

- (b) Why is the centrifugal term called a pseudo effect? Write its expression and [04]
explain in detail.

- Q-3 (a) Derive Schrodinger's equation for free particle in One dimension and [06]
Generalize it in three dimensions.

- (b) What is expectation value of a dynamical variable? [04]

OR

- Q-3 (a) Derive the equation of conservation of probability starting from Schrödinger's equation and obtain the expressions for probability density and probability current density. [06]

- (b) State Ehrenfest's theorem. [04]

- Q-4 (a) Prove that $U_{\min} = -\frac{a}{r_0^m} \left[1 - \frac{m}{n} \right]$ [06]

- (b) Explain the Born Haber cycle for NaCl. [04]

OR

- Q-4 (a) Explain the calculation of Madelung Constant of ionic Crystals. [06]

- (b) Discuss the properties of ionic Solids [04]

- Q-5 (a) Define point group symmetry and space group symmetry and explain in brief rotation, reflection symmetry operations. [06]

- (b) Derive the scheme to determine miller indices of plane with suitable example [04]

OR

- Q-5 (a) Define lattice parameters and discuss seven crystal systems. [06]

- (b) What is Atomic Packing Factor? Calculate APF for FCC. [04]

