

**PHY-501: NUCLEAR PHYSICS, ADVANCED QUANTUM MECHANICS-1 AND
INSTRUMENTATION(ATKT)**

INSTRUCTIONS:

1. Attempt all questions.
2. All questions carry equal marks.
3. Symbols have their usual meaning.
4. Scientific calculator is allowed.

Q.1(A) Discuss Electric quadrupole moment using orthogonality of nuclear states. [07]

OR

State the condition of EQM for the different shape of nucleus. Also prove that the quadrupole moment in the state with the Z-component as, the spin component I_z . [07]

$$Q_s = \frac{3I^2 - I(I+1)}{I(2I-1)} Q_B$$

Q.1(B) Define magnetic moment and show that magnetic dipole moment $\bar{\mu}_z$ of a nucleus in a definite parity is not equal to zero. [07]

OR

Discuss Hydrogen and D_2 molecular beam experiments in detail and state the comments. [07]

Q.2(A) State types of Potential and explain the excited state of Deuteron. [07]

OR

Derive an expression of σ_{SC} in case of spin dependence of neutron-proton scattering. [07]

Q.2(B) Explain effective range theory in n-p scattering. [07]

OR

Write a short note on Yukawa's meson theory of nuclear forces [07]

Q.3(A) Describe the experimental setup for scattering. Obtain an expression for total scattering amplitude. [07]

OR

Write an equation for Yukawa potential. Obtain condition for Born-Approximation in case of Yukawa potential. [07]

Q.3(B) State and prove the optical theorem. [07]

OR

Obtain an equation of phase shift for l^{th} partial wave in terms of phase shift. [07]

Q.4(A) Define transducer and state its desired characteristics. Explain photo emissive detector. [07]

OR

Discuss (i) Magnetic search coil and (ii) Piezoelectric transducer. [07]

(P.T.O)

Q.4(B) What do you mean by sensitivity and linearity of a transducer? Explain optical transducer. [07]

OR

“In a multistage cascade amplifier, the noise due to the first stage must be made minimum”—Justify. [07]

Q.5 Write Short Answers: [14]

- 1 Define nuclear particle density.
- 2 What do you mean by even parity?
- 3 Scattering length is positive is indicate _____ state.
- 4 Write the equation for Exponential potential $V(r)=$ _____.
- 5 _____ exchange parameter is change in the Majorana Potential.
- 6 Define scattering length.
- 7 In case of Heisenberg forces, the value of $(l+s)$ is odd, then the potential is _____.
- 8 What is unit of centrifugal distortion term in radial schrodinger equation?
- 9 “A beam is moving along z-direction then, the z-component of angular momentum is zero” [TRUE/FALSE]
- 10 For high energy scattering, the value of ‘ λ ’ is _____.
- 11 What is unit of differential scattering cross-section?
- 12 Give schematic of capacitor transducer.
- 13 Giving example, define calibration of transducer.
- 14 What is the temperature measurement range of K-type thermocouple?

=====BEST OF LUCK=====