5556051 Seat No. _____

M. Sc. (Part - II) Examination

April / May – 2003

Physics : Paper - I

(Nuclear Physics, Quantum Mechanics, General Relativity)

Time : **3** Hours] [Total Marks : **100**

Instructions : (1) All questions carry **equal** marks.

(2) Symbols have their usual meaning.

1 (a) Describe the molecular beam resonance method for determining the magnetic moments of nuclei.

(b) What is hyperfine structure ? Discuss the modifactions that occur in it in an external magnetic field.

OR

1 (a) Give the effective range theory of n–p scattering. Use the theory to find the binding energy of deuteron.

(b) Justify the existence of tensor forces in the nucleus.

2 (a) What do you understand by the term continuum ? Discuss the continuum theory of nuclear reaction.

(b) Derive the Breit–wigner formula for compound nucleus cross section.

OR

2 Why is it necessary to consider the collective motions of the nucleus ? Describe the collective model of the nucleus. Discuss the vibrational and rotational spectra of the nucleus.

3 Apply the first Born approximation to calculate the differential cross section of the scattering of electrons by screened coulomb potential. Examine the validity of this approximation.

OR

3 What is phase shift in scattering theory ? Obtain the expression for the differential scattering cross–section in terms of phase shift. Also obtain the optical theorem.

4 (a) Giving all the details obtain the radial wave equation for a Klein – Gordon particle interacting with a coulomb potential in terms of the variable rho.

(b) Define the invariant delta function for a complex scalar field and get its covariant integral representation. What is the principle of micro casuality ? Show that the positive frequency part of Φ should be associated with the annihilation operator.

OR

4 (a) Consider an electron in a magnetic field and find its allowed energy states and eigenfunctions. Show that it has a spin magnetic moment of value one Bohr magneton.

(b) Discuss the second quantization of non–relativistic Schrödenger field for system of fermions. Fond the relevant anti commuator at unequal times.

5 (a) State the principle of equivalence. Obtain the equation of motion of a particle moving under the influence of a pure gravitational field. Discuss the case when the gravitational field is weak as well as stationary.

(b) Discuss the effects of gravitation on particle mechanics, Maxwell's equations and electromagnetic force.

OR

5 (a) Find the transformation of the affine connection. Using tensor analysis, establish the relationship between the affine connection and the metric tensor. What are its important consequences ?

(b) Use the transformation of $\sqrt{\ }$ to define the covariant derivative. Fund the covariant divergence of a contra variant vector. What is the importance of covariant differentiation ?
