PRABHAT KUMAR COLLEGE, CONTAI

M.Sc. 4TH Semester Examinations 2021
(Under CBCS pattern)

Subject : Physics

PAPER/COURSE – PHS: 402

FULL MARKS : 40

TIME : 02 Hour

Candidates are required to give their answers in their own words as far as practicable.

The figures in the right-hand margin indicate full marks.

402.1: Nuclear Physics - II

Attempt any two (02) of the following: ***2 x 10***

1. (a) Explain nuclear shell model. Write down the achievements of the model. 5+3
   (b) Draw the states of 2-phonons quadrupole vibration. 2
2. Discuss slowing down of neutrons in a moderator. Calculate average log decrement of energy per collision. 5+5
3. (a) Classify neutrons according to energy scale. 2
   (b) Discuss the different sources of neutrons. 4
   (c) Using square well potential and appropriate boundary conditions, find the wave function of the bound state of deuteron. Show it graphically. 3+1
4. (a) Write down the characteristics of direct reaction. 2
   (b) Discuss the quantum numbers associated with elementary particles. 6
   (c) State CPT theorem. 2

(Internal Assessment - 05)

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402.2: Quantum Field Theory

Attempt any Two (02) of the following: ***2 X 10***

1. (a) State and explain the Noether's theorem of symmetry. Define conserved current and hence show that charge is conserved. Discuss the Lorentz symmetry and deduce conserved generator of the field.
   (b) Write down the Lagrangian density of the real scalar field and hence construct the Hamiltonian and momentum density of the field. [(2+2+3)+3]

2. (a) Discuss quantization (momentum expansion) of the Dirac field.
   (b) State the Wick's theorem and proof this for three bosonic operators. [6+4]

3. (a) Write down the Feynman diagram of the following terms:
   (i) $\frac{(-i\delta\ \ )^2}{8}\int d^4y_1 d^4y_2\ i\triangle_F(x_1-x_2) i\triangle_F(y_1-y_1)\ i\triangle_F(y_2-y_2)$
   (ii) $\frac{(-ig)^2}{4}\int d^4y_1 d^4y_2\ i\triangle_F(x_1-y_1) i\triangle_F(y_1-y_1)\ i\triangle_F(y_2-y_2)\ i\triangle_F(y_2-x_2)$
   (b) Calculate the Feynman propagator for transverse photon. [(2+2)+6]

4. (a) What do you mean by "Normal ordering and time ordering" of the field operators.
   (b) For complex scalar field, calculate the correlation function of the fields.
   (c) Show that vacuum expectation value of time ordered product of the odd numbers of field operators are vanishes. [3+5+2]

(Internal Assessment - 05)