M.Sc.

2009

4th Semester Examination

PHYSICS

PAPER—PH-2202

Full Marks : 40

Time : 2 Hours

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

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

Illustrate the answers wherever necessary.

Group—A

(Marks : 20)

1. Answer any *five* from the following : 2×5

(a) Discuss the exchange forces between the nucleons with examples.

(b) Establish the target capture $_{13}Al^{27}(d,p)_{13}Al^{28}$ nuclear reaction for $E_d > 50$ MeV.

(c) Give few examples of the Independent Particle models.

(d) What do you mean by the reaction channels for nuclear reactions ? Express with example.

(e) What are semi-magic and double magic nuclei ?

(f) Using single-particle shell model find the spin-parity values of the following (any *two*) ground state nuclides :

$$_{29}Cu^{63},\ _{6}C^{12} \text{ and } _{8}O^{17}.$$

(g) Present graphically the types of neutrons with energy.

(h) Give the range of life-time and nucleon traverse-time on the formation and disintegration of the compound nucleus.

2. Answer any *one* bit : 10×1

(a) What do you mean neutron optics ? Derive the relation between refractive index (μ) and scattering length (a) of a material with nuclei per unit volume(N) due to neutron for wave length 'λ', 2+8

(b) What do you understand by the level width (Γ) and level separation (D) between the levels of a continuum in nuclear reactions ?

Discuss the basic ideas of the continuum theory of nuclear reactions. 2+8

Group—B

(Marks : 20)

1. Answer any *five* bits : 2×5

(a) Prove that the time reversal operator is anti-unitary.

(b) State the usefulness of normal ordering of operators.

(c) Define gauge co-variant derivative why it was introduced ?

(d) $\hat{H}_{int}^{e.m} = e\bar{\psi}\gamma_\mu\psi A_\mu$.

(e) How does standard model predict neutral current ?

Evaluate $\hat{C}\hat{H}_{int}^{e.m}\hat{C}^{-1}$.

(f) $L = \frac{1}{2}\partial^\mu\phi\partial_\mu\phi - \frac{1}{2}m^2\phi^2$.

Prove that $m^2\phi + \Box\phi = 0$.

(g) Discuss Higg's mechanism.

(h) What do you mean by non-abelian symmetry ?

2. Answer any *one* bit :

(i) (a) For the process $e^-\mu^- \rightarrow e^-\mu^-$, write down the scattering amplitude with necessary Feynman diagram. 5

(b) Prove that

$$T_r\left[(\not{p}_2 + m)\gamma^\mu(\not{p}_1 + m)\gamma^\lambda\right]$$

$$= 4\left[p_2^\mu p_1^\lambda + p_2^\lambda p_1^\mu + m^2 g^{\mu\lambda} - p_1 . p_2 g^{\mu\lambda}\right] \quad 5$$

(ii) (a) Prove that the invariance of the scalar field Lagrangian under space-time translation leads to the conserved energy-momentum tensor

$$T_\nu^\mu = \frac{\partial L}{\partial(\partial_\mu \phi)} - L\,\delta_\nu^\mu. \quad 5$$

(b) What is CPT theorem? Write the consequence of CPT theorem. Why parity is not conserved in weak interaction?

1+2+2

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