(Pages : 3) N – 6236

Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, June 2022

Physics

PH 242 : NUCLEAR AND PARTICLE PHYSICS

(2020 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

(Answer any **five** questions. Each question carries **3** marks)

I. (a) Give the salient features of the collective model of nuclear structure.

(b) Explain what is meant by a compound nucleus.

(c) Explain magnetic confinement.

(d) Explain the term critical energy in liquid drop model.

(e) There are no known mesons of charge two. Give a simple explanation for this.

(f) Why a proton does not decay into a positron and a photon? Give reasons.

(g) Give the basic working principle of a proportional counter.

(h) Explain the concept of scattering length.

(5 × 3 = 15 Marks)

PART – B

(Answer **all** the questions. Each question carries **15** marks)

II. (A) (a) Discuss in detail the shell model of the nucleus.

(b) Give the specialities of magic numbers of nuclei.

OR

P.T.O.

(B) (a) Derive and explain Breit-Wigner resonance formula for nuclear reactions.

(b) What are stripping reactions?

III. (A) (a) State the general features and classification of nuclear fission reactors.

(b) Explain neutron cycle and the four factor formula.

OR

(B) (a) Discuss the thermonuclear reactions in the laboratory conditions.

(b) Explain the term ignition temperature and Lawson criterion.

IV. (A) (a) Draw the schematic representation of a Geiger-Muller counter and explain the same.

(b) Explain its principle and working operation.

OR

(B) (a) Explain in detail the eight fold way and SU (3) model for strong interaction.

(b) Draw the weighted diagram for baryon decuplets and explain the same.

(3 × 15 = 45 Marks)

PART – C

(Answer any **three** questions. Each question carries **5** marks)

V. (a) Which reaction produces more energy

(i) the fusion of $^{3}H_{1}$ and $^{3}He_{2}$ or

(ii) $^{2}H_{1}$ and $^{4}He_{2}$. Identify the reaction by the estimation of the Q-values?

(b) Use the harmonic oscillator shell model to obtain the expected configuration of the ground state of the nucleus ^{1}H and its total L, S, J and T quantum number and parity.

(c) Evaluate the Q value of the reaction $^{152}Eu + n \rightarrow {}^{152}Sm + P$. Given the atomic masses in units of u ($1u = 932 MeV/c^2$) $^{152}Eu_{63} = 151.92749$, $^{152}Sm_{62} = 151.919756$ $^{1}H = 1.007825$, neutron = 1.008665.

(d) In a nuclear reaction, the fission of U^{235} atom yields 200MeV. If energy of 3.6 kg of uranium is consumed in a day, find the power output of the reactor. Assume that the reactor is 25% efficient.

(e) A GM counter consists of a 10mm diameter grounded tube with a wire of 50μm at $+2 \times 10^3$V in the centre. Estimate the appropriate electric field at the wire.

(f) The Gell-Mann-Nishijima relation which gives the charge of mesons and baryons in terms of certain quantum numbers is $q = e(I_3 + B/2 + S/2)$. Identify the different terms.

(3 × 5 = 15 Marks)
