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Reg. No. : .....

Name : .....

Fourth Semester M.Sc. Degree Examination, June 2022

Physics

PH 242 : NUCLEAR AND PARTICLE PHYSICS

(2018–2019 Admission)

Time : 3 Hours Max. Marks : 75

PART – A

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

I. (a) Compare n-p scattering with p-p scattering.

(b) Explain the spin orbit interaction term in nuclear shell model.

(c) Explain the two opposing tendencies in a heavy nucleus which decide whether the nucleus is fissile or not.

(d) Briefly explain the main source of energy from the sun.

(e) What is a stripping reaction? Give one example.

(f) Explain the connection between symmetry and conservation laws.

(g) Give the basic principles underlying the formation of an output signal in a semiconductor radiation detector.

(h) Explain the quark structure of π^+ and π° and show how the charge and spin are accounted for.

($5 \times 3 = 15$ Marks)

P.T.O.

PART – B

Answer **three** questions. Each question carries **15** marks.

II. (A) (a) Discuss the following properties of nuclear forces.

(i) Saturation

(ii) Non-central nature

(iii) Exchange nature.

(b) How far does the deuteron corrborate the non-central nature?

OR

(B) (a) What are resonances nuclear reactions? Derive the Breit – Wigner formula for $l = 0$ resonance.

(b) Clarify the connection between the peak energy and width of the resonance cure with the properties of the excited state of the compound nucleus involved in the resonance.

III. (A) (a) Discuss the nuclear fission process and comment on the mass distribution of the fission fragments.

(b) Explain two main classes of nuclear reactors.

OR

(B) (a) Describe the conditions necessary for the construction of a nuclear fusion reactor in the laboratory.

(b) Write a note on the pinch confinement of a plasma.

IV. (A) (a) With the help of a neat diagram, explain the principle and working of a proton LINAC.

(b) What is its chief disadvantage and show how it is Nercome in a cyclotron?

OR

(B) (a) Bring out the details of the following interactions operating in the world of elementary particles, giving one example each :

(i) strong interaction

(ii) weak interaction.

(b) Illustrate the law of conservation of spin with reference to a specific elementary particle interaction.

($3 \times 15 = 45$ Marks)

PART – C

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

V. (a) A hypothetical force operates in a distant galaxy, having a range of 1 μm. Calculate the mass of the corresponding exchange parities involved.

(b) Obtain the shell model predications for the spins and parties of the ground states of the following nuclei :

(i) $_{7}N^{15}$

(ii) $_{12}Mg^{24}$

(iii) $_{4}Be^{9}$

(iv) $_{11}Na^{23}$

(c) A certain nuclear reaction has a threshold energy of 3.5 MeV. A resonance occurs at an incident energy of 4.7 MeV and has a width of 1.2 KeV. What is the energy and lifetime of the compound nucleus level excited in the reaction.

(d) In a nuclear reactor, the fission process starts with 100 neutrons. If the multiplication factor is 1.05, obtain the number of neutrons in the fourth generation.

(e) Show that in a cyclotron, the find energy of the accelerated particles does not depend on the RF accelerating voltage.

(f) Fill in the blanks with appropriate elementary particle in the following interactions. Consistent with conservation laws. Also that the conservation laws are satisfied.

(i) $p \rightarrow n$ + ...?.... + γ

(ii) $\pi^{\circ} \rightarrow \gamma +$ .....?....

(3 $\times$ 5 = 15 Marks)
