A–092

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MSCPH-511

M.Sc. PHYSICS (MSCPH)

(Nuclear Physics)

3rd Semester Examination, 2024 (June)

Time : 2:00 Hrs. Max. Marks : 70

Note* :–** This paper is of Seventy (70) marks divided into Two (02) Sections 'A' and 'B'. Attempt the questions contained in these Sections according to the detailed instructions given therein. ***Candidates should limit their answers to the questions on the given answer sheet. No additional (B) answer sheet will be issued.

Section–A

(Long Answer Type Questions) 2×19=38

***Note* :–** Section 'A' contains Five (05) Long-answer type questions of Nineteen (19) marks each. Learners are required to answer any *two* (02) questions only.

1. Mention important features of various nucleus models. Describe liquid drop model and obtain the mass formula for a nucleus.

2. Write short notes on the following :

   (i) Electric quadrupole moment

   (ii) Nuclear Angular momentum

   (ii) Magnetic dipole momentum

   (iv) Meson exchange theory

3. Describe and explain the salient features of β-decay of nuclei. What is evidence for the existence of neutrino ?

4. Derive the Breit-Weigner single level formula for scattering cross-section. Define the meaning of level width of a resonance in nuclear reaction.

5. Give an account of principle, construction and working of linear accelerator. Discuss the advantages of linear accelerator over circular accelerator.

Section–B

(Short Answer Type Questions) 4×8=32

***Note* :–** Section 'B' contains Eight (08) Short-answer type questions of Eight (08) marks each. Learners are required to answer any *four* (04) questions only.

1. Calculate the binding fraction of $^{4}_{2}He$ (α-particle). Masses of proton and neutron are 1.007825u and 1.008665u respectively. The mass of $^{4}_{2}He$ is 4.002604U.
2. Explain radioactive equilibrium. Define transient and secular equilibrium.
3. Describe the Gamow's theory of α-decay and how it explains Geiger-Nuttal Law.
4. Discuss conservation laws in nuclear reactions.
5. Discuss interaction of gamma rays with matter ? Explain the Dirac's theory of pair production.
6. Discuss the compound nucleus theory of nuclear reactions.
7. Obtain the Q-value for the decay $^{228}_{90}Th \rightarrow {}^{224}_{88}Ra + \alpha$. Where binding energy of $^{228}_{90}Th$, $^{224}_{88}Ra$ and α particle is 1.743077 GeV, 1.720301 GeV and 28.296 MeV respectively.
8. Explain the basic principle, construction and working of synchrotron.

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