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Printed Pages : 4 **EOE-036**

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0932 Roll No. | | | | | | | | | | |

B. Tech.

(Semester-III) Theory Examination, 2011-12

NUCLEAR SCIENCE

Time : 3 Hours] *[Total Marks : 100*

Note : Attempt questions from each Section as indicated. The figures in the right hand margin indicate marks.

Section-A

Attempt *all* parts of this question. 2×10=20

1. (a) What do you mean by nuclear spin ?
   (b) In what way nuclear forces are different from other forces.
   (c) Define magic numbers.
   (d) Why does Cyclotron fail to operate at very high energies ?
   (e) Define decay constant.
   (f) What are Fermi-Curie plots in beta-decay ?
   (g) What do you understand by positron emission topography (PET) ?

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(h) On what factors does the performance of an accelerator depend ?

(i) What do you mean by exoergic and endoergic reaction ?

(j) What are the different processes through which gamma radiation interacts with matter ?

Section-B

Attempt any *three* parts of this question. 10×3=30

2. (a) What is nuclear fission ? How is it explained on the basis of liquid drop model ?

(b) The half life of $_{92}U^{238}$ is 4.5×10^{9} years. Calculate the activity of one gram of $_{92}U^{238}$ (Avogadro number $=6.023\times10^{23}$).

(c) Why an accelerator is needed to explore the nucleus ? Describe briefly the theory and limitation of a cyclotron.

(d) What is Q-value in a nuclear reaction ? Outline its significance in certain nuclear reactions.

(e) Describe the various properties of nuclear forces. What do you mean by nuclear stability ?

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Section-C

Attempt *all* questions of this Section. 10×5=50

3. List the various experimental methods of finding the size of the nucleus. How will you determine the nuclear radius from the observation of beta-rays resulting from nuclear transition when the initial and final nuclei are mirror nuclei ?

Or

Explain the origin of the nuclear magnetic moment. Using the Schmidt single particle model, deduce expressions for the magnetic dipole moment.

4. Discuss briefly the nuclear shell model. How do the centrifugal term and spin orbit coupling term remove the degeneracy of the three-dimensional spherically symmetric harmonic oscillator ?

Or

Explain the collective model of nucleus and with this model explain the deviation of magnetic moments from Schmidt diagram.

5. Give an outline of Bohr's compound nucleus formation hypothesis of nuclear reactions. Discuss one example of experimental study leading to the verification of this hypothesis.

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Or

Explain the mechanism of direct nuclear reaction. Describe briefly how the angular distributions of such reactions can be accounted in a simple plane-wave Born approximation.

6. Describe the salient features of Fermi's theory of β-decay. What do you understand by allowed and forbidden transitions ?

Or

What do you understand by mass spectrograph ? Describe the principle of Aston's mass spectrograph.

7. Explain the working principle of bubble chamber and explain its advantages over the cloud chamber.

Or

Describe a modern synchrotron and give its working principle. Discuss its advantages over a cyclotron.

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