

**CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE FOR WOMEN,  
NUVEM-GOA**

**SEMESTER END EXAMINATION, AUGUST 2020**

**B.Sc. Semester: V (old course) Physics (Paper III) Nuclear Physics**

**Total marks: 30    Date: 06-08-2020    Duration: 2hrs    Total No. of pages: 2**

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**Instructions:**

- 1) *All questions are compulsory.*
- 2) *Figures to the right indicate maximum marks.*
- 3) *Use of log tables and non-programmable calculators is permitted.*
- 4) *Symbols have their usual meanings unless specified.*

**I. Answer any five of the following: (5 x 2 marks = 10)**

- a. Explain how radioactive carbon formed in the atmosphere enters the living organisms like plants and animals.
- b. Explain the K-capture process. Why is it considered to be a beta decay process?
- c. How is the nucleus said to be associated with a magnetic dipole moment? Why does a neutron have a magnetic moment despite neutral charge?
- d. Explain the saturation property of nuclear force.
- e. The half life of a certain element is 3000 years. How many years will be required by 1 gram of radium to lose 1 milligram.
- f. What is meant by an electric quadrupole moment? How is its value correlated to the shape of the nucleus?
- g. What is Geiger- Nuttall rule? Represent the rule graphically for a radioactive series.
- h. Radioactive material reduces to 20% of its initial quantity in 10 hours. Find its decay constant and half-life.

**II. Answer any four of the following. (4 x 5 marks = 20)**

1. a) Explain the term packing fraction. Give the plot of packing fraction versus mass number.
- b) Obtain the binding energy in MeV of Nitrogen nucleus.  
Given masses:  $M(N^{14}) = 14.0030 \text{ a.m.u}$  ,  $M(\text{proton}) = 1.0078 \text{ a.m.u}$ ,  
 $M(\text{neutron}) = 1.0086 \text{ a.m.u}$ .

2.   a) Give three properties of a neutrino, proposed by the neutrino hypothesis.  
      b) Give the energetics of  $\beta^+$  decay.
3.   a) Explain the pairing energy term and surface energy term in Weizsacker's semi-empirical mass formula.  
      b) Plot the fission yield curve for Uranium and explain its features.
4.   a) Give four evidences for magic numbers that supported the shell model.  
      b) Give two limitations and successes of a liquid drop model for the nucleus.
5.   a) Explain briefly how a nuclear chain reaction can be for peaceful purposes.  
      b) What is a breeder reactor? What are its advantages?
6.   a) What is Carbon dating? Explain.  
      b) What is the role of i) Moderator ii) Control rods in a nuclear reactor?

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