CARMEL COLLEGE OF ARTS, SCIENCE & COMMERCE FOR WOMEN,

NUVEM-GOA

SEMESTER END EXAMINATION

B.Sc. Semester: VI Nuclear Physics (PYD-106)

Max marks: 80 Date: 13/06/2022 Duration: 2hrs Total No. of pages: 3

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.***

Q.1. Answer any four of the following: (4X4=16)

a) Show that the nuclear density is a constant for a nucleus with mass number A.

b) If the number of nucleons in a copper nucleus is 64 and the number of nucleons in oxygen nucleus is 16. How much larger is the copper nucleus than an oxygen nucleus?

c) Give the energetics of β^+ decay. Why is the probability of β^- decay greater than β^+ decay?

d) Draw the graph of Binding energy per nucleon versus mass number. Give three salient features of this curve.

e) Give four properties of a nuclear force.

f) Estimate the mass of a meson using the Heisenberg uncertainty principle.

Q.2. Answer any four of the following: (4X4=16)

a) Obtain the expression for mean life of a radioactive sample.

b) Explain what you mean by Fissile and Fertile nuclei. Give two examples.

c) What is a Breeder reactor? Explain its working.

d) State the Geiger Nutall rule. Give the plots of half- life versus disintegration constant observed by him for different radioactive series.

e) Calculate the amount of energy produced by the fission of 1.00kg of U^{235} given the average fission reaction of U^{235} produces 200 MeV of energy per fission.

f) In Nuclear reactions define a 1) spallation 2) photodisintegration reactions

3. A p) A fossil bone in a museum has a count rate of 15 counts/min. A fresh bone has a count rate of 19counts/min. Calculate the age of the fossil bone (half life of the radioactive decay is 5570yrs) **(3)**

q) Explain the term secular equilibrium. **(3)**

OR

x) How is Carbon-14 formed in the atmosphere and used for fossil dating? **(3)**

y) Explain how natural radioactive elements are classified to form the radioactive series. **(3)**

3. B Derive the expression for number of atoms of A and B at any instant of time t. in successive radioactive disintegration of A→B→C type, where C represents the stable end product. **(6)**

4. A p) Give the working of ionisation chamber in nuclear detection. **(3)**

q) Give any three laws that are conserved during a nuclear reaction. **(3)**

OR

x) Explain 1) dead time and 2) quenching in a G.M counter **(3)**

y) A piece of ancient wood shows an activity of 3.9 disintegration per minute per gram of C^{14}. Estimate the age of wood piece, if the half-life of C^{14} is 5568 yrs. Assume the activity of fresh Carbon-14 as 15.6 disintegrations per minute per gram . **(3)**

4. B. Give the Gamow's theory for alpha decay. **(6)**

5. A p) Derive the expression for alpha disintegration energy. **(3)**

q) Explain how deuteron problem reveals the non-central nature of nuclear force **(3)**

OR

x) Explain the term K-capture in decay process. **(3)**

y) Define multiplication factor k, in the neutron cycle. What changes are observed in the nuclear chain reaction when value of k >1 and k=1? **(3)**

5. B Give the beta decay spectrum. Which two laws of physics were violated in this decay? Give the Pauli's hypothesis of neutrino for beta decay. **(6)**

6. A p) Explain three similarities between a liquid drop and a nucleus. **(3)**

q) Give the ground state spins and parities using the Jensen Mayer scheme for the shell model for for $^{17}O_8$, $^{27}Al_{13}$ and $^{42}Sc_{21}$ **(3)**

OR

x) Give three experimental evidences for Magic numbers that led to shell model. **(3)**

y) Give the role of 1) moderator 2) coolant 3) control rods in a nuclear reactor. **(3)**

6. B Show that Weisacker's semi –empirical mass formula is simplified as,
$_ZM^A = \alpha A + \beta Z + \Upsilon Z^2 \pm \delta$,
where A is mass number and Z is atomic number. Find the expression for charge of the most stable isobar. **(6)**

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