Q.P. Code :02229

[Time: $2\frac{1}{2}$Hours] **[Marks:75]**

Please check whether you have got the right question paper.

N.B:
1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Draw neat diagrams wherever necessary.
4. Symbols have usual meanings unless otherwise stated.
5. Use of log-table and non-programmable calculator is allowed.

Q.1. a) Attempt **any one:-**

i. State Q value equation of a nuclear reaction and obtain its solution. Hence discuss it for exoergic reactions in which the bombarding particle has very low and finite energy. **10**

ii. What is α decay paradox? How is it resolved by Gamow? **10**

b) Attempt **any one:-**

i. Compare stripping and spallation nuclear reactions. **05**

ii. What is α disintegration energy? Derive an expression for it using conservation principles. **05**

Q.2. a) Attempt **any one:-**

i. What are different types of beta decay? Explain with suitable examples. Discuss their energetics. **10**

ii. What is Mossbauer effect? What are the factors responsible for the broadening of gamma ray spectral lines? How can their effect be minimized? Describe the experimental set up to study Mossbauer effect. **10**

b) Attempt **any one:-**

i. Explain the salient features of a typical beta ray spectrum that posed difficulties in understanding beta decay. **05**

ii. Write a short note on nuclear isomerism. **05**

Q.3. a) Attempt **any one:-**

i. Draw a schematic diagram of a bubble chamber and explain its working What are its advantages? **10**

ii. Explain Bohr Wheeler Theory of nuclear fission and hence show that the stability condition against spontaneous fission is given by $\frac{z^2}{A} \geq 44$. **10**

b) Attempt **any one:-**

i. State the merits and demerits of GM counter. **05**

ii. What are mirror nuclei? Determine the mass difference of the two mirror nuclei. (Consider A to be odd) **05**

[P.T.O]

Q.4. a) Attempt **any one:-**

i. What is the chain reaction? Discuss thermal nuclear reactor and obtain four factor formula. **10**

ii. Give classification of elementary particles. Explain briefly what are electrons and positrons. **10**

b) Attempt **any one:-**

i. What are prompt and delayed neutrons? Explain the significance of delayed neutrons in nuclear reactor. **05**

ii. Write a short note on Mesons. **05**

Q.5. a) Attempt **any one:-**

i. Calculate the kinetic energy of α particle in the following decay: $^{212}_{84}Po \rightarrow {}^{208}_{82}Pb + \alpha$.
Given : Q value of nuclear reaction = 11.76 Me V **04**

ii. Complete the following nuclear reaction and find mass of X if Q value of the nuclear reaction is 2.38 MeV.

$$^{23}_{11}Na + {}^{1}_{1}H \rightarrow {}^{20}_{10}Ne + X$$

Given : M($^{23}_{11}Na$)=22.989770u, M($^{1}_{1}H$)=1.007825u

M($^{20}_{10}Ne$)=19.992440 u, 1 u = 931.5 Me V **04**

b) Attempt **any one:-**

i. The beta decay of $^{60}_{27}Co$ produces electrons of maximum energy 0.312 MeV. The daughter nucleus $^{60}_{27}Co$ eventually decays to ifs ground state by emitting two gamma rays of energies 1.173 MeV and 1.333 MeV in cascade. Draw the decay scheme and find the Q - value of the process. **04**

ii. The atomic masses of $^{64}_{28}Ni$, $^{64}_{29}Cu$ *and* $^{64}_{30}Zn$ are respectively 63.927956 u, 63.929761 u and 63.929140 u. Which of these are beta active and what are the natures of their beta activity?
Given: m_e= 0.51 MeV, 1u =931.5 MeV. **04**

c) Attempt **any one:-**

i. Estimate the number of ion pairs produced in a proportional counter by a 10 MeV proton, if all the proton energy is absorbed. Calculate the total charge that flows in the counter if the multiplication factor is 100. Given: Energy required for producing one ion pair is 35 MeV and e=1.6x10^{-19}C. **04**

ii. Determine the Coulomb coefficient a_c, in the semi empirical mass formula. Given: M($^{15}_{7}N$)=15.000108u, M($^{15}_{8}O$)=15.003070u, $(m_n - m_p)$=0.000844 u and 1u =931.5 MeV. **04**

d) Attempt **any one:-**

i. Why does U^{235}undergo fission when it captures thermal neutron whereas U^{238} does not? **03**

ii. Calculate the amount of energy released by 60g of $^{235}_{92}U$ if it is completely fissioned.
Given: Energy released per fission is 200.5 MeV. **03**
