Q.P. Code: 52274

Time: $2\frac{1}{2}$**hrs.** **Total Marks: 75**

N.B. : (1) **All** questions are **compulsory**.

(2) **Figures** to the **right** indicate **full** marks.

(3) Draw **neat** diagrams wherever **necessary**.

(5) Symbols have usual meaning unless otherwise stated.

(5) Use of **non-programmable** calculator is allowed.

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

(i) What is alpha decay paradox? Obtain an expression for the transmission probability of the α-particle through a rectangular barrier. **10**

(ii) Discuss the salient features of beta decay spectrum. How continuous nature of beta ray spectrum leads to violation of laws of conservation of energy and momentum? Explain how the paradox was resolved. **10**

(b) Attempt any **one:**---

(i) $_{83}Bi^{212}$ decays with half life of 60.5 min by emitting 5 groups of alpha particles with energies 6.08 MeV, 6.04 MeV, 5.75 MeV, 5.62 MeV, 5.60 MeV. Calculate alpha disintegration energies and sketch the energy level diagram. **5**

(ii) Why β^+ emission is favored over electron capture. **5**

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

(i) Explain what is Mossbauer effect? Draw and describe the schematic arrangement of Mossbauer's experiment in detail. **10**

(ii) What is liquid drop model of Nucleus? Write down the similarities between a nucleus and a drop of liquid. What are the outcomes and limitations of the liquid drop model? **10**

(b) Attempt any **one:**---

(i) Write a note on magic numbers in the nucleus. **5**

(ii) Derive the stability limit against spontaneous fission, $\frac{Z^2}{A} \geq 52$. **5**

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

(i) Explain the significance of carbon cycle in the process of energy production in stars. Give an account of controlled fusion as a source of energy on earth. **10**

(ii) Explain construction and working of Van de Graff generator in detail. **10**

(b) Attempt any **one:**---

(i) Describe in brief the process of asymmetric fission. **5**

(ii) How many neutrons will be there in the hundredth generation if the fission process starts from 1000 neutrons and k=1.05 **5**

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

(i) Discuss Yukawa's meson exchange theory of nuclear force. Estimate the mass of meson using uncertainty principle. What is Yukawa potential? **10**

(ii) What are particles and antiparticles? Write about the discovery and properties of antielectron, antiproton. **10**

(b) Attempt any **one:**---

(i) Give the classification of elementary particles in terms of bosons and fermions. **5**

(ii) Write the properties of u, d and s quark. Explain the structure of proton and neutron in terms of quarks. **5**

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

(i) Calculate the K.E. of α particle in the following decay $_{84}Po^{212} \rightarrow {}_{82}Pb^{208} + \alpha$. The atomic mass of $_{84}Po^{212}$, $_{82}Pb^{208}$ and α particle are 211.991876 u, 207.976650 u and 4.0039 u respectively. **4**

(ii) $_3Li^7$ and $_4Be^7$ have atomic masses 7.016005 u and 7.016929 u respectively. Which of them show β-activity and of what type? Calculate Q value for the possible reaction. **4**

(b) Attempt any **one:**---

(i) TI ^{203} atoms resulting from β-decay of Hg^{203} atoms emit four groups of conversion electrons with kinetic energies 266.3, 264.2, 263.6 and 193.3Kev. The electron binding energies in the K, L_I, L_{II} and L_{III} shells are 85.7, 15.4,14.8 and 12.7 Kev respectively. Calculate the energies of γ-quanta concurrent with the decay. **4**

(ii) For the isobaric family A=91, obtain the nuclear charge z_0 of the most stable isobar. **4**

(a_a=19 Mev a_c=0.60 Mev M_n=939.573 Mev, M_p=938.280 Mev)

(c) Attempt any **one:**---

(i) Protons are accelerated in a 100cm cyclotron. The oscillator frequency is 10 Megacycle. Calculate the magnetic field needed for the protons. Given: e = 1.6 x 10^{-19}C, Mass of proton M = 1.67 x 10^{-27}kg **4**

(ii) Calculate the amount of energy available if 1 gm of $_{92}U^{235}$is a completely fissioned. Given that the energy per fission 200MeV. **4**

(d) Attempt any **one:**---

(i) State lepton and baryon number conservation law. Identified whether the following elementary particle reaction are allowed or forbidden, **3**

$\Lambda^0 = p^+ + \pi^-$

$\Lambda^o = p^- + \pi^+$

(ii) A pion of mass 134 MeV/c^2 at rest decays by weak interaction into muon of rest mass 102 MeV/c^2 and an antineutrino. If the rest energy of antineutrino is zero, calculate the total kinetic energy of muon and antineutrino. **3**
