B. Sc./M. Sc. (Applied Physics) (Sem. III) (CBCS) Examination

November / December - 2018

XI - Basic Nuclear Physics

(New Course)

Faculty Code : 003

Subject Code : 0493004

Time : $2\frac{1}{2}$ Hours]   [Total Marks : **70**

1   Attempt any seven short questions : (Two marks each)   **14**

(1)   Define nucleus, isotopes and isomers.

(2)   What is radioactivity ? Give examples.

(3)   Explain radioactive dating.

(4)   Complete reactions :

(i) $^{7}_{3}Li +$ _____ $= {}^{4}_{2}He + {}^{4}_{2}He$

(ii)   _____ $= {}^{13}_{6}C + {}^{0}_{1}\beta$

(5)   Explain elastic scattering with example.

(6)   Define units of radioactivity.

(7)   What are reflectors in nuclear reactor ?

(8)   Derive an equation for half-life an isotope.

(9)   Explain in short: Research reactors.

(10) Explain: Surface energy.

2   (a)   Write answers of any **two** :   **10**

(1)   Explain nuclear shell model in detail.

(2)   Explain :

(i)   Coulomb energy

(ii) Volume energy.

(3)   Write a detailed note on magic numbers.

(4)   Derive an equation for semi empirical mass formula and also define the energy term.

(b) Write answers of any **two** : 4

(1) What is unified atomic mass unit? What is its energy equivalent ?

(2) Define binding energy.

(3) Write about the characteristics of binding energy curve.

(4) Write a short note on nuclear size.

3 (a) Write answers of any **two** : 10

(1) What is mean life of a radioactive isotope ? Derive an equation for mean life (τ).

(2) Derive Bateman's equation for radioactive decay.

(3) Discuss gamma decay in detail.

(4) Write a detailed note on conservation laws in radioactive decay.

(b) Write answer of any **one** : 4

(1) Write notes on :

(i) Positron emission

(ii) Electron capture.

(2) Write notes on :

(i) Secular equilibrium

(ii) Transient equilibrium.

4 (a) Write answers of any **two** : 10

(1) Explain nuclear fission and fusion with examples.

(2) What is Q value of a nuclear reaction ? Derive Q equation for nuclear reaction.

(3) Discuss conservation laws for nuclear reactions.

(4) Explain disintegration and photodisintegration with examples.

(b) Complete any **four** reactions : 4

(1) $^{27}_{13}Al + ^{1}_{0}n = \underline{\hspace{2cm}} + ^{4}_{2}He$

(2) $^{23}_{11}Na + ^{1}_{1}H = ^{20}_{10}Ne + \underline{\hspace{2cm}}$

(3) $^{20}_{42}Ca + ^{1}_{1}H = \underline{\hspace{2cm}} + ^{2}_{1}H$

(4) $^{9}_{4}Be + ^{4}_{2}He = ^{12}_{6}C + \underline{\hspace{2cm}}$

(5) $^{15}_{8}O + ^{2}_{1}H = \underline{\hspace{2cm}} + ^{1}_{1}H$

(6) $^{4}_{2}He + ^{11}_{5}B = ^{14}_{7}N + \underline{\hspace{2cm}}$

5 (a) Write detailed note of any **two** topic : **10**

      (1) Production Reactors.

      (2) Power Reactor.

      (3) Fast Breeder Reactor.

      (4) Boiling Water Reactor.

   (b) Write answers of any **two** : **4**

      (1) Why coolant is used in nuclear reactor ? Which materials are used as coolants ?

      (2) What is reactor shielding in a nuclear reactor ? Why it is needed ?

      (3) Draw a general sketch diagram of pressurized water reactor.

      (4) What are control materials in nuclear reactor ? What is the main function of control materials ?

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