B. Sc. / M. Sc. (Applied Physics)
(Sem. III) (CBCS) Examination
November / December – 2017
XI - Basic Nuclear Physics
(New Course)

**Faculty Code : 003**
Subject Code : 0493004

Time : **2½** Hours]　　　　　　　　　　[Total Marks : **70**

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

(1)　Define nucleus, mass number and atomic number.

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

(3)　What is radioactivity?

(4)　Write about the radioactive dating.

(5)　Explain elastic scattering with example.

(6)　Complete reactions :

(i)　$^{10}_{5}B + ^{4}_{2}He = ^{13}_{7}N +$ _____

(ii)　$^{13}_{7}N = ^{13}_{6}C +$ _____
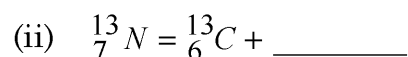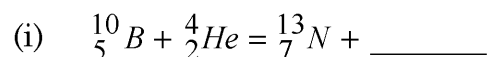
(7)　Why should moderators and reflectors to be used in a nuclear reactor?

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

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

(10)　Define units of radioactivity, Curie and Becquerel.

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

   (1) Explain nuclear shell model in detail.

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

   (3) Write a detailed note on magic numbers.

   (4) Define binding energy. Write about the characteristics of binding energy curve.

   (b) Explain any **two** term in detail :   **4**

   (1) Surface energy

   (2) Coulomb energy

   (3) Volume energy

   (4) Nuclear size

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

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

   (2) Explain the theory of alpha decay in detail.

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

   (4) Discuss quantum decay in detail.

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

   (1) Explain :

   (i) Positron emission and

   (ii) Electron capture.

   (2) Write notes on :

   (i) Secular equilibrium and

   (ii) Transient equilibrium.

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

    (1) Derive **Q** equation for nuclear reaction.

    (2) Explain nuclear fission and fusion with examples.

    (3) Discuss conservation laws for nuclear reactions.

    (4) Explain disintegration and photodisintegration with examples.

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

    (1) $^{122}_{52}Te + ^{4}_{2}He =$ _____ $+ ^{124}_{53}T$

    (2) $^{7}_{3}Li + ^{1}_{1}H = ^{4}_{2}He +$ _____

    (3) $^{23}_{11}Na + ^{1}_{1}H = ^{20}_{10}Ne +$ _____

    (4) $^{20}_{42}Ca + ^{1}_{1}H =$ _____ $+ ^{2}_{1}H$

    (5) $^{9}_{4}Be + ^{4}_{2}He = ^{12}_{6}C +$ _____

    (6) $^{4}_{2}He + ^{11}_{5}B = ^{14}_{7}N +$ _____

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

    (1) Production Reactors

    (2) Boiling Water Reactor.

    (3) Fast Breeder Reactor.

    (4) Power Reactor.

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

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

    (2) What is the use of a reactor coolant in nuclear reactor? Which materials are used as coolants?

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

    (4) Explain in short : Research reactors.