Reg. No. | | | | | | | | | |

BSCPHC 381

Choice Based Credit System Sixth Semester B.Sc. Degree Examination, September 2022
(2021 – 22 Batch Onwards)
PHYSICS
Nuclear Physics

Time : 3 Hours Max. Marks : 80

Instructions : *i) Answer questions from **all** Units.*
*ii) Scientific calculators are **allowed**.*

PART – A

1. Answer **any eight** of the following questions : **(1×8=8)**
   i) What is threshold energy of a nuclear reaction ?
   ii) What is radioactive series ?
   iii) What is radio carbon dating ?
   iv) What are nuclear forces ?
   v) What is a chain reaction ?
   vi) What is stellar energy ?
   vii) What are quarks ?
   viii) Write the necessary condition for the working of cyclotron.
   ix) What are hard cosmic rays ?

2. Answer **any six** of the following questions : **(2×6=12)**
   i) What is the significance of Q value of a nuclear reaction ?
   ii) What is K-electron capture ? Explain.
   iii) Define curie and becquerel.
   iv) Explain nuclear fission with an example.
   v) What are magic numbers ? Mention them.
   vi) Write any two drawbacks of liquid drop model.
   vii) What is quenching ? Name the compound used in organic quenching.
   viii) Write the decay scheme of μ^+ and μ^- particles.
   ix) Write any two advantages of cyclotron.

P.T.O.

PART – B

Unit – I

3. a) Explain the interactions of gamma rays with matter. **3**

   b) What is an endoergic reaction ? Deduce the expression for the threshold energy of an endoergic reaction. **5**

   c) With elements A, B and C forming a radioactive series (C being stable), derive an expression for the number of atoms of B if at start B was not present in the sample. **8**

OR

4. a) What is tunnel effect ? Quantitatively account for tunnel effect. **3**

   b) What is beta ray spectra ? Explain any four paradoxes of beta ray spectra. **5**

   c) Discuss the experiment leading to the discovery of neutrons. Explain any four properties of neutrons. **8**

5. a) A carbon specimen found in excavation contain 1/8 as much ^{14}C as an equal amount of carbon in living matter. Calculate the approximate age of the specimen. Half life of ^{14}C = 5568 years. **4**

OR

   b) Calculate the threshold energy required to initiate the reaction $^{31}P(n, p)\ ^{31}Si$. Given atomic masses $_{1}^{1}H$ = 1.00814 amu, neutron = 1.00895 amu. $_{15}^{31}P$ = 30.98356 amu and $_{14}^{31}Si$ = 30.98514 amu. **4**

Unit – II

6. a) Explain Yukawa's meson field theory. **3**

   b) Derive four factor formula for a nuclear reactor. **5**

   c) Describe with theory the working of dempster's mass spectrograph and explain how isotopic abundances can be determined. **8**

OR

7. a) Explain C-N cycle of fusion in stars. **3**

   b) Write any five properties of nuclear forces. **5**

   c) With a neat and labelled diagram, explain the working of a nuclear reactor. **8**

8. a) An alpha particle of energy 5 MeV approaches the gold nucleus with an impact parameter 2.6×10^{-13}m. Through what angle will it be scattered ? The atomic number of gold is 79. **4**

OR

b) A city requires 100 MW of electrical power per day which is supplied by a nuclear reactor of efficiency 40%. Calculate the amount of U – 235 fuel required per day of operation. (Assume the average energy of 200 MeV released per fission). **4**

Unit – III

9. a) Write a note on origin of cosmic rays. **3**

b) Describe the working of GM tube with the necessary diagram. **5**

c) Explain the principle of a betatron. Hence derive an expression for the final energy gained by the electrons. **8**

OR

10. a) Write a note on Van allen radiation belts. **3**

b) Explain the variation of cosmic ray intensity with :

i) Altitude and

ii) East-west direction. **5**

c) Explain the condition for synchronisation in a linear accelerator and obtain the expression for the maximum energy of the particles ejected from the accelerator. **8**

11. a) The radius of cyclotron DEE is 0.4 m and the applied magnetic field is 1.5 Wb/m^2. What is the maximum energy of a beam of protons ?
Given : Mass of proton = 1.67×10^{-27} kg. **4**

OR

b) Electrons are accelerated in a betatron working at 50 Hz frequency and has a stable orbit of radius 2 meter having the magnetic field strength 5T at the orbit. Calculate the average energy per revolution gained by the particles. (Express the energy in eV). Assume electrons are moving with velocity C. **4**

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