Seat No. _____

H-003-1016031

B. Sc. (Sem. VI) (CBCS) Examination

April - 2023

Physics : Paper - 601

(New Course)

Faculty Code : 003

Subject Code : 1016031

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

Instructions : (1) Make suitable assumption wherever necessary.
(2) Figure on the right indicates full marks.
(3) Non programmable calculator is permitted.
(4) Notations have their usual meaning.

1 (a) Answer each questions : (one mark each) **4**

(1) What is the approximate value of density of nucleus?

(2) What is impact parameter for backward scattering?

(3) Nucleus is positively charged. (True/ False)

(4) How many protons, neutrons and electrons respectively in the $^{206}_{82}Pb$ nucleus?

(b) Solve any **one** numerical : **2**

(i) If an alpha particle was released with zero velocity near the surface of a $_{90}Th^{228}$ nucleus. What would its K.E. be the when far away? Take $R_0 = 1.2$ fm, $K = 9 \times 10^9$ SI.

(ii) Find the binding energy per nucleon for $^{56}_{26}Fe$ nucleus from the data given below :
Mass of proton M_p = 1.007825 amu.
Mass of neutron m_n = 1.008665 amu.
Mass of Fe nucleus M_{Fe} = 55.934939 amu.
1 amu = 931.494 MeV.

(c) Answer any **one** : **3**

(1) Rutherford's explanation of alpha scattering experiment.

(2) Give evidence for shell model.

(d) Write any **one** in detail : **5**

(1) Show the nature of the graph of average binding energy per nucleon, against atomic mass number and explain its notable points.

(2) Write semi empirical mass formula and explain any three terms.

2 (a) Answer each question : (one mark each) **4**

(1) Write relative ionizing power of α, β and γ ?

(2) 5 mCi = _____ Bq. $5 \times 3.7 \times 10^7$.

(3) Give unit of decay constant.

(4) Half life of a radioactive element is 5 min. at the end of 20 min. its _____% quantity will remain undisintegrated.

(b) Solve any **one** numerical : **2**

(1) 1 gram of radium is reduced by 2.1 mg in 5 years by α-decay. Calculate the half life period of radium.

(2) If by successive disintegration of $^{238}_{92}U$, the final product obtained is $^{206}_{82}Pb$. How many α and β particles are emitted ?

(c) Answer any **one** : **3**

(1) Obtain the exponential law of radioactive disintegration.

(2) Explain internal conversion.

(d) Write any **one** in detail : **5**

(1) Explain Carbon Dating in detail.

(2) Explain Pauli's neutrino hypothesis for beta decay.

3 (a) Answer each question : (one mark each) **4**

(1) What is endoergic reaction?

(2) Define elastic scattering.

(3) $_1H^2 + \gamma \rightarrow {}_1H^1 + {}_0n^1$, This nuclear reaction is _____.

(4) In a process of pair production, the γ-rays disappears and is converted to _____ and _____ pair.

(b) Solve any **one** numerical : **2**

(1) The linear attenuation coefficient for 2 MeV gamma rays in water is about $5m^{-1}$. Find the relative intensity of a beam of 2 MeV gamma rays after it has passed through 0.1 m of water.

(2) Usually in laboratory, neutrons are obtained by bombarding α-particles, emitted from ^{226}Ra, on $^{9}_{4}Be$ through the reaction $^{9}_{4}Be + ^{4}_{2}He \rightarrow ^{12}_{6}C + ^{1}_{0}n$. The energy of these α-particles is 4.78 MeV. Find the maximum kinetic energy of neutron.

[Take M_{α} = 4.002603 amu, M_{Be} = 9.012183 amu, M_{c} =12.000000 amu, M_{n} = 1.0086 amu, 1 amu = 931.494 MeV]

(c) Answer any **one** : **3**

(1) Give one example of $(\alpha, n), (P, \alpha), (P, n)$ reaction.

(2) Explain Char. Curve of G.M. tube.

(d) Write any **one** in detail : **5**

(1) Describe the construction and working of scintillation counter.

(2) Derive the Q value equation for nuclear reaction.

4 (a) Answer each questions : (one mark each) **4**

(1) The larger the size of the body, the escape rate of neutron is small. (True/False)

(2) If multiplication factor, $K = 1$, then reactor is in _____ state.

(3) What is breeder reaction?

(4) Synchrocyclotron consists of one dee placed in a vacuum chamber. (True/False)

(b) Solve any **one** numerical : **2**

(1) Deuterons in a cyclotron describe a circle of radius 0.32 m just before emerging from the dees. The frequency of the applied e.m.f. is 10 MHz,, Find the flux density of the magnetic field and the velocity of deuterons emerging out of the cyclotron. Mass of deuterium = 3.32×10^{-27} kg; e = 1.6×10^{-19} C.

(2) Find energy released by 1 kg. of U^{235} in kilo watt hour. Avogrado number = 6.023×10^{23}.

(c) Answer any **one** : **3**

(1) Explain principle, construction and working of linear accelerator.

(2) Explain Bohr-Wheller theory of nuclear fission.

(d) Write any **one** in detail : **5**

(1) Explain Working and Principle of Betatron.

(2) What is nuclear reactor? Explain it in detail.

5 (a) Answer each questions : (one mark each) **4**

(1) Why fusion known as thermonuclear reaction?

(2) Which particles jointly called Baryons?

(3) Neutrinos have _____ charge.

(4) Write full form of LHC.

(b) Solve any **one** numerical : **2**

(1) Find the energy released in single helium nucleus formed by the fusion of two deuterium nuclei. Mass of ${}_1H^2 = 2.014102$ amu, Mass of ${}_2He^4 = 4.002604$ amu, 1 amu = 931.3 Mev.

(2) By the fusion of 1 kg deuterium $\left({}_1H^2\right)$ according to the reaction, $\left({}_1H^2 + {}_1H^2 \rightarrow {}^3_2He + {}_0n^1 + 3.27\ \text{MeV}\right)$ how long can a bulb of 100 W give light? ($N_A = 6.02 \times 10^{23}$,1 yr = 3.16×10^7 s)

(c) Answer any **one** : **3**

(1) Describe proton-proton cycle.

(2) Give properties of quarks.

(d) Write any **one** in detail : **5**

(1) Write note on quark model.

(2) Explain in detail : Plasma confinement.
