JA-003-1016031 Seat No. _____

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

August - 2019

Physics : Paper - 601

(New Course)

Faculty Code : 003

Subject Code : 1016031

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

Instructions : (1) Attempt all questions.
(2) Make suitable assumptions wherever necessary.
(3) Figures on the right indicates full marks.
(4) Non programmable calculator is permitted.
(5) Notations have their usual meaning.

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

(1) In alpha particle scattering experiment _____ is a source of alpha particle.

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

(3) What is impact parameter for backward scattering?

(4) Define isotope nuclei.

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

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

(2) 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 similarity between liquid drop and nucleus.

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

(1) Describe semi empirical mass formula.

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

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

(1) During the life time of a radioactive element as time passes the number of its nuclei _____.

(2) Internal conversion process is like photo electric effect. (True / False)

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

(4) Give unit of decay constant.

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

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

(2) 1 gram of radium is reduced by 2.1 mg in 5 years by α-decay. Calculate the half life period of radium.

(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 pauli's neutrino hypothesis for beta decay.

(2) Explain how we can determine the age of earth using radio isotopes.

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

(1) The pair production can take place only when the energy of γ-rays is more than _____ MeV.

(2) Define stopping power for Nuclear radiation.

(3) Complete the following nuclear reaction

$_5B^{10} + \_\_\_\_\_ \rightarrow {}_3Li^7 + {}_2He^4$

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

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

(1) Usually in laboratory, neutrons obtained by bombarding α-particles, emitted from ^{226}Ra, on $^{9}_{4}Be$ through the reaction $^{9}_{4}Be + He \rightarrow ^{12}_{6}C + ^{1}_{0}n$. 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]

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

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

(1) Explain Char. Curve of G.M. tube in detail.

(2) Describe the Rutherford's experiment of artificial transmulation.

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

(1) Describe the construction and working of ionization chamber.

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

4 (a) Answer each question : (One mark each) **4**

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

(2) Betatron is a device to accelerate _____ to very high energy.

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

(4) A particle Accelerator is a device for increasing _____ of charged particle.

(b) Solve any one numerical : **4**

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

(2) 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 deutrons emerging out of the cyclotron.
Mass of deuterium = 3.32×10^{-27} kg;
e = 1.6×10^{-19}C.

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

(1) Write note on breeder reactor.

(2) Explain principle and working of Proton synchrotron.

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

(1) Explain principle and working of Betatron.

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

5 (a) Answer each question : (One mark each) **4**

(1) Neutrinos have _____ charge.

(2) Any fermion would have its intrinsic spin _____.

(3) Define fusion.

(4) Write principle of H bomb.

(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) Estimate the temperature required for the D-T fusion reaction to occur if the KE of each particle is 0.225 MeV. The radius of the deuterium nucleus is 1.5 fm and tritium is 1.7 fm.
Take $K_B = 1.38 \times 10^{-23}$ J/K

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

(1) Explain proton-proton cycle.

(2) Give properties of quarks.

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

(1) Write note on quark model.

(2) Explain plasma confinement in detail.
