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DEPARTMENT OF PHYSICAL AND CHEMICAL SCIENCES
B.SC DEGREE EXAMINATIONS SECOND SEMESTER 2017/2018 ACADEMIC SESSION

COURSE CODE: PHY 408

COURSE TITLE: NUCLEAR AND PARTICLE PHYSICS

DURATION: 2 HOURS

INSTRUCTION: *Attempt any 4 of the 6 questions*

[Signature]

HOD's SIGNATURE

1(a) i. Mention four properties of nuclear forces.

ii. Differentiate between Isotopes and Isobars with examples

(b) Show that the kinetic energy of a moving particle is

$$K.E = M_0 C^2 \left[\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} - 1 \right]$$

2(a) Discuss in details Nuclear structure with reference to its composition and number of maximum electrons on the respective shells

(b) i. What is Binding Energy

ii. Determine the binding energy of Argon measured to be 39.97505 . (${}^{40}_{18}\text{Ar}$).

(mass of protons = 1.008145 a.m.u, mass of neutron = 1.008986 a.m.u)

3 (a) Write short note on the following :

i. Elastic Scattering

ii. Inelastic Scattering

iii. Radioactive capture

(b) Show that the wavelength of a relativistic particle is given as

$$\lambda = \frac{hc}{\sqrt{E_{Total}^2 - E_{Rest}^2}}$$

4(a) Define excitation potential of an atom

(b) A beam of 1 Mev neutrons of intensity 5.5×10^8 neutron per $cm^2 - sec$,strikes a thin lead target . If the area of the target is $0.85cm^2$ and $0.005cm$ thick. If the beam has a cross sectional area of $0.1cm^2$ and at 1 MeV the total cross sectional is 4.78 barns.

i. What is the rate of interaction with the target

ii. what is the probability that a neutron beam will collide with the nuclei.

5(a)i. Write briefly on Internal conversion and Isomeric Transition

ii. What is spontaneous fission

(b) ${}^{226}_{88}\text{Ra}$ undergoes α -decay to give radon (Rn). (Mass of ${}^{226}_{88}\text{Ra} = 226.0254u$, Mass of ${}^{222}_{86}\text{Rn} = 221.9859u$, Mass of ${}^4_2\text{He} = 4.03426u$)

(i) Write the decay equation. (ii) How much energy is released in the reaction

6 (a) Discuss the following with examples: i. α - emission ii. β - emission iii. electron capture

(b) The activity of ${}^{137}_{54}\text{Cs}$ was 1.3 mCi in today date 17 years ago. What is the current activity in Bq and GBq. Half life of ${}^{137}_{54}\text{Cs}$ is 30 years.