

**Bago University**  
**Department of Physics**  
**First Semester Examination, March 2019**

**Third Year (BSc)**  
**(Physics Specialization)**

**Phys 3103**  
**Nuclear Physics**  
**Time Allowed: (3) Hours**

Answer any Six questions.

- 1 (a) Explain any six facts of nuclear forces.  
(b) What are the magic numbers? The radius of  $^{165}\text{Ho}$  is 7.731 fm. Deduce the radius of  $^4\text{He}$ .
  - 2 (a) What are the basic assumptions of nuclear shell model? What are the magic numbers?  
(b) What nuclei have a radius equal to one-half the radius of  $^{236}\text{U}$ ?
  - 3 (a) Define half-life of a radioactive substance and derive the expression for it.  
(b) 1 gram of radium is reduced by 2.1 mg in 5 years by  $\alpha$  - decay. Calculate the half-life period of radium.
  - 4 (a) Explain the dating by radioactive decay of Carbon dating.  
(b) The present relative abundance of  $^{238}\text{U}$  to  $^{235}\text{U}$  in natural uranium is 99.3% to 0.7%. The half period of  $^{238}\text{U}$  and  $^{235}\text{U}$  are  $4.5 \times 10^9$  years and  $7 \times 10^8$  years respectively. Assume that at the beginning when the earth was formed the proportions of two isotopes are equal. Estimate the age of the Earth.
  - 5 (a) Derive the Alpha particle disintegration energy.  
(b) Calculate the time required for 10% of a sample of thorium to disintegrate. Assume the half life of thorium to be  $1.4 \times 10^{10}$  years.
  - 6 (a) Discuss the absorption of gamma rays.  
(b) The linear attenuation coefficient for 2 MeV gamma rays in water is about  $5\text{m}^{-1}$ . (i) Find the relative intensity of a beam of 2 MeV gamma rays after passed through 0.1m of water. (ii) How far must such a beam travel in water before its intensity is reduce to 1% its original value?
  - 7 (a) What are the construction features of the ionization chamber?  
(b) Calculate the ionization current produced by 3 MeV deuterons passing through a gas at 1000 per second assuming that 25eV is required to produce an ion pair.
  - 8 (a) Draw and discuss the Geiger-Muller counter.  
(b) A G.M counter wire collects  $10^8$  electrons per discharge. When the counting rate 500 counts/min, what will be the average current in the circuit?
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