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**School of Basic Sciences**

Master of Science in Physics  
Mid Term Examination - Nov 2023

Duration : 90 Minutes  
Max Marks : 50

**Sem I - C1PO105T - Nuclear Physics**General Instructions

Answer to the specific question asked

Draw neat, labelled diagrams wherever necessary

Approved data hand books are allowed subject to verification by the Invigilator

- 1) Explain the main features of the shell model of a nucleus. K2 (2)
- 2) List the properties of nuclear forces. K1 (3)
- 3) Draw the mass parabola curve of a nucleus. K2 (4)
- 4) Illustrate the basic assumptions of the nuclear shell model. K2 (6)
- 5) Using the liquid drop model, find the most stable isobars for  $A = 27$ ,  $A = 118$ , and  $A = 238$ . K3 (6)
- 6) Calculate the (i) mass defect, (ii) binding energy and (iii) the binding energy per nucleon for a  ${}^6_6\text{C}^{12}$  nucleus. Nuclear mass of  ${}^6_6\text{C}^{12} = 12.000000$  a.m.u., mass of hydrogen nucleus = 1.007825 a.m.u. and mass of neutron = 1.008665 a.m.u. Given  $1 \text{ a.m.u.} = 931 \text{ MeV}$ . K3 (9)
- 7) Define: (i) Mass defect, (ii) Binding energy, and (iii) Packing fraction and provide example. K4 (8)
- 8) Obtain the relation between Binding energy per nucleon and packing fraction. K4 (12)

**OR**

- Classify the transitions in  $\beta$ -decay and write the selection rules for allowed and forbidden transitions up to second order. K4 (12)