BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION MO/2024)

CLASS: IMSc **SEMESTER : V**
BRANCH: PHYSICS **SESSION : MO/2024**

SUBJECT: PH318 NUCLEAR AND PARTICLE PHYSICS

TIME: 02 Hours **FULL MARKS: 25**

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
***4*. Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	What are Isotopes, Isobars and Isotones ? Explain with examples.	[2]	1	1
Q.1(b)	Define Nuclear Form factor. Compute it for a nucleus of atomic number Z, assuming it as sphere of radius R of uniform charge density.	[3]	1	1,2
Q.2(a)	Define Binding energy of a Nucleus. Draw the Binding energy per nucleon vs mass number (A) curve and give some salient features of it.	[2]	1	1,2
Q.2(b)	Derive the Bethe-Weizacker Semi-Empirical mass formula for the binding energy of the nucleus and explain the various terms in it.	[3]	1	2,3
Q.3(a)	Define fermi energy for a degenerate fermion gas.	[2]	1	1
Q.3(b)	Compute the total average energy of a nucleus made of Z protons and N neutrons according to the Fermi gas model of the nucleus and show that it has an "asymmetry term" proportional to $(N-Z)^2/A$.	[3]	1	3
Q.4(a)	What are Magic numbers ? Which of these nuclei have magic number of protons and/or neutrons: $^{15}N, ^{39}K, ^{48}Ni$?	[2]	1	1,2
Q.4(b)	What are the evidences in favor of the shell model of the nucleus ?	[3]	1	1,2
Q.5(a)	Define Radioactivity. What are the kinds of radiation emitted by Radioactive elements and what are their properties ?	[2]	2	1
Q.5(b)	Define half-life of a Radioactive nucleus. A piece of ancient wooden boat shows an activity of ^{14}C equal to 3.9 decays/minute/gm. Estimate the age of the boat if the half-life of ^{14}C is 5568 years. Assume the activity of pure fresh ^{14}C as 15.6 decays/minute/gm.	[3]	2	1,3

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