MANIPAL ACADEMY of HIGHER EDUCATION
(Institution of Eminence Deemed to be University)

Reg.No.									

DEPARTMENT OF SCIENCES, IV SEMESTER M.Sc. (Physics)
END SEMESTER EXAMINATIONS, APRIL 2023
Nuclear Physics II [6013]
(CHOICE BASED CREDIT SYSTEM - 2020)

Time: 3 Hours Date: 28/04/2023 MAX. MARKS: 50

Note (i) Answer ALL questions
(ii) Draw diagrams, and write equations wherever necessary

		Marks	CO	BL
1 (i)	What are fission isomers?	2	2	1
(ii)	Explain fertile and fissile materials.	2	2	1
(iii)	Which nucleus has more symmetric mass distribution, ^{236}U or ^{257}Fm, while undergoing fission?	2	2	2
(iv)	Define Peak to valley ratio in the context of nuclear fission process.	2	2	1
(v)	On comparing the mass distribution curve of fission of ^{252}Cf or ^{256}Fm, which of the following has smaller peak to valley ratio? Why?	2	2	2
2 (i)	Consider the distribution curve of the total kinetic energy released in the proton-induced fission of ^{233}U for two cases. The energy of the proton is 9.5 MeV in case (a) and 20 MeV in case (b). Which case would have larger energy dip in the symmetric fission compared to the asymmetric fission? Give reason?	2	2	3
(ii)	Consider two cases of thermal neutron fission of ^{239}Pu. (a) Symmetric fission with mass 120 each, and (b) asymmetric fission of mass 130 and 110. Within liquid drop model which case is expected to have higher total kinetic energy released? What is observed experimentally? Give reason for the experimental observations.	3	2	3
(iii)	Write down the Briet-Wigner expression for the elastic and reaction cross- sections (Do not derive it). Derive the full-width of reaction cross section. Explain the origin of the dip in the elastic cross section just before $E = E_\lambda$, where E_λ is the resonance energy?	5	1	3
3 (i)	A neutron of energy 10 MeV is scattered off an Oxygen nucleus. What is its minimum energy after scattering?	2	2	2
(ii)	What are different methods for the detection of neutrons?	2	2	1

(iii)	Derive the solution of flux from the diffusion equation for an infinite planar source.	6	2	2
4 (i)	Which nucleus would you use to slow down the neutrons effectively, hydrogen or calcium? Explain.	2	2	2
(ii)	Define slowing-down density. Illustrate with an example.	2	2	2
(iii)	Derive the expression for the probability of neutron scattering from energy E to lower energy E' for the case of isotropic scattering. Is this probability dependent on the final energy of the scattered neutron? Derive the expression for the average energy of the scattered neutron for the case of isotropic scattering.	6	2	2
5	Derive the expression for neutron flux for neutrons slowing down in a hydrogen medium.	10	2	2