Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, December 2023

Course: Basics of Ion Accelerator and Beam Optics. **Semester: III**

Program: MSc. Physics **Time : 03 hrs.**

Course Code: PHYS 8074P **Max. Marks: 100**

Instructions:

1. **All questions are compulsory.**
2. **There are internal choices in Q 9 and Q 11.**
3. **Use of calculators is allowed.**

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	Explain the concept of matrix methods in designing and analyzing beam transport in particle accelerators.	**4**	**CO2**
Q 2	What are aberrations in focusing devices, and how do they affect beam quality? Provide examples.	**4**	**CO2**
Q 3	Give the principle for operation of MC-SNICS Ion source.	**4**	**CO1**
Q 4	A charged particle with a charge of +e and a mass of 9.11 x 10^{-31} kg is moving in a uniform magnetic field of 0.5 T. Calculate the radius of the circular path that the particle follows when its velocity is 2 x 10^{6} m/s.	**4**	**CO1**
Q 5	Calculate the ion fluence if a sample of Si of area 1 cm x 1 cm is irradiated by 100 keV Kr^{+} ions for 30 mins. Consider the beam current to be equal to $1\mu A$.	**4**	**CO3**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6	Describe the operation of radio frequency (RF) ion sources. How do they differ from other ion source types, and what are their advantages?	**10**	**CO1**
Q 7	Explore the use of Liouville's theorem in phase space dynamics and its applications in particle accelerators and beam transport.	**10**	**CO2**
Q 8	Explain the principles of operation of a Cyclotron. Calculate the frequency at which a proton orbits in a cyclotron with a magnetic field strength of 1.2 T.	**10**	**CO1**
Q 9	Discuss the role of quadrupole magnets in beam focusing, including the strengths and limitations of their operation. OR Sector and rectangular magnets have opposite focusing properties. Determine the geometry of a wedge magnet with equal focusing in both planes.	**10**	**CO2**

SECTION-C (2Qx20M=40 Marks)			
Q 10	Write short notes on the following (4 marks each): (a) Nuclear energy loss (b) Electronic energy loss (c) Thermal spike model (d) Coulomb explosion model (e) Sputtering	**20**	**CO3**
Q 11	Explore the advancements in materials synthesis and characterization methods based on ion beams, emphasizing their importance in various research fields. OR Design a comprehensive beam transport system for a particle accelerator, considering the use of focusing devices, beamline components, and minimizing aberrations.	**20**	**CO3**