


Name:			
Enrolment No:			
UNIVERSITY OF PETROLEUM AND ENERGY STUDIES End Semester Examination, May 2022			
Course: Basics of Ion Accelerators and Beam Optics Program: M. Sc. Physics Course Code: PHY8030P		Semester :III Time : 03 hrs. Max. Marks: 100	
Instructions: Your answer should be concise and to the point.			
SECTION A (5Qx4M=20Marks)			
S. No.		Marks	CO
Q 1	The magnetic field for a cyclotron is 2 T. The extraction radius is 0.8 m. Obtain the frequency (in MHz) and energy (in MeV) of the accelerated protons.	4	CO1
Q 2	Explain the medical applications of accelerators.	4	CO3
Q 3	Discuss cold-cathode and hot-cathode based ion sources.	4	CO2
Q 4	What are various ion beam analysis techniques? Discuss the principle and salient features of PIXE.	4	CO2
Q 5	Differentiate between thermoluminescence and ionoluminescence.	4	CO3
SECTION B (4Qx10M= 40 Marks)			
Q 6	Discuss Cockroft-Walton voltage multiplier along with its principle, construction and working.	10	CO1
Q 7	A proton beam is moving in a uniform 0.50 T magnetic field directed along the x-axis. At $t = 0$ the proton has velocity components $v_x = 1.50 \times 10^5$ m/s, $v_y = 0$, $v_z = 2.0 \times 10^5$ m/s. (a) At $t = 0$, find the force on the proton and its acceleration. (b) Find the radius of the resulting helical path, the angular speed of the proton, and pitch of the helix.	10	CO2
Q 8	How do ions lose their energy in materials? Explain thermal spike model.	10	CO3
Q 9	Describe the principle, construction and working of betatron. Obtain the betatron condition. Or What are basic limitations of cyclotron and how are they overcome in a synchrotron? Discuss in detail.	10	CO1

SECTION-C (2Qx20M=40 Marks)			
Q 10	Discuss the principle of ionization to produce ions and explain (i) ECR source and (ii) PIG source in detail.	20	CO2
Q 11	(a) Explain Corona discharge and show that surface charge density is high for smaller radius sphere. Discuss principle, construction and working of Van de Graff generator.	20	CO1
	OR		
	(b) Discuss focusing of charged particles using electromagnetic lenses and explain focusing using solenoidal magnets and quadrupole magnets.	20	CO1