

## M.Sc Semester-4 Examination

507

Physics

April-2024

Time : 2-30 Hours]

[Max. Marks : 70

Q.No.		QUESTIONS	MARK
1.	A	Explain resonance in nuclear reaction and obtain the Breit-Weigner dispersion relation for $l=0$ .	[07]
	B	Discuss the square well potential of infinite depth in detail.	[07]
		OR	
	A	Write the types of nuclear reactions and derive the equation for scattering cross section $\sigma_{sc}$ .	[07]
	B	Discuss the continuum theory of cross-section for the compound nucleus.	[07]
2.	A	Discuss Charge conjugate and Gell-Mann Nishijima scheme in detail.	[07]
	B	Discuss details on parity and time reversal.	[07]
		OR	
	A	Write a short note on Quarks, Flavors and Colours.	[07]
	B	State the classification of elementary particle and discuss the fundamental interactions in detail.	[07]
3.	A	What are Clebsh-Gordan's coefficients? Give a brief explanation of their importance.	[07]
	B	For the operators $J^2$ and $J_z$ , state their eigenvalue and eigen vector relations. Consequently, get the $J_z$ and $J^2$ matrices.	[07]
		OR	
	A	Provide a vector notation for the commutation relations that the angular momentum components obey.	[07]
	B	Given a representation where the eigenfunctions of $L_z$ and $L^2$ occur simultaneously, find the value of the uncertainty product $(\Delta L_x)(\Delta L_y)$ . What is this product's value when $l=0$ ?	[07]
4.	A	Obtain Klein-Gordan equation for a charged particle moving in an electromagnetic field. Show that this equation reduces to the Schrodinger equation of motion for the particle in an electromagnetic field in the non-relativistic limit.	[07]
	B	Show that the Dirac matrices must be even dimensional. Evaluate the charge density and current density for a free Dirac electron.	[07]
		OR	
	A	Show that the Dirac's equation automatically endows the hypothetical spinning motion of the electron.	[07]
	B	Prove that a Dirac electron has a magnetic moment given by; $\mu = \frac{e\hbar\sigma'}{2mc}$	[07]

5.	ANSWER IN BRIEF ANY SEVEN QUESTIONS FROM THE FOLLOWING [EACH QUESTIONS IS OF TWO MARKS]	[14]
1	Define stripping and pick-up reactions.	
2	Write the classification of target materials.	
3	The intrinsic parity of Boson is _____ and that of Fermions _____.	
4	Elementary particles are splits up depends on _____ and _____.	
5	State CPT theorem.	
6	Stripping reaction used to study _____ nuclear states while pick-up reaction used to study _____ nuclear states.	
7	The commutator relation $[L_x, [L_y, L_z]] = \text{_____}$ .	
8	The spin angular momentum gives _____ to the magnetic moment. (decrease, increase, similar, dissimilar)	
9	What are the ladder operators?	
10	Show that $\alpha_x \alpha_y = i \alpha_z$ , where, $\alpha$ 's are (4x4) Dirac matrices.	
11	State the significance of negative energy states suggested by Dirac.	
12	Show that $[\alpha_x \alpha_y, \alpha_y] = 2 \alpha_x$	

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