QP Code: RM22MSC039 | Reg. No | | | | | | | | | | | AR 22

GIET UNIVERSITY, GUNUPUR – 765022

M. Sc. (First Semester) Examinations, March – 2023

22PHPC104 – Quantum Mechanics - I

(Physics)

Time: 3 hrs | Maximum: 70 Marks

(The figures in the right hand margin indicate marks.)

PART – A **(2 x 10 = 20 Marks)**

Q.1. Answer all questions	CO#	Blooms Level
a. Define linear vector space.	CO1	K1
b. Show that commutator of two Hermitian operators is anti-Hermitian.	CO1	K2
c. Evaluate the scalar product of $\langle\phi\|\psi\rangle$ and $\langle\psi\|\phi\rangle$. Are they equal? Where $\|\psi\rangle=\begin{pmatrix}2\\-i\\2-3i\end{pmatrix}$ and $\|\phi\rangle=\begin{pmatrix}-3i\\2+i\\4\end{pmatrix}$	CO1	K2
d. Define Dirac delta function.	CO1	K2
e. What do you mean by time evolution operator?	CO2	K1
f. What is interaction picture?	CO2	K1
g. Show that L^2 commute with Lz and mention their combined eigen functions.	CO3	K2
h. Explain the raising and lowering operator.	CO3	K2
i. What are spin ½ particles?	CO4	K1
j. Mention the matrices of J^2 and Jz.	CO4	K1

PART – B **(10 x 5 = 50 Marks)**

Answer ***ANY FIVE*** questions	Marks	CO#	Blooms Level
2. a. Define commutator algebra and mention its properties.	7	CO1	K2
b. Discuss the completeness and closure properties of the basis set.	3	CO1	K1
3.a. Define scalar product of vectors and explain their properties.	7	CO1	K2
b. Show that the product of two unitary operators is also a unitary operator.	3	CO1	K2
4. a. Write the short notes on: (i) Schrodinger picture	5	CO2	K2
b. (ii) Heisenberg picture	5	CO2	K2
5.a. Discuss the operator method in the solution of harmonic oscillator problem.	7	CO2	K2
b. Mention the matrix form of operators.	3	CO2	K1
6. Derive orbital angular momentum operators in spherical polar coordinates.	10	CO3	K2
7.a. What are Pauli spin matrices? Discuss their properties.	6	CO4	K2
b. Obtain the eigen values and eigen functions of Spin.	4	CO4	K2
8. a. Discuss the addition of two angular momenta.	3	CO4	K2
b. Mention the properties of C.G. coefficient. Obtain the C.G. coefficients in matrix form (only) in the case of J_1= 1/2 and J_2 =1/2.	7	CO4	K2

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