

BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)

CLASS: IMSc / MSc  
BRANCH: PHYSICS

SEMESTER : VIII/I  
SESSION : MO/2024

SUBJECT: PH404 QUANTUM MECHANICS

TIME: 3 Hours

FULL MARKS: 50

INSTRUCTIONS:

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
  2. Attempt all questions.
  3. The missing data, if any, may be assumed suitably.
  4. Before attempting the question paper, be sure that you have got the correct question paper.
  5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.
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		CO	BL
Q.1(a)	Prove that for an Hermitian matrix $H$ , eigenfunctions corresponding to different eigenvalues of $H$ are orthogonal.	[5] 1	1,2
Q.1(b)	Show that position and momentum representation of eigenkets are Fourier transform of each other.	[5] 1	2,3
Q.2(a)	Write down the postulates of quantum mechanics.	[5] 1	1,2
Q.2(b)	Discuss the properties of ladder operators of a quantum harmonic oscillator.	[5] 1	1,2
Q.3	Find the average position of the electron in a Hydrogen atom in the ground state given by $\psi_{100} = \frac{1}{\sqrt{\pi a_0^3}} \exp(-r/a_0)$	[10] 3	2,3
Q.4	Briefly discuss (anomalous) Zeeman effect.	[10] 4	1,2
Q.5	Find the matrix elements of $S^2$ operator, where $S = S_1 + S_2$ , in the product basis of two spin-half particles.	[10] 5	2,3

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