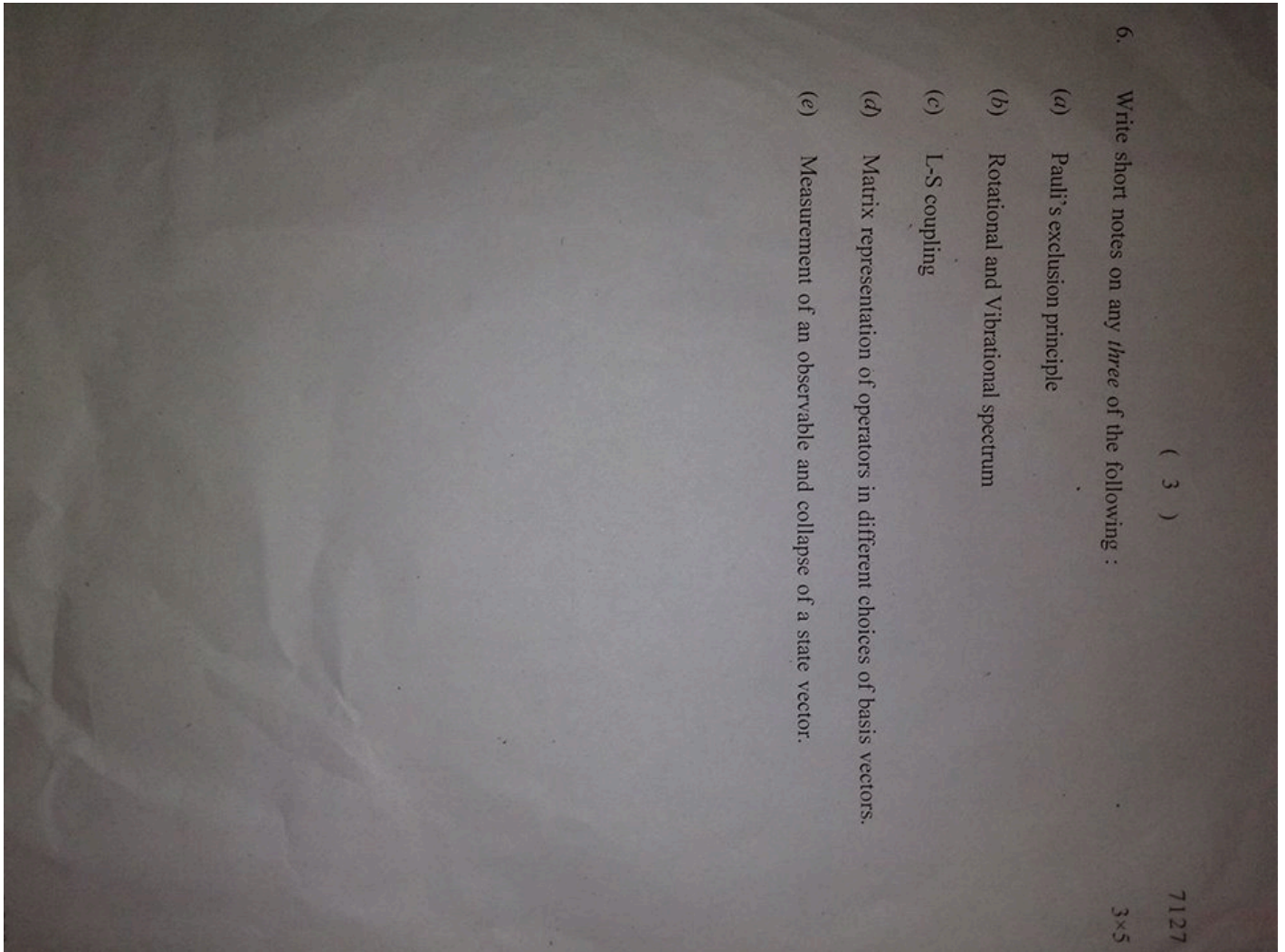


Here is the Question Paper of Quantum Mechanics and Applications-II for the FYUP batch(2013-2016) of the Delhi University for the Physics Honors Students.

The exam was conducted on 20-05-2016.

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2. (a) (i) Is the state $\psi = e^{-3\phi} \cos \theta$ an eigenfunction of :
 $A_\phi = \partial/\partial\phi$ or of $B_\theta = \partial/\partial\theta$
- (ii) Are A_ϕ and B_θ Hermitian ?
- (iii) Find the commutator $[A_\phi, B_\theta]$.
- (b) Derive the effect of the operations of j_+ and j_- operators on the eigenstates of j^2 . 6,9
3. (a) Solve the Harmonic Oscillator problem using ladder operators.
- (b) State and prove Schwartz inequality. 12,3
4. (a) Explain the Normal Zeeman splitting of spectral lines due to the $2p$ and $3d$ levels using the energy level diagram.
- (b) Derive the expression for the Spin-Orbit interaction energy and show that the doublet separation decreases as the quantum numbers ' n ' and ' l ' increase and that it is also directly proportional to the fourth power of the periodic number of the atom. 6,9
5. (a) Calculate by the variation method, the ground state energy of a Helium atom explaining your choice of the wave function.
- (b) Evaluate the Lande ' g ' factor and the total magnetic moment for the $^2P_{3/2}$ and $^2D_{3/2}$ states. 12,3

S. No. of Question Paper : 7127		Roll No.	4101439054
Unique Paper Code : 2221602		F-6	
Name of the Paper : Quantum Mechanics and Application-II			
Name of the Course : B.Sc. (H), Physics, Erstwhile FYUP			
Semester : VI			
Duration : 3 Hours		Maximum Marks : 75	

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. 1 is compulsory.

Attempt five questions.

All questions carry equal marks.

1. (a) Define adjoint of an operator in the *bra* and *ket* notations and explain the properties of Hermitian operators.

(b) Show that :

$$[H, p_x] = \frac{-\hbar}{i} \left(\frac{dN(x)}{dx} \right),$$

where H is the Hamiltonian.

(c) State and prove Ehrenfest's theorem.

(d) What are Singlet and Triplet states? Explain with diagrams.

(e) The quantum numbers of electrons in a two-electron system are $l_1 = 2, s_1 = 1/2$ and $l_2 = 3, s_2 = 1/2$. Assuming j-j coupling between them, find all the possible states.

5×3

P.T.O.

[mailmunch-form id="77023"]



Manas Sharma

I'm a physicist specializing in computational material science with a PhD in Physics from Friedrich-Schiller University Jena, Germany. I write efficient codes for simulating light-matter interactions at atomic scales. I like to develop Physics, DFT, and Machine Learning related apps and software from time to time. Can code in most of the popular languages. I like to share my knowledge in Physics and applications using this Blog and a YouTube channel.

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