Registration no:

Total Number of Pages: 02 **M.Sc.I**
FPYC703

7th Semester Regular / Back Examination 2019-20
QUANTUM MECHANICS - I
BRANCH: M.Sc.I(AP)
Max Marks: 70
Time: 3 Hours
Q.CODE: HRB244
Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

Q1 **Answer the following questions:** **(2 x 10)**

a) Define linear vector space.
b) Define basis vectors and linear dependence of vector space.
c) What is Hilbert space? Give its properties.
d) Define linear and adjoint operators.
e) What is projection operator? Give its properties.
f) Explain Eigen value equation.
g) What are raising and lowering operators?
h) Define spin angular momentum
i) What is density matrix?
j) What do you mean by incoming and ou going spherical waves?

Q2 **a)** Discuss the Schmidt orthogonalization procedure. **(5)**
b) Define Bra and Ket vectors. Explain the properties of Kets, Bras and Bra-Kets. **(5)**

Q3 **a)** Show that the eigenvalues of a Hermitian matrix are all real and eigenvectors corresponding to distinct eigen values are orthogonal. **(5)**
b) Show that the eigen values of a unitary matrix are of unit modulus. **(5)**

Q4 **a)** Obtain the equation of motion for a state function and for an operator in Schrodinger picture. **(5)**
b) Using matrix method, obtain the energy levels of one dimensional harmonic oscillator. **(5)**

Q5 **a)** Deduce the commutation relation for the components of angular momentum L_x, L_y and L_z. Show that L^2 commutes with any of the three components. **(5)**
b) Find out the Pauli spin matrices. Discuss the properties of Pauli spin matrices. **(5)**

Q6 **a)** Derive the eigen values of J^2 and J_z **(5)**

b) Calculate the Clebsch-Gordan coefficients for $j_1 = \frac{1}{2}$ and $j_2 = \frac{1}{2}$. **(5)**

Q7 Solve the radial part of Schrodinger's equation for the hydrogen atom and hence obtain the energy eigen values. **(10)**

Q8 **Write short answer on any TWO:** **(5 x 2)**

a) Spinor transformation under rotation

b) Heisenberg picture

c) Expansion of plane waves in terms of spherical waves

d) Bound states of a three dimensional square well