Roll No. | | | | | | | | | | | | |

Total No. of Pages : 02

Total No. of Questions : 11

M.Sc.(Physics) (2018 Batch) (Sem.–1)

QUANTUM MECHANICS-I

Subject Code : MSPH-413-18

Paper ID : [75124]

Time : 3 Hrs. Max. Marks : 70

INSTRUCTION TO CANDIDATES :

1. **SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.**
2. **SECTION-B contains SEVEN questions carrying FIVE marks each and students have to attempt any SIX questions.**
3. **SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.**

SECTION-A

1. Answer briefly :

a) What is Hermitian operator?

b) What is Fermi's golden rule?

c) State Heisenberg uncertainty principle.

d) What is Green's function?

e) Define scattering amplitude and scattering length.

f) What is variation method?

g) Define the term 'Anti-Symmetric Wavefunction'.

h) What do you mean by the eigen function and eigen value of a matrix operator?

i) State and write Optical theorem.

j) What is WKB approximation?

SECTION-B

2. Derive the commutation relations of angular momenta. Prove that $[L^2\ L] = 0$.

3. Calculate the ground state energy of the one dimensional simple harmonic oscillator using the uncertainty principle.

4. Discuss the perturbation theory of degenerate levels.

5. Calculate the Clebsch Gordon coefficients for $j_1 = 1$ and $j_2 = 1/2$.

6. In the case of two electron system, how do we define the states into singlet and triplet states for this system?

7. Show that if two eigen functions of a Hermitian operator belonging to unequal eigen values are not normalizable. Then they may not be orthogonal.

8. Show that the expectation value of the momentum p for a bound state of one particle system is zero for a stationary state.

SECTION-C

9. Give the theory of Born approximation for calculation of the scattering of a particle by a centre of force. Apply this to the problem of α-scattering from the coulomb's field of a nucleus.

10. Consider a particle of mass m in the one dimensional oscillator potential. Now a perturbation is added. Calculate the new energy eigen functions and eigenvalues, respectively, to first and second order of perturbation theory.

11. How are the selection rules in the case of hydrogen atom and simple harmonic oscillator connected with transition probability?