CC-282

M. Sc. EXAMINATION, Dec. 2018

(Third Semester)

(Main & Re-appear)

PHYSICS

PHY603B

Quantum Mechanics-II

Time : 3 *Hours*] [*Maximum Marks :* 100

Before answering the question-paper candidates should ensure that they have been supplied to correct and complete question-paper. No complaint, in this regard, will be entertained after the examination.

Note : Attempt *Five* questions in all, selecting at least *one* question from each Unit. All questions carry equal marks.

Unit IV

7. (a) Explain and discuss the semi-classical theory of radiative transitions in atoms and derive the expression for transition probability of induced emission. **16**

(b) What is electric dipole approximation ? **4**

8. Derive Dirac relativistic equation and find its plane wave solutions. **20**

Unit I

1. (a) Using WKB approximation, explain the phenomenon of one dimension barrier penetration and find the expressions of coefficients of reflection and transmission. **15**

(b) What are the criteria for the validity of WKB approximation ? **5**

2. (a) Derive and discuss Fermi-Golden rule. **15**

(b) What is harmonic perturbation ? **5**

Unit II

3. (a) Give the explanation of Born approximation and discuss its validity for exponential potential. **16**

(b) What is partial wave analysis ? **4**

4. (a) Explain the scattering by a rigid sphere. **12**

(b) What are phase shifts ? How are these related to potential ? **8**

Unit III

5. (a) Explain and discuss the collisions of two identical particles. **10**

(b) Explain the different statistics on the basis of distinguishability and indistinguishability of identical particles and find the total number of states occupied by two identical particles. **6**

(c) Write the spin eigen functions and eigenvalues for $S = \frac{3}{2}$ and also discuss the orthonormality conditions. **4**

6. (a) Explain the effect of spin on the energy levels of a helium atom and discuss the resulting singlet and triplet states. **15**

(b) Find commutation relation $\left[\hat{\sigma}^2, \hat{\sigma}_x\right]$. **3**

(c) Write the matrix forms of $\hat{\sigma}_x, \hat{\sigma}_y$ and $\hat{\sigma}_z$. **2**