Roll No..... Total No. of Printed Pages : 4

Code No. : B02/101

Second Semester Online Examination, May-June, 2022

M. Sc. Physics

Paper I

[Quantum Mechanics]

Time : Three Hours] [Maximum Marks : 80

Note : *Part A and B of each question in each unit consist of 'very short answer type question' which are to be answered in one or two sentences. Part C 'Short answer type' and D 'Long answer type' of each question should be answered within the word limit mentioned.*

UNIT-I

1. (A) What is quantum mechanical tunneling ? **2**

(B) Write condition of validity for W. K. B. approximation. **2**

(C) Find out the ground state of hormonic oscillator by variation method, if Hamiltonian operator is

$$H = \frac{\hbar}{2}\frac{d}{dx^2} + 2\pi^2 v^2 x^2$$

and variable x extends over the range $-\infty$ to $+\infty$. *(word limit 200-250)* **4**

P.T.O.

OR

Write short notes on sudden approximation.

(D) Discuss times dependent pertubation Theory. *(word limit 400-450)* **12**

OR

Establish connection formula for penetration of a bassier by using W.K.B approximation method

UNIT-II

2. (A) Corelate differential scatering cross-section and total scatering cross section. **2**

(B) Write condition of validity of Born-appreximation. **2**

(C) Write the radial part of the schrodinge equation that describe scatering by the square well potential.

$$V_{(r)} = \begin{cases} -V_0 & 0 < r < a \\ 0 & r < a \end{cases}$$

and solve. Considering the scattering only due to S waves derive the expression for s wave phase shift. *(word limit 200-250)* **4**

OR

Evaluate the scattering amplitude in the Born-approximation for scatering by potential.

$$V_0 = V_0 \exp\left(\frac{-\alpha r}{r}\right)$$

when V_0 and $\propto$ are constant find $\sigma(\theta)$.

(D) Discuss the method of partial wave analysis to desire the scatering cross section for skin less particles in a short range potential. *(word limit 400-450)* **12**

OR

Construct the green's function for free particle and use it to white the total wave function in the first Born approximation.

UNIT-III

3. (A) Write Unrenbeck-Gondsmit hypothesis for electron spin. **2**

(B) Explain negative energy state. **2**

(C) Write Paulis spin matrices and prove $[\sigma_x, \sigma_y] = 2i\sigma z$. *(word limit 200-250)* **4**

OR

Deduce Pouli's exclusion principle from stater's determinant.

(D) Deduce Dirac equation in electro magnetic field. *(word limit 400-450)* **12**

OR

Write Klein-Gorden eq^n,for free particle. Explain probability density and current density.

UNIT-IV

4. (A) Explain forbidden transition. **2**

(B) Write difference between spontaneous and stimulated emission. **2**

(C) Show that for optical frequencies, at thermal equilibrium corresponding to $T \approx 1000^o$ K, the no. of spontaneous emission for exceeds the no. of stimulated emission. *(word limit 200-250)* **4**

OR

Write electric dipole selection rules.

(D) Find expression for transition probability for absorption and induced emission.

(word limit 400-450) **12**

OR

Explain quantization of electromagnetic field using creation and annihilation operators.

❐ ❐ ❐ ❐ ❐ d ❐ ❐ ❐ ❐ ❐