# Gandhi Institute of Engineering and Technology University, Odisha, Gunupur
## (GIET UNIVERSITY)

M.Sc. (Second Semester - Regular) Examinations, July – 2025
### 24MPHPC12004 – Quantum Mechanics-II
(Physics)

Time: 3 hrs                                            Maximum: 60 Marks

**(The figures in the right-hand margin indicate marks)**

| PART – A | (2 x 5 = 10 Marks) |
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Q.1. Answer *ALL* questions

| | | CO # | Blooms Level |
|---|---|---|---|
| a. | Explain the characteristics of Effective potential. | CO1 | K1 |
| b. | The Hamiltonian of one-dimensional harmonic oscillator is given by:$H = \frac{P^2}{2m} + \frac{1}{2}Kx^2 + bx^n$, separate the perturbed and unperturbed Hamiltonian? | CO2 | K1 |
| c. | What is variational method for approximation? What is the ground state energy of He atom by this method? | CO3 | K1 |
| d. | What are connection formulae? | CO4 | K1 |
| e. | Mention the basic assumption of the Scattering theory. | CO5 | K1 |

| PART – B | (10 x 5 = 50 Marks) |
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Answer *ALL* the questions

| | | Marks | CO # | Blooms Level |
|---|---|---|---|---|
| 2. a. | Determine the radial equation for motion of a body in spherically symmetric wave. | 5 | CO1 | K2 |
| b. | Evaluate the solution of Schrodinger's equation for a free particle in spherical polar coordinate system. | 5 | CO1 | K2 |
| | (OR) | | | |
| c. | Derive the Expression of plane waves in terms of spherical waves. | 10 | CO1 | K2 |
| 3.a. | Evaluate the second order correction for the energy eigen value and eigen function in case of Time independent non-degenerate case. | 10 | CO2 | K2 |
| | (OR) | | | |
| b. | What is Linear Stark effect? Derive the expression for Ground state and first excited state of Hydrogen atom. | 10 | CO2 | K2 |
| 4.a. | Applying variational method, evaluate the energy level of ground state of Helium atom. | 10 | CO3 | K2 |
| | (OR) | | | |
| b. | Derive the general solution for approximate wavefunction using WKB method. | 10 | CO3 | K2 |
| 5.a. | Explain Born Approximation? Derive the expression for scattering amplitude using 1st Born approximation and discuss its validity. | 10 | CO4 | K2 |
| | (OR) | | | |
| b. | State and prove the Optical theorem. | 5 | CO4 | K1 |
| c. | Discuss the method of partial wave analysis scattering. | 5 | CO4 | K1 |
| 6.a. | Derive the total scattering cross section a thigh energy by a Hard sphere using the method of Partial wave analysis. | 10 | CO5 | K2 |
| | (OR) | | | |
| b. | Discuss about Resonant Scattering. | 5 | CO5 | K1 |
| c. | Derive the Scattering cross section from a square potential well. | 5 | CO5 | K2 |

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