



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

M.Sc. (First Semester - Regular) Examinations, January – 2026  
**24MCYPC11003 – Physical Chemistry-I**  
(Chemistry)

Time: 3 hrs

Maximum: 60 Marks

**Answer ALL questions**  
(The figures in the right hand margin indicate marks)

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

- |  | CO # | Blooms Level |
|--|------|--------------|
| a. What is the point groups of cyclobutane?  | CO1  | K2           |
| b. Briefly define azeotropic mixtures in the context of non-ideal binary miscible liquids. | CO2  | K2           |
| c. Calculate the product of $(C_2^y \cdot \sigma_{zy})$ and $(\sigma_{xz} \cdot C_2^z)$ .  | CO3  | K2           |
| d. Draw the wave function plot in SHO, when $n = 5$ and $6$ .                              | CO4  | K2           |
| e. What is half-life?  | CO5  | K2           |

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

- |   | Marks | CO # | Blooms Level |
|---|-------|------|--------------|
| 2. a. Explain GOT by taking H <sub>2</sub> O molecule as an example.  | 8     | CO1  | K3           |
| b. Draw the group multiplication table of ammonia.  | 2     | CO1  | K2           |
| (OR)  |       |      |              |
| c. Explain axis of symmetry, plane of symmetry and improper axis of rotation with suitable example.   | 6     | CO1  | K3           |
| d. Calculate the order of triangle having each angle 60°.   | 4     | CO1  | K3           |
| 3.a. Discuss the phase diagram for one component system application to H <sub>2</sub> O molecule.   | 8     | CO2  | K3           |
| b. What is degree of freedom for the following system:<br>$N_2(S) \rightleftharpoons N_2(l) \rightleftharpoons N_2(g)$  | 2     | CO2  | K2           |
| (OR)  |       |      |              |
| c. Discuss the phase diagram of the sulphur system.   | 8     | CO2  | K3           |
| d. Define the triple point.   | 2     | CO2  | K2           |
| 4.a. An electron is confined in a 1D box of length 1 nm. Calculate the energy required (in Joules or eV) for the electron to transition from the ground state ( $n=1$ ) to the first excited state ( $n=2$ ). | 5     | CO3  | K3           |
| b. Draw the wave probability plot for 4 <sup>th</sup> and 5 <sup>th</sup> excited state of particle in 1-D box.   | 5     | CO3  | K3           |
| (OR)  |       |      |              |
| c. Find the degeneracy of the energy level in 3D box corresponding to $(n_x, n_y, n_z) = (1, 2, 2)$ and $(n_x, n_y, n_z) = (1, 2, 3)$   | 5     | CO3  | K3           |
| d. Find out the values of $[p_x, x]$ , $[x, p_x]$ , $[x, [x, p_x]]$ and $[p_x, p_x]$ .  | 5     | CO3  | K2           |
| 5.a. Calculate the delocalisation energy of allyl cation and anion.   | 8     | CO4  | K3           |
| b. Find out the value of $x$ in ethane in HMO theory.   | 2     | CO4  | K2           |

(OR)

- |  |   |     |    |
|--|---|-----|----|
| c. Prove that delocalization energy of cyclobutene is zero.                                      | 5 | CO4 | K3 |
| d. Calculate the bond order of ethane.   | 5 | CO4 | K2 |
| 6.a. Derive the expression for radioactive decay constant and write a C program to calculate it. | 5 | CO5 | K2 |
| b. Explain first-order reaction rate constant and write a C program for its evaluation.          | 5 | CO5 | K2 |

(OR)

- |  |   |     |    |
|--|---|-----|----|
| c. Write the formula for energy of an electron in hydrogen atom and develop a C program to calculate it. | 5 | CO5 | K2 |
| d. Write a C program to calculate the radius of Bohr orbit for a given quantum number.                   | 5 | CO5 | K3 |

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