

(i) Printed Pages : 3

Roll No. ....

(ii) Questions : 9 Sub. Code : 

1	7	4	5	3
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Exam. Code : 

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B.A./B.Sc.(General) 5<sup>th</sup> Semester  
(2124)

### CHEMISTRY

(Same for B.Sc. Microbial & Food Technology)

Paper :XIX Physical Chemistry–A

Time Allowed : Three Hours]

[Maximum Marks : 22

**Note** :— (1) Attempt *five* questions in all, selecting *one* question each from Units I, II, III and IV and Q. No. 9 is compulsory.

(2) Use of log tables and simple calculator is allowed.

#### UNIT—I

1. (a) What is the concept of particle in one-dimensional box ? What is the Schrodinger wave equation for such a case ? How can this equation be solved for  $\Psi$  and  $E$  ? 2
- (b) What is an operator ? When are the operators said to commute ? Explain with an example that the operators usually do not commute. What is the commutator of the two operators  $\hat{A}$  and  $\hat{B}$  ? What is its value when the operators commute ? 2
2. (a) What is Planck's radiation law ? How do Wien's law and Rayleigh Jean's law follow from it ? 2
- (b) Applying de Broglie relationship, derive Schrodinger wave equation. 2

## UNIT—II

3. (a) What are the criteria or the conditions for the formation of molecular orbitals from atomic orbitals ? 2
- (b) What do you understand by Linear Combination of Atomic Orbitals (LCAO) ? How can it be applied to  $H_2^+$  ion to calculate its energy ? Comment on the values of the energy obtained. 2
4. (a) Derive the values of the coefficients of atomic orbitals in the three  $sp^2$  hybrid orbitals. 2
- (b) Discuss the application of LCAO-MO method to the study of  $H_2$  molecule. Compare the results obtained with the experimental values. 2

## UNIT—III

5. (a) How do photochemical reactions differ from thermal reactions ? Give at least four differences. 2
- (b) Discuss the Lambert's law and Beer's law. Is Beer's law applicable in the case of concentrated solution of light absorbing substances ? 2
6. (a) Derive the relationship between Einstein (in calories) and the wavelength of the radiation (in angstrom units). 2
- (b) Draw Jablonski diagram. Depict the non-radiative (radiationless) and radiative transitions, internal conversion and inter system crossing, fluorescence and phosphorescence. 2

## UNIT—IV

7. (a) Explain the term "Photosensitization" with at least three examples about their mechanism. 2
- (b) What do you mean by quantum yield of a photochemical reaction? Explain why photosynthesis of HCl has very high quantum yield while that of photosynthesis of HBr is very low. 2
8. (a) What is the absorption coefficient of a solute which absorbs 90% of a certain wavelength of light beam passed through 1 cm cell containing 0.25 M solution? 2
- (b) What is meant by primary and secondary processes in photochemistry? Explain with the help of an example. 2

### (Compulsory Question)

9. (a) What do Hamiltonian operator stand for? 1
- (b) State and explain Heisenberg's uncertainty principle. 1
- (c) Compare the important characteristics of  $\sigma$  and  $\pi$  molecular orbitals. 1
- (d) Write expression for Compton shift and explain the results obtained for scattering angles of  $0^\circ$ ,  $90^\circ$  and  $180^\circ$ . 1
- (e) What is resonance fluorescence? Give one example. 1
- (f) Write a short note on 'Chemiluminescence'. 1