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End Semester Examination of Semester-II, 2016

Subject : CHEMISTRY (PG)

Paper : CEMPG-203

Full Marks : 40

Time : 2 Hrs

The figures in the margin indicate the marks corresponding to the question

Candidates are requested to give their answers in their own word as far as practicable.

Illustrate the answers wheeever necessary.

Answer one question from each group

Group A

10x1=10

1. a) Prove that the operator $\frac{-\hbar}{2m} \frac{\partial^2}{\partial x^2}$ is a linear operator.

2

b) If Hamiltonian operator, $\hat{H} = \left(-\frac{d^2}{dx^2} + x^2 \right)$ and the state

function, $\psi(x) = A \cdot x \cdot e^{-\frac{x^2}{2}}$. then show that this state function is an eigen function of the operator and also find out the eigen value.

2+2

(2)

- c) \hat{P}_x is hermitian operator; Justify or criticize two operators. 2
- d) 'If \hat{A} and \hat{B} are commute each other then they must have a same common set of eigen functions' — Justify the statement. 2
2. a) If $\psi = e^{-\frac{x^2}{2}}$, then check whether ψ is a well behaved function, or not in the range $-\infty$ to $+\infty$. 2
- b) Define Hermitian operator. Show that Hamiltonian operator is Hermitian. 2+3
- c) $e^{\hat{A}} \cdot e^{\hat{B}} = e^{(\hat{A}+\hat{B})}$ — under what condition-it will be true? 3

Group B

10x1=10

3. a) Derive the exact uncertainty principle for position (x) and momentum (P_x) measurements of a quantum particle and comment. 6
- b) Define precise value and expectation value in quantum mechanics. 2+2
4. a) State Frank Condon Principle for vibronic transitions. Give an expression of transition moment integral for vibronic transition and state its significance. 3+3
- b) What do you mean by zero-point energy? Also find out its value. 2+2

(3)

Group C

10x1=10

5. a) Derive a relation between the Einstein co-efficient of induced absorption and spontaneous emission. 5
- b) Why Kasha's rule does not fit with the azulene? 2
- c) Define mirror image relation between absorption and emission spectra. What information do you get from the deviation of this relationship? 2+1
6. a) What do you mean by asymmetric and electrophoretic effects? Compute electrophoretic component of velocity of a moving ion. 2+2+2
- b) Define Stoke's shift? 2
- c) Why emission spectra is independent of excitation wave length? 2

Group D

10x1=10

7. a) Derive Clausius-Mossotti Equation. 6
- b) What interaction energy is developed between a monopole and a dipole? 4
8. a) 'Dipole-induced dipole interaction energy is independent of temperature' — Explain. 3
- b) What is London dispersive force? 2
- c) Explain the temperature dependence of dipole-moment of HCl. 2
- d) 'Br₂ is liquid but I₂ is solid' — Explain. 3
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