Sanjay Ghodawat University, Kolhapur   2018-19

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FY M Sc   **School of Sciences | Department of Chemistry**

CHS 506   **Physical Chemistry - II**   Sem-II

26May 2018   **Examination: ESE**   **Max Marks: 100**   Time 3 Hr
10:30 AM to 1:30pm.

Instructions: 1) All Questions are compulsory.

2) Use of calculator is allowed

		Marks	CO
Q.1	Short answer (each one mark)		
1.	Write conditions for well behaved wave function.	10	506.1
2.	What is condition for normalized wave function?		506.1
3.	Eigenvalues of Hermitian operator are ……………..		506.1
4.	State orthogonality condition for wave function.		506.1
5.	What is the eigen value of one dimensional box wave function.		506.1
6.	Write Debye-Huckel equation for mean activity coefficient of an electrolyte at appreciable concentration.		506.2
7.	Activity coefficient of an ion should decreases with ……….ionic strength of the solution.		506.2
8.	Define adsorption isotherm		506.3
9.	Give an example of non-ionic surfactant.		506.3
10.	Adsorption is endothermic in nature. True or false.		506.3

Q.2   Solve the following (Eight marks)   20

a)   Derive a wave equation for a free particle in the one dimension box.   506.

OR

i) Find the energy of an electron moving in one-dimension in an   506.
infinitely high potential box of width 1Å.

(mass of electron 9.1×10^{-31} kg and h = 6.63×10^{-34} Js)

ii) Which of the following are the eigenfunctions of the operator

$\dfrac{\partial^2}{\partial x^2}$? Find out the eigenvalue for them

i) sin x   ii) e^{2x}

b)   Explain Debye-Hückel of interionic attraction in ionic atmosphere.   506.2

OR

Derive expression for Gibbs adsorption isotherm.   506.3

c)   Solve the following (Four Marks)

What is micelle formation? Write different shape and structures of   506.3
micelles.

Q.3   Write note on any four (Five mark each)

                                                                              20
a)   Explain Eigenfunctions of a Hermitian operator corresponding to   506.1
different eigenvalues are orthogonal.
b)   Write a note on Ladder operator.   506.1
c)   Write note on quantitative Debye-Hückel verification of limiting law   506.2
d)   Explain electrophoresis method   506.3
e)   Write types of adsorption isotherm.   506.3

Q.4   Short answer (each one mark)   **10**

1. .... Region in which rotation of molecule take place   506
2. What is Heisenberg uncertainty principle?   506
3. Which are conditions for moment of inertia for spherical top molecule?   506
4. CH_4 molecule does not show a microwave rotational spectrum. True or   506
    false.
5. The zero point energy for simple harmonic oscillatoris........   506.
6. Morse function for anharmonic oscillator is given by equation.......   506.
7. Selection rule for anharmonic oscillator is.........   506.
8. The separation of first line from the exciting line is ....   506.
9. Selection rule for rotational Raman spectra is......   506.
10. Write rule of mutual exclusion   506.

Q.5   Solve the following (Eight marks)   **20**

a) Derive energy equation and selection rule for rigid diatomic molecule.   506.

                OR

a) The fundamental and first overtone transitions of $^1H^{35}Cl$ are centered at   506.
    2886 cm^{-1} and 5668 cm^{-1} respectively. Evaluate the equilibrium
    vibration frequency ($\overline{\omega_e}$), anharmonicity constant (x_e), the exact zero-
    point energy, and the force constant of the molecule.

b) Derive energy equation and selection rule for anharmonic oscillator   506.

                OR

    Define stokes and Antistokes line. Explain pure rotational Raman   506.
    spectra for linear molecule.

c) Solve the following (Four Marks)

    How many normal modes of vibrations are possible for the following   506.
    molecules?
        HBr, CH_3I, C_6H_6, OCS

Q.6		Write note on any four (Five mark each)	**20**	
	a)	Factors on which intensity of spectral lines depends		506.4
	b)	Give classification of molecules based on their three principal moments of inertia.		506.4
	c)	Effect of isotopic substitution		506.4
	d)	Overtone and combination frequencies of molecule		506.4
	e)	Vibration Raman spectra of water molecule		506.4

Total 100

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