Total No. of Questions : 6] **SEAT No. :**

P1378 **[Total No. of Pages : 3**

[5123]-201
M.Sc. - I (Semester - II)
PHYSICAL CHEMISTRY
CHP - 210 : Fundamentals of Physical Chemistry - II
(2013 Pattern) (5 Credit)

Time : 3 Hours] ***[Max. Marks : 50***

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***All questions are compulsory.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic table / calculator is allowed.***
5) ***Neat diagrams must be drawn wherever necessary.***

Physico - Chemical Constants

1.	Avogadro Number	N	=	6.022×10^{23} mol^{-1}
2.	Boltzmann Constant	k	=	1.38×10^{-16} erg K^{-1} molecule^{-1}
			=	1.38×10^{-23} J K^{-1} molecule^{-1}
3.	Planck Constant	h	=	6.626×10^{-27} erg s
			=	6.626×10^{-34} J s
4.	Electronic Charge	e	=	4.803×10^{-10} esu
			=	1.602×10^{-19} C
5.	1 eV		=	23.06 k cal mol^{-1}
			=	1.602×10^{-12} erg
			=	1.602×10^{-19} J
			=	8065.5 cm^{-1}
6.	Gas Constant	R	=	8.314×10^{7} erg K^{-1} mol^{-1}
			=	8.314 J K^{-1} mol^{-1}
			=	1.987 cal K^{-1} mol^{-1}
7.	Faraday Constant	F	=	96487 C equiv^{-1}
8.	Speed of light	c	=	2.997×10^{10} cm s^{-1}
			=	2.997×10^{8} m s^{-1}
9.	1 cal		=	4.184×10^{7} erg
			=	4.184 J
10.	1 amu		=	1.673×10^{-27} kg
11.	Bohr magneton	β_c	=	-9.274×10^{-24} J T^{-1}
12.	Nuclear magneton	β_n	=	5.051×10^{-27} J T^{-1}
13.	Mass of an electron	m_c	=	9.11×10^{-31} kg

P.T.O.

SECTION - I

Q1) Attempt the following : **[10]**

a) Give the principle of ESR spectroscopy.

b) Pure rotational Raman Spectra of linear molecule exhibit first line at 6B cm^{-1} but remaining at 4B cm^{-1}. Explain.

c) How electronically excited molecule loses its energy by phosphorescence.

d) What is Fellget advantage in FTIR?

e) Explain any two factors which affect the width of spectral lines.

Q2) Attempt any two of the following : **[10]**

a) How does optics of IR spectroscopy differ from Raman spectroscopy? Discuss the merits and demerits of Raman spectroscopy.

b) Discuss rotational fine structure of electronic - vibration transition.

c) Explain photoelectron spectroscopy. Why is high vaccum needed for its study?

d) Explain classical theory of Raman effect.

Q3) Solve any one of the following : **[5]**

a) Find the value of rotational constant for the molecule $Br^{79}F^{19}$ if the most intense spectral line at 300k is for the transition J=17$\rightarrow$J==18.

b) The rotational constant for the V=0 state of the molecule is 10 cm^{-1} and V=1 state is 9.5 cm^{-1}. Estimate the rotational constant in the state V = 2.

SECTION - II

Q4) Attempt the following : **[10]**

a) Write any secular determinant for ethylene molecule.

b) Draw bonding and anti-bonding wave functions for H_2 molecule using valence bond theory.

c) What are Weiss indices?

d) Give preparation of ^{22}Na isotope.

e) Give the principle of isotope dilution technique.

Q5) Attempt <u>any two</u> of the following : **[10]**

a) Explain the Huckel theory of cyclobutadiene.

b) Discuss zone diffusion technique to calculate diffusion coefficient.

c) Explain the use of radio isotopes to determine the solubility of sparingly soluble salt.

d) Derive the expression for normalization constant for H_2 molecule using molecular orbital theory.

Q6) Solve <u>any one</u> of the following : **[5]**

a) Miller indices of the plane of a crystal are 436. Calculate the intercept on crystallographic axes.

b) The half - life period of a radio - element is 24.5 minutes. How much of it would be left after 30 minutes, if the initial amount of the radioelement is 1g.