Bago University
Department of Chemistry
First Semester Examination, March 2019

Third Year BSc **Chem-3102**
Chemistry Specialization **Physical Chemistry III**
Answer *any six* Questions **Time Allowed: (3) hours**

1. (a) Fill in the blanks with the correct word(s), unit(s), and etc., as necessary.
   (i) Only molecules with permanent —— will show rotational spectroscopy.
   (ii) Molecular spectra are —— spectra, which are closed spaced lines.
   (iii) In X ray region, the molecule suffers change in ——.
   (iv) The rate of evaporation from the surface is proportional to the —— of the surface.
   (v) No activation energy involved in the —— adsorption process.
   (vi) The symbol —— represents surface tension.

   (b) Select the correct statement(s), word(s), unit(s) and etc., given in the followings.
   (i) Radiations are associated with (electric, magnetic, electric and magnetic) fields.
   (ii) Translational energy is a kind of (kinetic, quantum, mechanical) energy.
   (iii) Non-linear molecules have (one, two, three) rotational degree of freedom.
   (iv) If the liquid spreads over the solid surface, contact angle cos θ is (>0, < 0, equal to zero).
   (v) The rate of chemical adsorption (decreases with increase pressure, increases with increase pressure, is independent of pressure).
   (vi) Ethyl alcohol molecule has structurally (2, 3, 6) different kinds of hydrogen atoms giving nmr signals.

2. (a) What is meant by the following terms and phrases?
   (i) Molecular spectroscopy (ii) wavelength (iii) frequency
   (iv)Planck's constant (v) transmittance (vi) Einstein
   (b) Illustrate the different modes of transition, which may give rise to different spectra.

3. (a) State Franck- Condon Principle. Illustrate the different modes of transition, which may give rise to different spectra.
   (b) A dental hygienist uses us X-rays (λ = 1.00A) to take a series of dental radiographs while the patient listens to a radio station (λ = 325cm) and looks out the window at the blue sky (λ = 473 nm).What is the frequency (s^{-1}) of the electromagnetic radiation from each source? ($c = 3x10^8 m\ s^{-1}$)

4. (a) Illustrate the whole spectrum of the electromagnetic regions.
   (b) Why tetramethylsilane (TMS) is used as an internal standard? Explain with structure.

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5.(a) Solve the following system of linear equations by Cramer's Rule.

$$\begin{aligned} 4x+y+z+\ w &= 1 \\ x-y+2z-3w &= 0 \\ 2x+y+3z+5w &= 0 \\ x+y-z-\ w &= 2. \end{aligned}$$

(b) Determine the sign of the following permutation.

$$\begin{bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{bmatrix}.$$

6.(a) Find the inverse of the following matrix.

$$\begin{pmatrix} 3 & -1 & 5 \\ -1 & 2 & 1 \\ -2 & 4 & 3 \end{pmatrix}.$$

(b) Compute the rank of the following matrix.

$$\begin{pmatrix} 3 & 5 & 1 & 4 \\ 2 & -1 & 1 & 1 \\ 7 & 1 & 2 & 5 \end{pmatrix}.$$

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