VIT

Final Assessment Test (FAT) – June 2022

Programme	B.Tech	Semester	Winter Semester 2021-22
Course Title	ENGINEERING CHEMISTRY	Course Code	BCHY101L
Faculty Name	Prof. S Arockiasamy	Slot	A2+TA2
Time	3 Hours	Class Nbr	CH2021222300113
		Max. Marks	100

SECTION A (10 X 10 Marks)

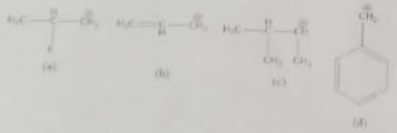
Answer any 10 questions

1. (a) Heat supplied to a Carnot engine is 1796 kJ. Calculate how much useful work can be done by the engine which works between 0°C and 100°C. [10]

   (b) Calculate the efficiency of a power station operates with superheated steam at 271°C (T_h = 551 K) and discharges the waste heat into the environment at 24°C (T = 282 K).

2. $[CoF_6]^{3-}$ is paramagnetic but $[Co(NH_3)_6]^{3+}$ is diamagnetic, however both are octahedral. Explain in detail by applying VBT by drawing the necessary electronic configuration for both. (Atomic Number of cobalt = 27) [10]

3. Draw the resonance or hyperconjugation structures of the following compounds wherever applicable and explain their stability. [10]



(a) (b) (c) (d)

4. Construct the cell diagram and explain the working by giving out the cell representation, net cell reactions and also calculate the EMF using Nernst's equation for the following electrochemical cells . [10]

   (a) The anodic and cathodic reactions are given below,

   Ca -----> $Ca^{2+} + 2e^-$ (E^o = -2.87V, Ca^{2+} = 0.04M)

   $Cu^{2+} + 2e^-$ -----> Cu (E^o = 0.35V, Cu^{2+} = 0.1M)

   (b) The anodic and cathodic reactions are given below,

   Zn -------> $Zn^{2+} + 2e^-$ (E^o = -0.77V, Zn^{2+} = 0.02M)

   $Pb^{2+} + 2e^-$ -----> Pb (E^o = 0.15V, Pb^{2+} = 0.15M)

5. Explain the preparation and mechanism of TiO_2 nanoparticles from $Ti(O^iPr)_4$ (titanium iso-propoxide) precursor by a bottom-up approach method in detail. Sketch the scheme and mechanism neatly. [10]

6. (a) Explain the following transitions by giving out an example for each [10]

   (i) $n-\pi^*$, (ii) $\pi-\pi^*$, (iii) $n-\sigma^*$

   (b) A sample extracted from a plant contains the following compounds, ***dimethyl ketone*** and ***1,3-butadiene***. The former has two λ_{max} whereas the latter has only one λ_{max} in their UV-Vis spectrum. Explain by giving out the absorption graph.

7. (a) When 2.4g of a fuel on complete combustion in slight excess of oxygen, increased the temperature of the water in a calorimeter containing 0.7 kg of water from 31°C to 38°C. Calculate the HCV of the fuel. The water equivalent of the calorimeter is 114g. [10]

(b) When 2.0 g of a pre-analyzed sample containing 91%C, 6%H and 3% ash is burnt in a bomb calorimeter containing 500g of water the following results are obtained
Increase in temperature = 2.7°C; The water equivalent = 800g; Cooling correction = 0.07°C.
Fuse wire correction = 10 cal; Acid correction = 44 cal.
Calculate the HCV and LCV of the fuel?

8. (a) Predict and explain whether the following reaction is spontaneous or not: The standard entropy (S^o) (J/K.mol) values at 25°C are given below. [10]

(i) $A_g + B_g \longrightarrow C_{(l)}$; (A : S^o = 132; B : S^o = 202; C; S^o = 72.1)

(ii) $D_g + E_g \longrightarrow F_{(l)}$; (D : S^o = 127; E : S^o = 198; F :S^o = 68.1)

(b) Explain the variation in IR frequency for the following compounds by drawing necessary structures. IR frequency of CO of $[Mn(CO)_6]^+$ is 2090 cm^{-1} but of $[V(CO)_6]^-$ is 1860 cm^{-1}.

9. (a) Apply the rules of aromaticity to identify the most stable compound and give out the resonance structures for both. [10]

(a) (b)

(b) Explain the construction and functioning of Dye sensitized solar cell using Ru-based Dye molecule

10. (a) Explain the process and types of doping of a conducting polymer Polyaniline with the addition of I_2 and Na with necessary reactions. [10]

(b) Explain he principle, working and application of UV-Visible spectroscopy with a suitable block diagram.

11. Explain the purification of water by Zeolite method in detail with necessary diagram and chemical reactions. [10]