



Final Assessment Test (FAT) – January/February 2023

Programme	B.Tech.	Semester	Fall Semester 2022-23
Course Title	ENGINEERING CHEMISTRY	Course Code	BCHY101L
Faculty Name	Prof. T S PRATHIMA	Slot	C1-IC1
		Class Nbr	CH2022231701024
Time	3 Hours	Max. Marks	100
Answer any 10 questions			

PART-A (10 X 10 Marks)

Answer any 10 questions

- (a) 50% of a first-order reaction is complete in 35 minutes. Calculate the time required to complete 80% of the reaction. (5 marks) [10]

(b) For a gas phase reaction $A+B \rightarrow C+D$ ΔH° for the reaction is $-206.1 \text{ kJ mol}^{-1}$, while the ΔS° is $+215 \text{ J/K mol}$. Calculate the ΔG° at 25°C and determine if the reaction is spontaneous at that temperature. At what temperature will the reaction attain equilibrium? (5 marks)
- (a) Draw crystal field splitting diagram with proper labels and calculate CFSE with pairing energy for (5 marks) [10]

i) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$ or ii) $\text{K}_4[\text{MnF}_6]$

(b) Show the electron count in the following complexes: (5 marks)

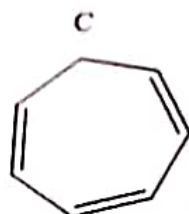
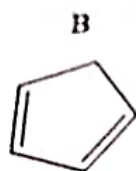
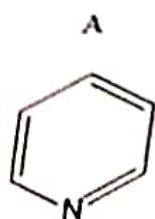
i) $[\text{Cr}(\text{PPh}_3)_2(\text{CO})_4]$ and ii) $[\text{Fe}(\text{CH}_3)_3(\text{CO})_2]$
- (a) Illustrate how hyperconjugation and resonance effects can stabilize carbocations, with suitable examples. (5 marks) [10]

(b) Explain how computational methodologies can help promoting chemistry research for producing new materials. You can illustrate by taking any suitable examples. (5 marks)
- (a) Among the Intermediates A and B given below, explain which is less stable? Justify your answer with an appropriate diagram and explanation. (5 marks) [10]



- (b) What microscopic techniques are useful in characterising nanomaterials? Briefly discuss the functioning of any one of the techniques. (5 marks)
- With a neat diagram, describe the functioning of a silicon solar cell or a Li ion battery, giving details of the charge movements, the importance of the material used. [10]
 - (a) Explain what is a catalyst in relation to the activation energy of a chemical reaction. (5 marks) [10]

(b) Which among the following are aromatic? Why? In what form can you make the non-aromatic compounds into aromatic ones? (5 marks)



7. (a) Describe the fundamental process that is behind the functioning of a UV-vis spectrophotometer (5 marks) [10]
 (b) Describe the Scherrer equation and explain its significance. (5 marks)
8. Explain the method used to determine the calorific value of a solid fuel with appropriate diagram and also derive the formula for the same. [10]
9. (a) In the zeolite and ion-exchange methods for water purification, how are the exhausted materials regenerated? Explain with neat diagrams and chemical equations. (5 marks) [10]
 (b) Discuss any two advantages and two disadvantages of an alkaline fuel cell. Also provide the half cell reaction happening at the anode of such a cell (5 marks)
10. (a) What are composite materials? Mention their classifications and application with an example each. (5 marks) [10]
 (b) Explain the synthesis and applications of ABS or bakelite (5 marks)
11. By taking haemoglobin and chlorophyll as examples, explain the role of metals in biological functions [10]
12. (a) What are the differences between top-down and bottom-up approaches for nanomaterial synthesis? (5 marks) [10]
 (b) Write briefly about conducting polymers with an example. (5 marks)





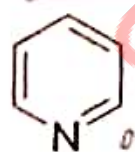
Final Assessment Test (FAT) – January/February 2023

Programme	B.Tech.	Semester	Fall Semester 2022-23
Course Title	ENGINEERING CHEMISTRY	Course Code	BCHY101L
Faculty Name	Prof. Kiran Kumar Tadi	Slot	C2+TC2
		Class Nbr	CH2022231701037
Time	3 Hours	Max. Marks	100

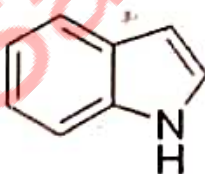
Section I (10 X 10 Marks)

Answer any 10 questions

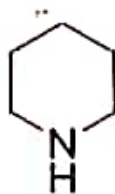
1. a. Calculate (i) work done, (ii) the change in internal energy, (iii) the change in enthalpy and (iv) the quantity of heat exchanged during reversible adiabatic expansion of 2 moles of an ideal monoatomic gas from 5 dm^3 to 25 dm^3 at 27°C . Assume $C_v = 1.5 R$. [10]
2. b. Define the term 'catalyst'. Classify the catalysis with two examples each. [10]
3. The decomposition of an unknown chemical substance required activation energy of 200 kJ mol^{-1} at 800 K with a rate constant of $0.8 \text{ dm}^3 \text{ mol}^{-1} \text{ sec}^{-1}$. Calculate the Arrhenius frequency factor (A) and evaluate the rate constant at 500 K . [10]
4. Calculate the octahedral crystal field splitting energy for a metal with seven 'd' electrons under (i) high and (ii) low spin conditions. Also mention the hybridization pattern and magnetic properties under each case. [10]
5. a. The proximal histidine of haemoglobin displays poor affinity towards molecular oxygen as compared to the distal one. Illustrate the structural constraints that affect the binding affinity for Fe^{2+} towards CO or CN^- . [10]
6. b. Discuss the role of Mg^{2+} towards photosynthetic property of chlorophyll. [10]
7. Compare and elaborate the various factors that influence the stability of carbocations, carbanions and free radicals with suitable examples. [10]
8. Identify aromatic, anti-aromatic and non-aromatic compounds from the following with proper explanation. [10]



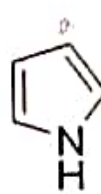
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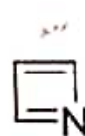
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V

9. Explain the principle, construction, applications, advantages and disadvantages of lithium ion batteries. [10]
10. a. What are semiconductors? Explain the effect of temperature on its conductivity. [10]
- b. Elaborate on the methods to enhance the conducting properties of any given polymer. [10]
11. What are nanoparticles? Elaborate on any one chemical method for the synthesis of nanoparticles. [10]
12. a. Describe the various components of UV-Visible spectrophotometer along with its functions. [10]
- b. What are chromophores and auxochromes? Discuss the various possible electronic excitations in UV-visible spectroscopy. [10]

11. a. With the below given powder X-ray diffraction data calculate the size of the crystal. [10]
 $2\theta = 0.7543$ radians, FWHM of sample = 0.0876 radians, $k = 0.45$ and $\lambda = 0.308$ nm.

b. Calculate gross and net calorific value for 0.92 g of a coal sample that was estimated to contain the following: C = 90 %; H = 8 % and ash = 2 %. The following data were obtained when the above coal was tested in bomb calorimeter. Wt. of water taken = 550 g, water equivalent of calorimeter = 2,200 g, rise in temperature = 2.42 °C, fuse wire correction = 10.0 cal, acid correction = 50.0 cal. Assume that the latent heat of condensation of steam as 580 cal/g.

12. a. Explain how reverse osmosis is more efficient than ion exchange method. [10]

b. Discuss the principle involved in sacrificial anodic protection and impressed current method to protect metals from Corrosion



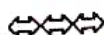
Final Assessment Test (FAT) – January/February 2023

Programme	B.Tech.	Semester	Fall Semester 2022-23
Course Title	ENGINEERING CHEMISTRY	Course Code	BCHY101L
Faculty Name	Prof. Jayanta Parui	Slot	F1+TF1
		Class Nbr	CH2022231700656
Time	3 Hours	Max. Marks	100

Section A (10 X 10 Marks)

Answer any 10 questions

- ① Explain in brief about the principle involved in Carnot cycle with a neat diagram and mention its applications in detail. [10]
- ② a. Ligands generally influence the colour of the complexes. Explain the statement with suitable examples. [10]
b. Calculate the crystal field splitting energy for a metal with five 'd' electrons under (i) high spin and (ii) low spin conditions.
- ③ Describe in brief the stability aspects of carbocation and carbanion with relevant examples. [10]
- ④ You are provided with a natural dye derived from agro based source material as one of the component. Construct a solar cell by incorporating the above component and describe its working principle with a neat diagram. [10]
- ⑤ How polymers are made conductive? Explain the classification and mechanism of conducting polymers with relevant examples. [10]
- ⑥ Explain the working principle of UV-Visible spectroscopy and SEM. [10]
7. Describe the method which is used to provide residual hardness of water less than 2ppm. Draw diagram and write equations for the same. [10]
- ⑧ a. Write short notes on enzyme catalysis and the mechanism involved in it. [10]
b. Explain the structure, properties and applications of ferrocenes?
9. a. Describe the preparation method of an azo dye. [10]
b. Explain the components, construction and working principle of SOFC in detail with a neat diagram.
- ⑩ a. Write short notes on the working principle of OLED. [10]
b. Find out the crystallite size of the given nanomaterial using p-XRD data:
Peak position $2\theta = 21.81^\circ$, FWHM of sample = 2.81° , $k = 0.9$ and $\lambda = 1.5406 \text{ \AA}$ (degree to radian = Degree $\times \pi/180$).
11. a. Explain in brief about the preparation of nanoparticles by sol-gel method with an illustration. [10]
b. Write short notes on corrosion control- protection methods.
- ⑫ a. Explain pseudo first order reaction with an example. [10]
b. Describe the working principle involved in Reverse Osmosis.



**VIT**

Vellore Institute of Technology

Reg. No. : **22BEE1136****Final Assessment Test (FAT) - JUNE/JULY 2023**

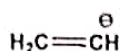
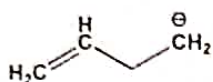
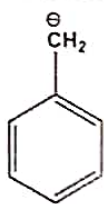
Programme	B.Tech.	Semester	Winter Semester 2022-23
Course Title	ENGINEERING CHEMISTRY	Course Code	BCHY101L
Faculty Name	Prof. LAKKOJI SATISH	Slot	D1+TD1
		Class Nbr	CH2022232300241
Time	3 Hours	Max. Marks	100

Part A (10 X 10 Marks)**Answer any 10 questions**

01. (a) Body A and Body B are in thermal equilibrium with each other and another body C is in equilibrium with B. Discuss the law of thermodynamics behind this system in detail. (5 marks) [10]
- $$\boxed{A} \rightleftharpoons \boxed{B} \rightleftharpoons \boxed{C}$$
- (b) A cylinder contains 0.25 mol of nitrogen gas. How much work is done to compress the gas at a constant temperature of 80 °C from a volume V_1 to $\frac{1}{2}V_1$ (5 marks)
02. (a) Derive the logarithmic equation of first order rate equation and its graphical representation. (5 marks) [10]
- (b) Discuss the effect of temperature on the rate of a reaction using Arrhenius equation. (5 marks)
03. (a) Discuss the structure of $(K_4[Fe(CN)_6])$ and show how it is different from the simple salt, KCN (5 marks) [10]
- (b) Transition metals with electronic configurations d^1 , d^2 and d^3 have similar crystal stabilization energies (CFSE) for both low and high spin complexes– Explain with relevant CFSE calculations. (5 marks)

04. (a) Arrange the following carbanions in the increasing order of stability and explain. (5 marks)

[10]



(b) Explain the following

i) Cyclopentadiene is non-aromatic while cyclopentadienyl anion is aromatic (2.5 marks)



ii) While pyrrole is aromatic, its protonated form is non-aromatic (2.5 marks)



05. (a) Show how 'intercalation chemistry' can be utilized in the Lithium ion batteries using relevant charging and discharge equations (5 marks)

[10]

(b) Bring out the major differences between monocrystalline, polycrystalline and amorphous silicon based solar cells (5 marks)

06. (a) Classify and explain the types and applications of composites with suitable examples. (5 marks) [10]
(b) Explain why polyethylene is a non-conductor of electricity while polyacetylene is. (5 marks)
07. (a) Bring out any four differences between nano and bulk materials with proper explanations. (5 marks) [10]
(b) Illustrate the principle and working of OLEDs (5 marks)
08. Explain the principle, instrumentation and applications of UV Visible spectroscopy using suitable examples. [10]
09. (a) Explain the differences between optical, diffraction and electron microscopic techniques. (5 marks) [10]
(b) Illustrate the working principle of Scanning Electron Microscopy (5 marks)
10. Both Zeolite and Ion exchange resin methods employ similar chemistry – Among them, identify the method which reduces the hardness to the lowest ppm level. Support your answer explaining the softening processes involved in these methods. [10]
11. (a) Illustrate the principle and working of reverse osmosis method for water treatment. (5 marks) [10]
(b) Large iron pipes can be protected from corrosion by connecting to a piece of Zinc - Explain the principle behind this method. (5 marks)
12. (a) Explain the principle and working of bomb calorimeter using a schematic representation (5 marks) [10]
(b) A good petrol is a bad diesel, and a bad petrol is a good diesel. Explain. (5 marks)





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
Programme	B.Tech.	Semester	Winter Semester 2022-23
Course Title	ENGINEERING CHEMISTRY	Course Code	BCHY101L
Faculty Name	Prof. Buthanapalli Ramakrishna	Slot	E1+TE1
		Class Nbr	CH2022232300225
Time	3 Hours	Max. Marks	100


Section A (10 X 10 Marks)


Answer any 10 questions

01. (a) Mention the laws of thermodynamics and give their significance. [10]
- (b) The decomposition of an unknown substance required a minimum energy of 250 kJ mol^{-1} . If the rate constant of the above reaction at 1000 K is $3.6 \text{ dm}^3 \text{ mol}^{-1} \text{ sec}^{-1}$, calculate the Arrhenius factor and the rate constant at 750 K .
02. Calculate (i) work done, (ii) the change in internal energy, (iii) change in enthalpy and (iv) quantity of heat exchanged during reversible isothermal expansion of 2 moles of an ideal monoatomic gas from 5 dm^3 to 10 dm^3 at 300 K at 1 atm pressure. [10]
03. Calculate the crystal field splitting energy and find the orbital hybridization for $[\text{NiF}_6]^{4-}$ and $[\text{Ni}(\text{CN})_6]^{4-}$ complexes. Also mention the magnetic properties under each case. [10]
04. (a) Explain the stability of the following complexes based on 18-electrons rule. [10]
 i) $\text{Ni}(\text{CO})_4$ ii) $\text{Ni}(\text{CO})_2(\text{NH}_3)_2$
 (b) Discuss briefly the role of Mg in photosynthesis process.
05. Identify the aromatic, anti-aromatic and non-aromatic compounds from the below with justification and mention their order of stability. [10]
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06. (a) Explain the synthesis and application of either aspirin or paracetamol. [10]
 (b) Describe the various factors that determine the stability of carbocations with one example.
07. (a) With following electrode reactions [10]
 $\text{Sn}^{2+} - 2e^- \rightarrow \text{Sn}$ ($E^\circ = -0.15 \text{ V}$, $\text{Sn}^{2+} = 0.04 \text{ M}$)
 $\text{Ni}^{2+} + 2e^- \rightarrow \text{Ni}$ ($E^\circ = 0.26 \text{ V}$, $\text{Ni}^{2+} = 0.4 \text{ M}$)
 construct a cell, give the cell representation, net cell reaction and calculate the emf.
 (b) Briefly discuss the working of a dye sensitized solar cell
08. Explain the construction, working principle, applications, advantages and disadvantages of lithium ion batteries and bring out the differences with a fuel cell [10]

09. (a) Describe Sol-gel method for synthesizing SiO_2 nanoparticles in detail. [10]
(b) What is a composite? Bring out the differences between a polymer, metal and ceramic matrix composites.
10. (a) Explain the various transitions occurring in the UV-vis electronic spectroscopy with proper illustration and examples. [10]
(b) Calculate the crystallite size (D) of the given nanomaterials using the following XRD data:
Peak position $\theta = 0.214$ rad, FWHM (β) of sample = 2.45° , $k = 0.87$ and $\lambda = 1.5406 \text{ \AA}$
11. (a) Define HCV and LCV and predict the one which will be higher with explanation. [10]
(b) Calculate the gross and net calorific value of Ig of a solid fuel using Bomb calorimeter containing 250 g of water and a water equivalent of 2000 g. Given that the latent heat of condensation of steam is 587 cal/g. The sample was found to contain 90 % of C, 8 % of H and 2 % of ash. The acid and fuse wire corrections were given as 50 cal and 10 cal respectively. The observed rise in temperature of water was 2.5°C
12. (a) Discuss the sacrificial anodic protection method to protect metals from corrosion. [10]
(b) Briefly discuss the ion exchange water softening process with a neat sketch.

