

End Term Examination 2016-17
B.Tech First Year I Semester
AHC 1001: Engineering Chemistry

Time 2 Hrs. 30 Minutes

Max. Marks: 40

SECTION -A

NOTE : - Attempt all questions**(1 × 16 = 16 Marks)**

- I. Arrange CO , Cl_2 and O_2 in order of their increasing bond length.
- II. Arrange the following in order of their increasing stability.
 $(CH_3)_2\overset{+}{C}H$, $(C_6H_5)_2\overset{+}{C}H$ and $CH_3\overset{+}{C}HCOCH_3$
- III. Draw Enantiomers and distereomers structures of Tartaric acid.
- IV. Draw Newmann projections of anti and skew conformers of n -butane.
- V. Write Dulong – Petit formula for calculation of GCV of a fuel.
- VI. Define Calorific value of a fuel. Which form of coal possesses highest Calorific value?
- VII. Which process is better for removing hardness of water and why?
- VIII. Why molecular weight of polymers is determined as an average molecular weight?
- IX. Write structures of monomers of Buna-N.
- X. A water sample contains 408 mgm. of $CaSO_4$ per litre. Calculate its hardness in terms of $CaCO_3$ equivalent.
- XI. What is relation in between different units of hardness of water?
- XII. Write the formula of two biodegradable polymers.
- XIII. Time taken for completion of 75% of a first order reaction is 60 min. What will be time for change of 50% of this reaction?
- XIV. How much rust ($Fe_2O_3.3H_2O$) will be formed when 50 kg of iron have completely rusted away?
- XV. Define chromophore in UV spectroscopy

- XVI. For a reversible reaction if the activation energy and ΔH for the forward reaction is 400 KJ mol^{-1} and -200 KJ mol^{-1} respectively. Calculate activation energy for the reverse reaction.

SECTION -B

NOTE : - Attempt any four questions (3×4= 12 Marks)

- I. What do you mean by anodizing? Explain with diagram.
- II. The transmittance of an aqueous solution of unknown compound is 20% at 25°C for $3 \times 10^{-5} \text{ M}$ solution in 4 cm cell. Calculate molar extinction coefficient.
- III. 3. The rate constant of a reaction is $1.5 \times 10^{-7} \text{ sec}^{-1}$ at 50°C and $7.5 \times 10^{-7} \text{ sec}^{-1}$ at 100°C . Evaluate Arrhenius parameters A and E_a .
- IV. What are corrosion inhibitors? Explain how anodic inhibitors provide protection against corrosion.
- V. "IR spectra is often characterized as molecular finger prints". Comment on it.

SECTION -C

NOTE : - Attempt any three questions (4×3=12 Marks)

- I. Derive rate law equation for second order reaction when concentration of both the reactants is different. Also prove that if one of the reactant is taken in excess in this reaction, then reaction terminates to first order.
- II. What is corrosion? Explain wet theory of corrosion by absorption of oxygen with suitable diagram.
- III. Calculate NMR signals and splitting signals in the following compounds
 - a. $\text{CH}_3\text{CH}_2\text{OH}$
 - b. $(\text{CH}_3)_2\text{CH.CHO}$
- IV. What is Nano Technology? How can nanotechnology promise to build products with both extreme precision in structure and environmental cleanliness in the production process?

End Term Examination, Even Semester 2016-17

B. Tech., I-Year, II-Semester

AHC 1101 : Engineering Chemistry

Time: 2½ Hours

Max. Marks: 40

Section- A

Note: Attempt All Questions.

(1x16=16)

- I. What is the difference between order and molecularity?
- II. Calculate the bond order of NO^+ .
- III. What is synthetic Petrol?
- IV. Write two industrial applications of Lubricant.
- V. Define centre of symmetry.
- VI. Mention the units of hardness.
- VII. What are the salts responsible for the formation of scales?
- VIII. Define Tacticity.
- IX. Write the formula of Potash glass.
- X. Write the structural unit and two important applications of Nylon 66.
- XI. Distinguish between flash point and fire point.
- XII. Define passivity.
- XIII. Calculate the fundamental mode of vibrations in CO_2 molecule in IR spectroscopy.
- XIV. Differentiate between gross calorific value and net calorific value?
- XV. What is Unit of rate constant of Second order reaction?
- XVI. Write two industrial applications of Bio material.

Section- B

Note: Attempt Any Four Questions.

(3x4=12)

- I. What is Pitting Corrosion? Explain with reactions.

- II. What options are available to control corrosion? Discuss how corrosion can be controlled by modifying environment.
- III. What is Nano technology? Write three industrial applications each of fullerene and Carbon Nano tube.
- IV. Predict the number of signals and multiplicity of the respective signals in the following compounds:
 (a) CH_3CH_3 (b) $\text{ClCH}_2\text{CH}_2\text{CH}_2\text{Cl}$ (c) $\text{Cl}_2\text{CHCH}_2\text{Cl}$
- V. With the help of data given below, show that the decomposition of H_2O_2 in aqueous solution is of first order reaction.

Time (Min)	0	10	20	30
Volume of KMnO_4 Used (in ml)	25	20	15.7	12.5

Section- C

Note: Attempt Any Three Questions.

(4x3=12)

- I. Differentiate SEM and TEM. Discuss how Nano technology is important in industries.
- II. a. Discuss the industrial implications of corrosion.
 b. Calculate the pH of a litre of solution containing 0.1M CH_3COONa and 0.01 M CH_3COOH solutions. K_a for CH_3COOH is 1.8×10^{-5} .
- III. Explain with reactions, the rusting of iron in acidic medium in absence of oxygen and in neutral medium in presence of oxygen.
- IV. What is Beer-Lambert law in UV-VIS absorption spectroscopy? A compound having concentration 10^{-3} g/l resulted absorbance value 0.20 at λ_{max} 510 nm using 1.0 cm cell. Calculate its absorptivity and molar absorptivity values. The molecular weight of compound is 400.

Roll No.

End-Term Theory Examination
Odd-Semester, 2017-18

Program: B. Tech. I Year

Subject: Engineering Chemistry (AHC 1101)

Time: 3 hr

Max. Marks: 50

Section A

Note: 1. All questions are compulsory and carry five marks each. $7 \times 5 = 35$

2. Marks are also indicated against each question wherever required.

Q. 1. Applying the concepts of Molecular orbital theory, draw the Molecular Orbital diagram of O_2 molecule. Also, state the magnetic character and calculate the bond order of O_2 molecule. (3+1+1)

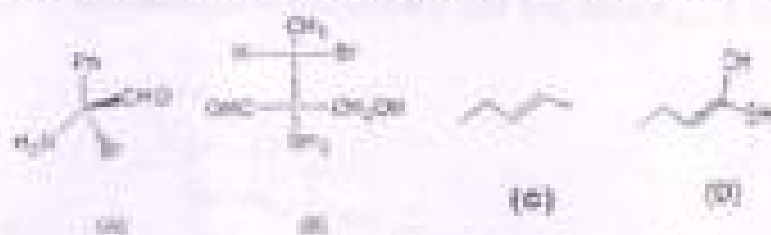
Q. 2. Explain the principle of synthesis of petrol by 'Fisher Tropsch Method' with the help of suitable diagram (properly labeled) and reaction involved in it.

OR

a) Explain the mechanism of Hydrodynamic lubrication. Also, mention its industrial applications. (2+1)

b) Enumerate the industrial applications of Ceramics. (2)

Q. 3. a) Determine R/S or E/Z configuration of the following: (2)



b) Deduce the expression for the first order rate constant. Also, write the expression for half life of this reaction. (2+1)

Q. 4. a) Focusing on the basic concept of 'Reverse osmosis process'; elaborate the mechanism of treatment of hard water with a well labeled diagram. (3)

b) Calculate the temporary and permanent hardness of water sample containing: $Mg(HCO_3)_2 = 7.3 \text{ mg/L}$, $Ca(HCO_3)_2 = 16.2 \text{ mg/L}$, $MgCl_2 = 9.5 \text{ mg/L}$, $NaCl = 5.85 \text{ mg/L}$. (2)

- Q. 5. a) What do mean by Vulcanization of Rubber? How it can be done? (2)
 b) Outline two industrial applications of Nano-materials. (1)
 c) Match the following: (2)

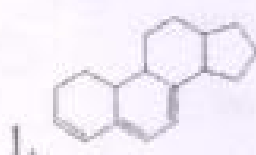
Polymer	Application
a. Bio-pol	i. Textiles
b. PLA	ii. Packaging
c. Bakelite	iii. Tube of tires
d. Butyl rubber	iv. Ion exchange resin

- Q. 6. According to the latest study conducted by CC Technologies Labs, Inc. losses due to corrosion alone in USA is going to be more than \$1.0 trillion per annum very shortly. *So, in order to minimize the effects of corrosion, prepare a blue print on 'Corrosion control'.*

OR

- a) Mention the implications of corrosion on global economy. (2)
 b) Analyze 'Liquid metal Corrosion'. (2)
 c) Explain the term "Passivity" with suitable example. (1)

- Q. 7. a) Define **chemical shift** and **Coupling constant** in NMR spectroscopy.
 b) Calculate the λ_{max} value for the following compounds: (2)



- c) Calculate the total no. of vibration in HCl & CO₂. (2+2+1)

Section B

Note: All the questions are compulsory.

2x3=6

- I. i. a) A buffer solution contains 0.4 mole of NH₄OH and 0.50 mole of NH₄Cl per liter. Calculate the pH of this solution. (Given K_b of NH₄OH at r.t. is 1.75x10⁻⁵). (1)

- b) Why fingerprint region is important in IR spectroscopy? (1)
- ii. Define 'Pilling Bedworth rule'. Also, propose an outline of the different types of oxide layers. (1+1)
- iii. a) What is graphene? (1)
- b) Outline the types of vibrations involved in IR spectroscopy. (1)

Note: All the questions are compulsory.

3x3=3

IL.i. a) Predict the number of signals in the following compounds: (1)



b) Differentiate SEM & TEM in Nanotechnology. (2)

c) ii. Establish the first order rate constant for the following reaction:



The following data was obtained on hydrolysis of ethyl acetate at 25 °C in HCl.

Time (Minute)	0	75	119	183	∞
Vol. (ml)	9.62	12.10	13.10	14.75	21.0

iii. Describe the mechanism of corrosion involved in release of H_2 type and absorption of O_2 type.

End-Term Examination
Odd-Semester, 2018-19

Program: B.Tech.
Subject with Code: Engg. Chemistry,
Time: 3 Hour

Year: 1st
BCHC0101
Maximum Marks: 50

Section A

Attempt all questions

[5x7=6 marks]

Ques 1.

[3+2]

- (i) Draw the molecular orbital diagram of N_2 , find out bond order and also assign magnetic behavior.
- (ii) Differentiate enantiomers and diastereomers.

Ques 2.

[3+2]

- (i) How experimentally calorific value of a fuel is determined by bomb calorimeter? Explain with neat diagram.
- (ii) Calculate the volume of air required for complete combustion of 20 litres of propane (C_3H_8).

Ques 3.

[3+2]

- (i) With the help of suitable diagram discuss reverse osmosis or ion exchange process for the treatment of hard water.
- (ii) What do you mean by smart Materials? Give any two examples of smart Materials.

Ques 4.

[3+2]

- (i) Discuss the mechanism of thick film lubrication. Give two examples of solid lubricants.
- (ii) In a polymer sample, 20% molecules have molecular mass 15,000, 45% have molecular mass 30,000 and rest have 40,000. Calculate number average and mass average molecular mass of polymer sample.

Ques 5.

[2+1+2]

- (i) If in first order reaction time taken for the completion of 35% of the reaction is 15 min. calculate the time for completion of 70% of the reaction.
- (ii) Write important industrial applications of ceramics.
- (iii) Discuss the implications of corrosion on global economy.

Ques 6.

[3+2]

- (i) With reference to UV-Visible spectroscopy, discuss different types of electronic transitions (with examples) for organic molecules.
- (ii) Define annealing. Why it is required during the manufacturing of glass.

Ques 7.

[3+2]

- (i) Outline the different methods used for the protection of metal from corrosion.
- (ii) The hardness of 1 litre of water was removed by a zeolite softener which needed 117 mg NaCl for regeneration, calculate hardness of water sample.

Section B

Attempt all questions

Ques 1.

[3x2 = 6 marks]

- (i) Calculate total number of fundamental vibrations, stretching vibrations and bending vibrations for CO_2 and phenol.
- (ii) Calculate pH of one litre of solution containing 0.2M NH_4OH and 0.25 M NH_4Cl solution. K_b for NH_4OH is 1.8×10^{-5} .
- (iii) What are nanomaterials? Define quantum dot and graphene.

Ques 2.

[3x3 = 9 marks]

- (i) What is corrosion? Discuss the theory of electrochemical corrosion with absorption of oxygen.
- (ii) Derive second order rate equation when concentration of both the reactants is same and also show that time taken for half completion of this reaction is inversely proportional to the initial concentration of the reactant.
- (iii) Discuss the theory of NMR spectroscopy. How many proton NMR signals will you get for Toluene and $\text{CH}_2=\text{CHCH}_3$.

University Roll No.....

End-Term Theory Examination, 2018-19
B.Tech. I Year, II Semester
Engineering Chemistry (BCHS 0101)

Time: 3.0 Hr

Max. Marks: 50

Section- A

Note: Attempt all questions.

7x5 = 35

1. Applying the concept of Molecular orbital theory, explain the nature of bonding in Oxygen molecule by drawing its molecular orbital diagram, calculate bond order and predict its magnetic behavior.
2. (a) Determine the calorific value of a fuel using the principle of Bomb calorimeter.
(b) Calculate the gross and net calorific value of a coal sample, containing 84% of carbon, 1.5% sulphur, 6% nitrogen, 5.5% hydrogen and 8.4% oxygen. (Given latent heat of steam = 587cal/gram)
3. (a) Differentiate thermoplastic and thermoplastic polymer.
(b) Mention the composition, properties and industrial application of Borosilicate glass.
4. (a) What are boiler problems? Which of the following is more dangerous: Scale or Sludge
(b) A Zeolite bed exhausted by softening 4000 L of water sample requires 10 L of 15% NaCl for regeneration. Calculate the hardness of water sample.
5. (a) Derive 'Henderson-Hasselbalch' equation to calculate the pH of a basic buffer.
(b) Calculate the pH of a solution obtained by mixing 50 mL of 0.1M HCl with 50 mL of 0.2 M NaOH.
6. (a) Derive the integrated rate equation for first order reaction.

(b) For the second order reaction



At 25°C, $K = 6.21 \times 10^{-3} \text{ L Mol}^{-1} \text{ Sec}^{-1}$. Calculate the time required for the hydrolysis of 85% ester of the initial concentration of the reactants in the following reaction mixture: (0.05M ester + 0.1M NaOH).

7. (a) State 'Pilling-Bedworth' rule?

(b) Make a blue print for corrosion control.

Section B

Note: Attempt all questions.

3x2 = 6

1. Define the term Auxochrome and Chromophore in UV-Visible spectroscopy.
2. What is the range of Finger print region in IR spectroscopy? Highlight its significance.
3. What do you understand by equivalent and non equivalent proton? How many signals are obtained in NMR spectrum of the following compounds?



Note: Attempt all questions.

3x2 = 6

4. (a) Differentiate Order of reaction and Molecularity.
(b) Calculate the energy of activation of a reaction, whose rate constant is tripled by 10 °C rises in temperature in vicinity of 27 °C.
5. What is Corrosion? Discuss the mechanism of absorption of O₂ type corrosion.
6. Discuss the various industrial applications of nanotechnology.

End Term Examination, Odd Semester 2019-20

Program:B.Tech, Branch: CS, Year: I, Semester: I

Subject Code: BCHS0101 Subject Title: Engineering Chemistry

Time: 3 Hour

Maximum Marks: 50

Section- A

Note: Attempt ANY FIVE Questions.

$5 \times 4 = 20$ marks

- (I) Draw the molecular orbital diagram of F_2 , find out bond order and also assign magnetic behavior.
- (II) (a) Write the raw materials used in manufacturing of ceramics.
- (b) Which monomer units are used for teflon, polylactic acid and polystyrene.
- (c) Discuss the mechanism of thin film lubrication.
- (III) (a) Calculate the amount of air required for the complete combustion of 7Kg of pure carbon.
- (b) Mention the most stable and least stable conformation of n-butane.
- (IV) What is Pilling Bedworth rule? Discuss any four methods for the prevention of metallic corrosion,
- (V) Write your views on fullerenes and carbon nano tubes? Write important applications of nanotechnology.
- (VI) (a) Hardness is represented in $CaCO_3$ equivalent, why?
- (b) Derive Henderson equation for acidic buffer.

Section- B

Note: Attempt ALL Questions.

$5 \times 3 = 15$ marks

- (I) Calculate the amount of lime (80% pure) and soda (85% pure) required for the softening of 10,000 liters of water containing: $\text{Mg}(\text{HCO}_3)_2 = 14.6$ ppm, $\text{MgSO}_4 = 24$ ppm, $\text{CaCl}_2 = 22.2$ ppm, and $\text{HCl} = 3.65$ ppm.
- (II) What is activation energy? Explain why increase in temperature increases the rate of reaction.
- (III) How many proton NMR signals will you get for:
- (a) $\text{CH}_3\text{COCH}_2\text{CH}_3$ (b) Nitro benzene
- (c) $\text{CH}_2=\text{CHCHO}$
-
- (IV) (a) Discuss the importance of finger print region in IR spectroscopy.
- (b) Which type of electronic transition is not possible in $\text{C}_2\text{H}_5\text{OH}$.
- (V) What are smart Materials? Define piezoelectric and pyroelectric materials with examples.

Section- C

Note: Attempt ANY THREE Questions.

3 × 5 = 15 marks

(I) [3+2]

(a) Derive an integrated rate expression of a reaction whose half life time is independent to the initial concentration of the reactant.

(b) A second order reaction is 30% completed in 50 min. calculate the time for completion of 80% of the reaction

(II) [3+2]

(a) Define corrosion? Discuss the theory of electrochemical corrosion with evolution of hydrogen.

(b) Calculate pH of 10^{-8}M NaOH.

(III) [3+2]

(a) Briefly explain the construction and working of zeolite process for the treatment of hard water.

(b) How the scale formation be prevented by calgon conditioning.

(IV) [3+2]

(a) With reference to IR spectroscopy, discuss different types of fundamental vibrations.

(b) Calculate λ_{max} for the following:



Course Name: Engineering Chemistry

Course Outcome

After studying this course students will be able to:

- CO1. Compute the calorific value of fuel by Bomb calorimeter and Dulong's formula.
- CO2. Identified the use of polymer, glass, ceramic, and lubricants in various Engineering applications.
- CO3. Apply various methods for the removal of hardness of water for both industrial and domestic applications.
- CO4. Interpret molecular structure based on spectroscopic analysis.
- CO5. Conceptual understanding of nanomaterials and their applications in the field of Engineering and medical sciences.

Printed pages: 04

Univ. Roll No.

End Term Examination, Even Semester 2021-22

B. Tech. (Common to all branches) I Year, II Semester

BCHS 0101: Engineering Chemistry

Time: 3 Hours

Max. Marks: 50

Instructions:

1. Write your university roll number immediately on receipt of this question paper.
 2. Read the statement of each question carefully before attempting. *Give proper justification where desired.*
 3. All questions in Sections A and B are compulsory.
 4. Write the question number/part carefully while attempting the question in the answer booklet.
 5. Use only a blue ball pen for writing exams and avoid the use of a pencil/highlighter/whitener while writing your answers.
 6. Marks indicated against each question are full marks.
 7. You cannot leave the examination hall before the scheduled time.
- Beware! Do not write anything on this question paper except your roll number. Failing may lead to booking yourself to unfair means.***

Section – A

4 x 5 = 15 Marks

No.	Detail of Question	Marks	CO	BL	KL
1	Apply molecular orbital theory to illustrate the bonding in the N_2^{-1} molecule.	4	CO5	A	C
2	(i) Which among <i>o</i> -nitrophenol and <i>p</i> -nitrophenol is more acidic and why? (ii) Discuss the electron sea model of metallic bonding with the help of a well-labeled diagram.	2+2	CO2	A	C
3	Write the monomers of the following polymers: (i) Nylon-6,6 (ii) Buna-S (iii) Natural rubber (iv) Bakelite	4	CO2	U	C
4	With the help of a well-labeled diagram demonstrate the construction and working of the <i>Ion-exchange process</i> for softening hard water. Also, write the reactions involved in it.	4	CO4	A	M
5	Write the point of differences between the following pairs: (a) Piezoelectric and pyroelectrics materials (b) SEM and TEM	4	CO5	C	M

Section – B

3 x 5 = 15 Marks

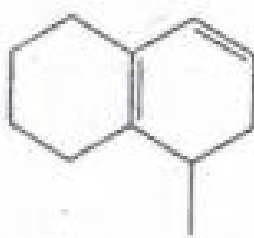


No.	Detail of Question	Marks	CO	BL	KL
1	Derive an expression for the Henderson-Hasselbatch equation of acetate buffer. Calculate the pH of the solution obtained by mixing 0.1 M CH_3COOH and 0.15 M CH_3COONa . Given $pK_a = 4.76$ for CH_3COOH .	3	CO1	R	F

2	What do you understand by Corrosion? Write its consequences.	3	CO2	A	C
3	Calculate the amount of lime (90% pure) and soda (98% pure) for the treatment of 10^6 litres of water containing: $\text{Ca}(\text{HCO}_3)_2 = 8.1$ ppm; $\text{CaCl}_2 = 33.3$ ppm; $\text{MgCl}_2 = 38$ ppm; $\text{Mg}(\text{HCO}_3)_2 = 14.6$ ppm.	3	CO3	An	C
4	Discuss the mechanism of corrosion by O_2 absorption type and H_2 evolution type.	3	CO4	A	C
5	Derive an expression for a specific reaction rate of a first-order reaction and its half-life. Also, draw the plot representing the relationship between specific reaction rate and time.	3	CO5	R	M

Section – C

5 x 3 = 15 Marks

Q. No.	Detail of question	Marks	CO	BL	KL
1	Differentiate Order and Molecularity. What do you understand by Pseudo-molecular reactions? Give an example of a Pseudo-molecular reaction. Calculate the order of reaction which follow the rate law given below: (i) $r = K [\text{A}]^{0.5} [\text{B}]^{1.5}$ (ii) $r = K [\text{A}][\text{B}]^2$ What will be the order of reaction when conc. of A is taken in excess for each of the cases?	5	CO2	C	M
2a	Give the properties and uses of (ANY ONE): (i) Fullerenes (ii) Carbon nanotubes	3	CO4	A	F
2b	A first-order reaction is 20% completed in 10 minutes. Calculate: (i) the specific rate constant of the reaction and (ii) the time taken for the reaction to go to 75% completion.	2	CO4	C	F

3	<p>Citing suitable examples explain the terms 'chromophore and auxochrome' in UV spectroscopy? Calculate the λ_{max} of the following compounds.</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>(a)</p> </div> <div style="text-align: center;">  <p>(b)</p> </div> <div style="text-align: center;">  <p>(c)</p> </div> </div>	5	CO3	An	C
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End of Question paper

Course Name: B. Tech.**Course Outcome**

After studying this course students will be able to:

- CO1. Compute the calorific value of fuel by Bomb calorimeter and Dulong's formula.
- CO2. Identified the use of polymer, glass, ceramic, and lubricants in various Engineering applications.
- CO3. Apply various methods for the removal of hardness of water for both industrial and domestic applications.
- CO4. Interpret molecular structure based on spectroscopic analysis.
- CO5. Conceptual understanding of nanomaterials and their applications in the field of Engineering and medical sciences.

Printed pages: 04

Univ. Roll No.

End Term Examination, Odd Semester 2022-23

B. Tech. (CSE) I Year, I Semester

BCHS 0101: Engineering Chemistry

Time: 3 Hours

Max. Marks: 50

Section – A

Note: All questions are compulsory

4 x 5 = 20 Marks

No.	Detail of Question	Marks	CO	BL	KL
1	Illustrate the bonding nature in the dioxygen molecule. Also, calculate bond order and compare its stability with O_2^+ .	4	CO5	A	C
2	What are ceramic materials? How they can be classified? Enlist important applications of ceramic materials. OR Write the name of monomer of natural rubber. Why the applications of natural rubber are restricted? Suggest suitable modification in properties of natural rubber for broad range applications.	4	CO2	A	C
3	Describe the working principle of 'Bergius method' for synthesis of petrol with a well	4	CO2	U	C

	labelled diagram. Compare it with 'Fisher Tropsch' method. OR What are lubricants? How they are classified? Cite suitable examples for each type.				
4	Derive an expression for the rate constant for first order reactions. Draw a plot for first order reaction. Also, prove that half life of first order reaction is independent on initial concentration of reactants.	4	CO4	A	M
5	What do you understand by corrosion of metal surfaces? Enumerate implications of corrosion to economy and society of a nation. Construct a chart indicating methods for corrosion control. OR State the following terms (ANY FOUR): (i) Pilling-Bedworth rule (ii) Differential aeration corrosion (iii) Scale and sludge (iv) Graphene (v) Piezoelectric materials	4	CO5	C	M

Section – B

Note: All questions are compulsory

3 x 5 = 15

No.	Detail of Question	Marks	CO	BL	KL
6	Identify the type of hardness caused by the following species when present in water: $\text{Ca}(\text{HCO}_3)_2$, MgSO_4 , MgCO_3 , HCl , CaSO_4 , Na_2SO_4	3	CO1	R	F
7	Calculate the pH of a solution obtained by mixing 100 mL of 0.25 M HCl solution to 150 mL of 0.15 M of NaOH. Predict the nature of resulting solution. OR How pH of solutions is maintained in chemical laboratories? Calculate the pH of a solution obtained by mixing 0.25 M sodium acetate to 0.2	3	CO2	A	C

	M acetic acid. Given K_a for acetic acid is 1.8×10^{-5} .				
8	Calculate temporary, permanent and total hardness having following composition: $\text{Ca}(\text{HCO}_3)_2 = 8.1 \text{ ppm}$; $\text{CaCl}_2 = 33.3 \text{ ppm}$; $\text{NaCl} = 5.5 \text{ ppm}$; $\text{MgCl}_2 = 38 \text{ ppm}$; $\text{Mg}(\text{HCO}_3)_2 = 14.6 \text{ ppm}$.	3	CO3	An	C
9	Nanomaterials are boon to the human civilization. Justify the statement. OR Differentiate SEM and TEM.	3	CO4	A	C
10	What are biomaterials? Give two examples. Also, enlist any two applications of biomaterials.	3	CO5	R	M

Section – C

Note: All questions are compulsory

5 x 3 = 15

Q. No.	Detail of question	Marks	CO	BL	KL
11	Describe 'Zeolite process' for softening hard water by illustrating with the help of well labelled diagram. Write reactions involved and merits & demerits of this process.	5	CO2	C	M
12a	Differentiate order and molecularity of a reaction.	2	CO4	A	F
12 b	A first-order reaction is 75% completed in 10 minutes. Calculate: (i) the specific rate constant of the reaction and (ii) the time taken for the reaction to go to 85% completion.	3	CO4	C	F
13	Differentiate dry and wet corrosion. Also, discuss the mechanism of corrosion by absorption of oxygen type.	5	CO3	An	C

End of Question paper

Course Name: Engineering Chemistry

Course Outcome

After studying this course students will be able to:

- CO1. Compute the calorific value of fuel by Bomb calorimeter and Dulong's formula.
- CO2. Identified the use of polymer, glass, ceramic, and lubricants in various Engineering applications.
- CO3. Apply various methods for the removal of hardness of water for both industrial and domestic applications.
- CO4. Interpret molecular structure based on spectroscopic analysis.
- CO5. Conceptual understanding of nanomaterials and their applications in the field of Engineering and medical sciences.

Printed pages: 04

Univ. Roll No.

End Term Examination, ^{Even} ~~Odd~~ Semester 2022-23

B. Tech. (All branches) I Year, II Semester

BCHS 0101: Engineering Chemistry

Time: 3 Hours

Max. Marks: 50

Section – A

Note: All questions are compulsory

4 × 5 = 20 Marks

No.	Detail of Question	Marks	CO	BL	KL
1	Molecular orbital theory is essentially based on the LCAO that leads to molecular orbitals which are responsible for describing bonding nature molecules. Considering the significance of molecular orbitals, create a molecular orbital picture of N ₂ molecule. Also, apply the concept of bond order, justify why N ₂ molecule is most stable among gaseous constituents in the atmosphere.	4	CO5	A	C
2	Outline the method of preparation of ANY TWO of the polymers given below and list any two relevant industrial applications of each. (a) Buna-S (b) Polystyrene (c) PHB (d) Nylon-6,6	4	CO2	A	C
3	Apply the concept of hydrogen bonding to account the reasons for the following: (a) o-nitrophenol is more volatile than p-nitrophenol. (b) alcohols are soluble in water whereas ethers not. (c) H ₂ O is a liquid whereas H ₂ S is gas.	4	CO2	U	C




	(d) Ice float over water. OR Functional materials are generally characterized as those materials which possess particular native properties and functions of their own. Considering the statement, describe 'Piezoelectric and pyroelectric material' by citing at least two example of each type of materials.				
4	'Hyperfiltration' or 'reverse osmosis' process has been considered as the most effective way for the treatment of hard water. Sketch a block diagram of Reverse process to demonstrate the mechanism of treatment of hard water. In a study, it was found that daily consumption of RO water has alarmed certain health issues in consumers, can you identify the reasons for the above statement.	4	CO4	A	M
5	Corrosion of metals is a serious threat to economy of a country. Itemize the economic and ecological implications of corrosion. Also, construct a chart indicating methods for corrosion control. OR Nanotechnology is a boon to the modern society. Enumerate the reasons for this statement with special reference to the inherent properties of nanomaterials. Also, list industrial applications of nanomaterials.	4	CO5	C	M

Section – B

Note: All questions are compulsory

3 x 5 = 15

No.	Detail of Question	Marks	CO	BL	KL
6	Corrosion can take place in both dry and wet environment. The formation of oxide layer on metal surface in the presence air/oxygen is common phenomenon under dry condition. Identify, the types of oxide layers formed on the metal surface. Also, apply the 'Pilling – Bedworth rule' for describing the nature of	3	CO1	R	F

	oxide layer (protective or non-protective) in terms of specific volume ratio.				
7	Nanomaterials can't be seen through naked eye or through normal microscope. But several computers assisted sophisticated techniques like SEM and TEM enable the researchers / scientist to create a picture of nanomaterials. Highlight any three basic differentiating factors of the two important electron microscopic techniques.	3	CO2	A	C
8	<p>Apply Woodward-fisher rule' for the calculations of λ_{max} of the following compounds:</p> <div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>(i)</p> </div> <div style="text-align: center;">  <p>(ii)</p> </div> <div style="text-align: center;">  <p>(iii)</p> </div> </div> <p style="text-align: center;">OR</p> <p>Calculate temporary, permanent and total hardness having following composition: Ca (HCO₃)₂ = 16.2 ppm; CaCl₂ = 66.6 ppm; MgCl₂ = 76 ppm; Mg (HCO₃)₂ = 29.2 ppm, NaCl = 5.55 ppm.</p>	3	CO3	An	C
9	<p>Consider the rate law equation given below and answer the association questions:</p> $r = k [A][B]^{0.5}$ <p>(a) What will be the overall order of reaction? (b) What will be the order of reaction if the reactant A is taken in excess. (c) What will be the order of reaction in terms of reactant A?</p>	3	CO4	A	C
10	<p>Demonstrate the mechanism involved in 'release of H₂' and 'absorption of O₂' type corrosion.</p> <p style="text-align: center;">OR</p> <p>Identify the IR active and IR inactive molecule from the compounds given: H₂, N₂, HCl, CO₂, O₂, CH₄</p>	3	CO5	R	M

Section – C

Note: All questions are compulsory

5 x 3 = 15

Q. No.	Detail of question	Marks	CO	BL	KL
11	Draw a well labelled diagram of 'Zeolite process' for softening hard water. Write all types of reactions involved. A zeolite softener was 90% exhausted when 10,000 L of ground water and 50 L of 10% NaCl solution was needed for regeneration of zeolite bed. Calculate the hardness of ground water.	5	CO2	C	M
12	<p>(a) Consider a reaction indicated below:</p> $A + B \longrightarrow \text{products}$ <p>Derive an expression for the rate constant of the reaction when the concentration of B was taken in excess.</p> <p>(b) Rate constant of the reaction get doubled when temperature of a reaction was increased from 27 °C to 37 °C. Calculate activation energy of the reaction. (Given, $R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$).</p>	5	CO4	A	F
13	Buffer solutions are generally applied in laboratory to maintain a constant pH. Taking a suitable example of buffer solution, outline the mechanism of buffering action. Also, derive Henderson equation for the acetate buffer. Calculate the pH of a solution obtained by mixing 0.25 M sodium acetate to 0.15 M of acetic acid. Given pK_a of acetic acid = 4.74.	5	CO4	C	F

End of Question paper