

TRIBHUVAN UNIVERSITY  
INSTITUTE OF ENGINEERING  
**Examination Control Division**

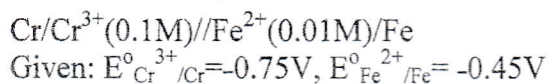
2082 Chaitra

| Exam.       | Regular (New Course)  |            |        |
|-------------|-----------------------|------------|--------|
| Level       | BE                    | Full Marks | 60     |
| Programme   | BCE, BME,<br>BAG, BCH | Pass Marks | 24     |
| Year / Part | I / I                 | Time       | 3 hrs. |

**Subject: - Engineering Chemistry (ENSH 103)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
- ✓ The figures in the margin indicate Full Marks.
- ✓ Assume suitable data if necessary.

1. What is polarization and over potential? Calculate the EMF of the following cell at 25°C. [2+3]



OR

What is battery? Explain the charging and discharging process in lithium-ion battery with suitable chemical reactions.

2. Derive Henderson-Hasselbalch equation for acidic buffer solution. Calculate the change in pH of buffer system having 200mL of 0.1M  $\text{CH}_3\text{COOH}$  and 0.1M  $\text{CH}_3\text{COONa}$  when 1 millimole NaOH is added into it. ( $K_a$  for  $\text{CH}_3\text{COOH} = 1.8 \times 10^{-5}$ )

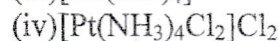
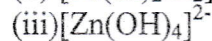
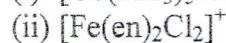
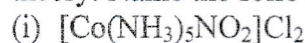
3. Define catalyst with suitable example. Explain photocatalytic dye degradation with suitable figures and reactions. Mention two important selection criteria of catalyst.

4. Discuss the basic principles of Nuclear Magnetic Resonance (NMR) spectroscopy. Explain the splitting pattern of proton in NMR spectrum of ethyl alcohol.

OR

What is chromatography? Explain the basic principle of thin layer chromatography (TLC) with suitable diagram. Also mention its applications.

5. Predict the magnetic and geometry property of  $(\text{FeF}_6)^{3-}$  on the basis of valence bond theory. Name the following complexes by IUPAC system.



6. a) Explain crystal field splitting of d orbitals in octahedral complexes.

b) What are alloys? Write the applications of aluminum alloys.

7. What is green chemistry? Explain any four principles of green chemistry with suitable examples.

8. How does BOD differ from COD? Write the effects of radioactive substances in water. Give some advantageous ideas to manage e-waste.

9. Define nanotechnology. Classify nanomaterials based on their dimensions including examples. Explain the ball milling process of preparation of nanomaterials.

10. Differentiate between organic and inorganic polymer. Explain the free radical mechanism of addition polymerization with an example.

11. What is conducting polymer? Write the preparation and applications of Kevlar and Polymethyl methacrylate (PMMA).

OR

Write short notes on:

- a) Preparation and uses of Polyphosphazene  
b) Cellulose

12. a) How can you prepare nitrocellulose? Write its uses.

b) Write the important requisites of a good quality paint. Describe the types and uses of lubricants.

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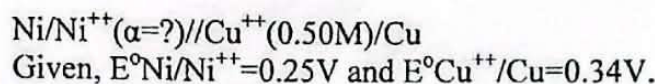
2082 Kartik

| Exam.       | Back (New Course)    |            |        |
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| Year / Part | I / I                | Time       | 3 hrs. |

**Subject:** - Engineering Chemistry (ENSH 103)

- ✓ Candidates are required to give their answers in their own words as far as practicable.
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1. How does a galvanic cell generate electricity? Calculate the concentration of  $\text{Ni}^{++}$  in the cell at  $25^\circ\text{C}$ , if the emf is 0.601V. [1+4]



OR

Write Tafel equation and mention its applications. Discuss the mechanism of electrochemical corrosion. [2+3]

2. Define buffer range and buffer capacity. How many gram of sodium acetate is needed in 100 ml of 0.2 M acetic acid to prepare buffer solution of pH 5.8? ( $\text{pka} = 4.74$ ). [2+3]
3. Write the differences between homogenous and heterogeneous catalysis? Discuss the process of electrocatalysis with reference of water splitting. [2+3]
4. Define chromatographic technique. Write down the principle and applications of paper chromatography. [1+2+2]

OR

What do you mean by NMR spectroscopy and write its principle? Discuss the NMR spectrum of acetaldehyde. [1+2+2]

5. a) Explain the formation of  $[\text{Ni}(\text{NH}_3)_6]^{2+}$  on the basis of valence bond approach and predict its hybridization, geometry and magnetic behavior. [3]
- b) Write the formula of the following co-ordination compounds; [4×0.5]
- (i) Potassium tetrachlorozincate (II)
  - (ii) Dicyanoargentate (I) ion
  - (iii) Dichloro-tetra-aqua chromium (III) cation
  - (iv) Pentaammine nitritocobalt (III) sulphate
6. a) What is a particulate matter? Describe the impact of  $\text{NO}_x$  (air pollution) on human health and write its remedies. [1+2+2]
- b) What is e-waste? How is it responsible for pollution? Give the methods to manage e-waste. [1+2+2]
7. Define nanoscience and nanotechnology. What are the differences between bottom up and top down approach of nanomaterials? [2+3]

8. a) Briefly discuss the mechanism of anionic addition polymerization with a suitable example. [3]
- (i) What are silicones? Draw the possible structures of siloxane polymer obtained by hydrolyzing dialkyldichlorosilane. [1+1]
- b) Write the preparation and uses of Perlon U and Polycarbonate. [2.5+2.5]

OR

- Show your acquaintance with cellulose and polythiazyl. [2.5+2.5]
9. a) What are the types of lubricants? Write its functions. [1+2]
- b) Starting from benzene, how will you prepare TNT? [2]
10. Write short notes on: [2×2.5]
- a) Postulates of CFT
- b) Aluminum alloys

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| Exam.       | Regular (New Course - 2080 Batch) |            |        |
|-------------|-----------------------------------|------------|--------|
| Level       | BE                                | Full Marks | 60     |
| Programme   | BCE, BME, BAG,<br>BCH             | Pass Marks | 24     |
| Year / Part | I / I                             | Time       | 3 hrs. |

**Subject: - Engineering Chemistry (SH 103)**

- ✓ Candidates are required to give their answers in their own words as far as practicable.
- ✓ Attempt All questions.
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1. a) What is cell notation? For the given galvanic cell,  
 $\text{Zn(s)}/\text{Zn}^{++}(0.1\text{M})//\text{Ag}^+(0.2\text{M})/\text{Ag(s)}$ , calculate the EMF of the cell,

Where  $E^\circ_{\text{Zn}^{++}/\text{Zn}} = -0.76\text{V}$  and  $E^\circ_{\text{Ag}^+/\text{Ag}} = 0.80\text{V}$ .

[1+4]

OR

Explain the polarization with a suitable example.

[5]

2. Derive the Henderson's equation for basic buffer. 1.64 gm of anhydrous sodium acetate is added to 200 ml of 0.2 M acetic acid. What is the pH of buffer? ( $K_a = 1.8 \times 10^{-5}$ )

[1+4]

3. a) What are heterogeneous and homogeneous catalysts?

b) Explain the process of photocatalysis with reference of water splitting.

[2+3]

4. Define chromatographic technique. Write the principle and applications of paper chromatography.

[1+4]

OR

a) Write the principle and applications of IR spectroscopy.

b) Show your acquaintance with spin splitting in NMR spectroscopy.

[4+1]

5. Define chelate with an example. Using VBT, predict the geometry and magnetic property of  $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ .

[1+2.5+1.5]

Write IUPAC name of the following complexes:

i)  $\text{K}_3[\text{Fe}(\text{CN})_6]$  (ii)  $[\text{Co}(\text{NH}_3)_6]^{3+}$  (iii)  $[\text{Cr}(\text{en})_3\text{Cl}_3]$

6. Write down the postulates of crystal field theory. Also mention the applications of Cerium.

[3+2]

7. a) Why is e-waste being a concern in the current world? Briefly discuss any four principles of green chemistry.

[1+4]

b) Mention the different water pollutants and its control measures.

[2+3]

8. What are nanomaterials? Classify nanomaterials on the basis of their dimensions.

[1+4]

9. a) i) Explain the free radical mechanism of polymerization with an example.

ii) Write the preparation and uses of polyphosphazene?

[3+2]

b) Write the preparation and applications of kevlar and epoxy resin polymer.

[2.5+2.5]

OR

Discuss the following polymers:

i) Conducting polypyrrole

ii) Carbon fiber reinforced polymers.

iii) Chitin

[2+1.5+1.5]

10. i) What is lubricant? Write the functions of lubricant.

ii) Write the preparation and application of TNT.

[3+2]

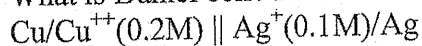
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2081 Kartik

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1. What is Daniel cell? Find the emf of the following cell at 25°C:



Given  $E^{\circ}_{\text{Ag}^{+}/\text{Ag}} = 0.80\text{V}$  and  $E^{\circ}_{\text{Cu}^{++}/\text{Cu}} = 0.34\text{V}$

[1+4]

OR

Define polarization and overpotential. Write Butler volmer equation and mention its application.

[2+3]

2. Write the mechanism of buffer action. To 1 liter of buffer solution containing 0.1M  $\text{NH}_4\text{OH}$  and 0.2M  $\text{NH}_4\text{Cl}$ , if, 0.2gm of  $\text{NaOH}$  is added, what will be the pH of resulting solution? ( $\text{pK}_b$  for ammonia = 4.74).

[2+3]

3. Explain about photo catalysis and electro catalysis.

[2.5+2.5]

4. Which type of molecules are IR active? Write the principle and applications of NMR.

[1+4]

OR

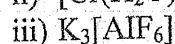
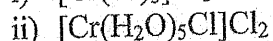
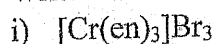
What is X-ray? Discuss the X-ray diffraction (XRD) as an analytical technique for characterization of organic compound.

[1+4]

5. Write down the postulates of crystal field theory. Write the application of cerium.

[2+3]

6. Write the IUPAC names of followings.



On the basis of VBT, explain the structure and hybridization involved in  $[\text{Ni}(\text{CN})_4]^{2-}$  ions.

[1.5+3.5]

7. a) Write down five principles of green chemistry. Explain. Briefly discuss about the management of bio-degradable waste into energy.

[2.5+2.5]

- b) What is meant by water quality standard? Describe water pollution with reference to turbidity, BOD and COD.

[1+4]

8. Classify nanomaterials based on their dimensions. Explain the CVD method of preparation of nanomaterials.

[2+3]

9. a) What are addition polymers? Explain the mechanism of cationic polymerization.

[1+4]

- b) Define fiber reinforced polymer. Write the preparation and use of polythiazyl and polycarbonate.

[1+4]

OR

- b) What are conducting polymer? Write the synthesis and applications of polyaniline and Sulphur based polymer.

[1+4]

10. a) Write the requisite of good paints. Mention any two impacts on environment.

[3+2]

- b) Write the preparation and uses of glycerol trinitrate.

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1. How does an electrolytic cell differ from galvanic cell? Consider the following reaction at 25°C.



What will be the potential of the cell, if the concentration of  $\text{Zn}^{++}$  and  $\text{Cd}^{++}$  ions are 0.05 M and 0.1 M respectively? [2+3]

OR

Define overvoltage and polarization. Write the Butler Volmer equation and mention its applications. [3+2]

2. Derive the Henderson-Hasselbalch equation for acidic buffer. Calculate the pH of resulting solution when 0.005mole of NaOH is added to 150ml of 0.1M acetic acid solution ( $\text{pK}_a=4.74$ ). [2+3]
3. Write down the selection criteria of a catalyst. Explain the various methods used for the hydrogen production from fossil fuels. [2+3]
4. What is Chromatography? Describe the principle and applications of thin layer Chromatography. [1+2+2]

OR

What is spectroscopy? Describe the principle of IR spectroscopy. Draw IR absorption spectrum of ethanol and explain the position of each band. [1+2+2]

5. On the basis of VBT, explain the hybridization, structure and magnetic behavior of  $[\text{FeF}_6]^{3-}$  ions. Write the IUPAC names of followings. [3+2]
- (i)  $\text{Na}_2[\text{NiCl}_4]$  (ii)  $[\text{Co}(\text{NO}_3)_6]^{3-}$  (iii)  $[\text{Cr}(\text{en})_2\text{Cl}_2]^+$  (iv)  $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Cl}_2$
6. Write down the postulates of crystal field theory. Also mention the applications of Neodymium. [3+2]
7. a) What is green chemistry? Briefly discuss any four major principles of green chemistry. [1+4]
- b) Differentiate between BOD and COD. Write the adverse environmental effect of excess COD in water. [2+3]
8. Explain the preparation of nanomaterials by ball milling and Exfoliation method. [2.5+2.5]
9. a) How does addition polymer differ from condensation polymer? Explain the free radical mechanism of addition polymerization with suitable example. [2+3]
- b) What are conducting polymers? Write the preparation and uses of Epoxy Resin and Polyphosphazene. [1+2+2]

OR

Write short notes on:

- (i) Preparation and uses of Polyaniline (ii) Hardening of cement [2.5+2.5]

10. a) What is primary explosive? Write the preparation and uses of TNG. [1+2]
- b) What are the requisites of good paint? [2]

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