Roll no | | | | | | | | | |

NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa 403 401

B. Tech 1st yr (Batch A)

Programme Name: B.Tech

End Semester Examination, April 2019

Course Name: Chemistry **Course Code: CY150**

Date: 30/4/2019 **Time:** 9:30 AM

Duration: 3 hour 0 Minutes **Max. Marks:** 100

1. Answer all the questions
2. Answer for sub questions have to be labeled properly
3. Find reduction potential data as an annexure

1. Suppose a zinc rod is dipped into a 1.0 M $CuSO_4(aq)$ solution containing a copper rod and the system is allowed to stand for several hours. What do you predict for the voltage measured between the Zn(s) and Cu(s) rods? 3 Marks

2. The cell diagram for the lead-acid cell that is used in automobile and truck batteries is 8 Marks

$$Pb(s)|PbSO_4(s)|H_2SO_4(aq)|PbO_2(s), PbSO_4(s)|Pb(s)$$

(a) Determine the balanced equation for the net cell reaction.
(b) Use the data in Appendix to calculate the value of E°cell.
(c) Calculate the value of $\Delta G°$.
(d) How many lead-acid cells are in a 12 V car battery?

3. A construction company is installing an iron culvert (a long cylindrical tube) that is 40.0 m long with a radius of 0.900 m. To prevent corrosion, the culvert must be galvanized. This process is carried out by first passing an iron sheet of appropriate dimensions through an electrolytic cell containing Zn^{2+} ions, using graphite as the anode and the iron sheet as the cathode. If the voltage is 3.26 V, what is the cost of electricity for depositing a layer 0.200 mm thick if the efficiency of the process is 100 percent? The electricity rate is Rs. 2 per kilowatt hour (kWh), where the density and MW of Zn is 7.14 g/cm^3, and 65.4 g respectively. 7 Marks

4. Consider a galvanic cell that uses the following half-reactions: 5 Marks

$$MnO_4^-(aq) \rightarrow Mn^{2+}(aq)$$
$$Sn^{4+}(aq) \rightarrow Sn^{2+}(aq)$$

(a) What is the oxidizing agent, and what is the reducing agent?
(b) Write a balanced equation for the overall cell reaction.
(c) Calculate the standard cell potential.

5. Consider a galvanic cell that uses the following half-reactions: 10 Marks

$$2H^+(aq) + 2e \rightarrow H_2(g)$$
$$Al^{3+}(aq) + 3e \rightarrow Al(s)$$

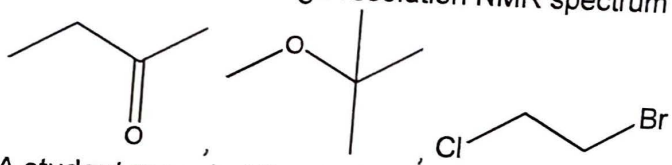
(a) What materials are used for the electrodes? Identify the anode and cathode, and indicate the direction of electron and ion flow.
(b) Write a balanced equation for the cell reaction, and calculate the standard cell potential.
(c) Calculate the cell potential at 25 °C if the ion concentrations are 0.10 M and the partial pressure of H_2 is 10.0 atm.
(d) Calculate $\Delta G°$ (in kilojoules) and K for the cell reaction at 25 °C
(e) Calculate the mass change (in grams) of the aluminum electrode after the cell has supplied a constant current of 10.0 A for 25.0 min.

6. Calculate the number of normal vibrational modes possible for SO_2 and CO_2 molecule. Identify each of them and predict whether the motion is IR active or not. Justify your answer. 6 Marks

7. Calculate the absorption frequency corresponding to the -C -H stretching vibration treating the group as a simple diatomic C-H molecule with a force constant of $k = 5.0 \times 10^2$ N/m. 4 Marks

8. The solution EPR spectrum of a nitroxide radicle shows three lines centered at 316.7 mT, 331.2 mT, and 345.7 mT respectively when spectrum is recorded at the frequency of 9.3×10^9 Hz. Calculate the isotropic hyperfine coupling constant 'a' and g-factor. The EPR line is due to single nitrogen (I=1) present in the molecule, so predict the intensity ratio of EPR lines. Given: $h = 6.626 \times 10^{-34}$ J.s, $\beta = 9.274 \times 10^{-24}$ J/T 4 Marks

9. Predict the low and high resolution NMR spectrum of following molecules 9 Marks



10. A student recorded the UV-Vis spectrum of p-nitroanilene in benzene as the solvent. The student noticed a complex spectrum. He went to his professor and asked for his advice. This professor advised him not to use benzene as a solvent to record UV-Vis spectrum and recommended him to use different solvent. 3 Marks

(a) Explain why benzene should not be used to record UV-Vis spectrum

(b) Suggest two solvents that can be used to record UV-Vis spectrum

11. Explain the following: 6 Marks

(a) Ethylene, C_2H_4 is a planar molecule, but hydrazine, N_2H_4 is not.

(b) ICl_2^- is linear, but NH_2^- is bent.

12. Draw the d orbital energy diagram for square planer and trigonal bipyramidal geometry 5 Marks

13. Draw the molecular orbital diagram for CO, CN^- molecule and predict the bond order, magnetic property 10 Marks

14. Identify the hybrid orbitals used by the phosphorus atom in each of the following species: (a) PCl_4^+ (b) PCl_6^- 4 Marks

15. Arrange the following complexed in their ascending order of their crystal filed splitting energy and explain them with respect to color. 4 Marks
$[CoF_6]^{4-}$ (Green); $[Co(CN)_6]^{4-}$ (Orange); $[Co(NH_3)_6]^{2-}$ (Yellow); $[Co(H_2O)_6]^{3+}$ (Blue)

16. The 6 ml of wastewater is diluted to 300 ml using distilled water. A 2.5ml of this aerated water has been taken in each of the two standard BOD bottle. Initially, bottle 1 was mixed with the reagents (KOH, $MnSO_4$, H_2SO_4, KI) and titrated against $Na_2S_2O_3$ in presence of starch indicator. During this titration, 2.1 ml of 0.0025N $Na_2S_2O_3$ was consumed. The second bottle was incubated in the dark for five days at 20°C. The reagents (KOH, $MnSO_4$, H_2SO_4, KI) were mixed at the end of the 5^{th} day and titrated against $Na_2S_2O_3$ in presence of starch indicator. During this titration, 1.3 ml of 0.0025N $Na_2S_2O_3$ was consumed. Determine BOD of wastewater 5 Marks

17. Explain the following with necessary chemical equation and diagram (a) Carbonate conditioning, b) Phosphate conditioning 4 Marks

18. How many milligrams of FeSO4 dissolved per liter give 220 ppm of hardness? [MW of FeSO4 is 136] 3 Marks

NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa 403 401

1st yr B. Tech (Batch A)

Programme Name: B.Tech

Mid Semester Examination, February-2019

Course Name: Chemistry | **Course Code: CY150**

Date: 26/02/2019 | **Time: 9:30 AM**

Duration: 1 hour 30 Minutes | **Max. Marks: 50**

1. Answer all the questions
2. Answer for sub questions has to be labeled properly
3. Find reduction potential data as an annexure

1. Industrially, copper is purified by electrolysis. The impure copper acts as the anode, and the cathode is made of pure copper. The electrodes are immersed in a $CuSO_4$ solution. During electrolysis, copper at the anode enters the solution as Cu^{2+} while Cu^{2+} ions are reduced at the cathode. (a) Write half-cell reactions and the overall reaction for the electrolytic process. (b) Suppose the anode was contaminated with Zn and Ag. Explain what happens to these impurities during electrolysis. (c) How many hours will it take to obtain 1.00 kg of Cu at a current of 18.9 A? — 5 Marks

2. Lead storage batteries are rated by ampere hours, that is, the number of amperes they can deliver in an hour. (a) Show that 1A.h = 3600 C. (b) The lead anodes of a certain lead-storage battery have a total mass of 406 g. Calculate the maximum theoretical capacity of the battery in ampere hours. (c) Calculate $E°$cell and $\Delta G°$ for the battery. — 5 Marks

3. Based on the standard reduction potentials in annexure, calculate the standard reduction potential for the half-reaction — 4 Marks

   $Fe^{3+}(aq) + 3e \rightarrow Fe(s)$ $E°$= ?

4. Calculate the equilibrium constant for the following reaction at 298 K — 4 Marks

   $Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$

5. A concentration cell ceases to operate when the concentrations of the two cell compartments are equal. At this stage, is it possible to generate an emf from the cell by adjusting another parameter without changing the concentrations? Explain. — 3 Marks

6. A piece of magnesium ribbon and a copper wire are partially immersed in a 0.1 *M* HCl solution in a beaker. The metals are joined externally by another piece of metal wire. Bubbles are seen to evolve at both the Mg and Cu surfaces. (a) Write equations representing the reactions occurring at the metals. (b) What visual evidence would you seek to show that Cu is not oxidized to Cu^{2+}? (c) At some stage, NaOH solution is added to the beaker to neutralize the HCl acid. Upon further addition of NaOH, a white precipitate — 5 Marks

forms. What is it?

7. A spoon was silver-plated electrolytically in an $AgNO_3$ solution. (a) Write the diagram for the process. (b) If 0.884 g of Ag was deposited on the spoon at a constant current of 18.5 mA, how long (in minutes) did the electrolysis take? 4 Marks

8. In an electrolysis experiment, a student passes the same quantity of electricity through two electrolytic cells, one containing a silver salt and the other a gold salt. Over a certain period of time, she finds that 2.64 g of Ag and 1.61 g of Au are deposited at the cathodes. What is the oxidation state of gold in the gold salt? 5 Marks

9. Explain cold and hot soda lime process with proper chemical equation and diagram 5 Marks

10. What are zeolites and explain the zeolite process of water treatment with proper chemical equation and diagram. 5 Marks

11. Explain with proper chemical equation, advantage and disadvantage of the following (a) Carbonate conditioning, (b) Phosphate conditioning (c) Calgon conditioning of 5 Marks

Farmagudi, Ponda, Goa 403 401

Programme Name: B.Tech

Mid Semester Examination, September-2018

1st Sem
Section : B

Course Name: Chemistry
Date: 22/09/2018
Duration: 1 hour 30 Minutes

Course Code: CY150
Time: 11:30 AM
Max. Marks: 50

1. Answer all the questions
2. Answer for sub questions has to be labeled properly
3. Find reduction potential data as an annexure

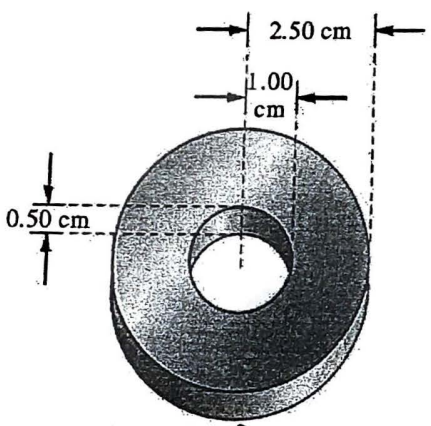
1. Two voltaic cells are assembled in which the following reactions occur. 5 Marks

$V^{3+}(aq) + Ag^{+}(aq) + H_2O(l) \rightarrow VO^{2+}(aq) + 2H^{+}(aq) + Ag(s)$ $E^{o}_{cell} = 0.439$ V

$V^{2+}(aq) + VO^{2+}(aq) + 2H^{+}(aq) \rightarrow 2V^{3+}(aq) + H_2O(l)$ $E^{o}_{cell} = 0.616$ V

Use these data and other values from annexure to calculate E^{o} for the half reaction of $V^{3+}(aq) + 1e \rightarrow V^{2+}(aq)$

2. A Ni anode and a Fe cathode are placed in a solution with $[Ni^{2+}] = 1M$ and then connected to a battery. The Fe cathode has the shape shown below. How long must electrolysis be continued with a current of 1.50 A to build a 0.050 mm thick deposit of nickel on the iron? (Density of nickel = 8.90 g/cm^3.) 6 Marks



3. A solution containing both Ag^{+} and Cu^{2+} ions is subjected to electrolysis. Copper is plated out after a current of 0.75 A is passed through the solution for 2.50 hours. If the total mass of metal is 3.50 g, what is the mass percent of silver in the product? 5 Marks

4. Electrolysis is carried out for 2.00 h in the following cell. The silver cathode, which has a mass of 25.0782 g, weighs 25.8639 g after the electrolysis. The platinum anode weighs the same before and after the electrolysis. 5 Marks

(a) Write plausible equations for the half-reactions that occur at the two electrodes.

(b) What must have been the magnitude of the cur-rent used in the

electrolysis (assuming a constant cur-rent throughout)?

(c) A gas is collected at the anode. What is this gas? 5 Marks

5. A voltaic cell is constructed as follows:

$Ag(s) \mid Ag^+(sat\ Ag_2CrO_4) \parallel Ag^+(0.125\ M) \mid Ag(s)$

What is the value of Ecell? For Ag_2CrO_4, Ksp = 1.1×10^{-12}. 5 Marks

6. For the voltaic cell,

$Sn(s) \mid Sn^{2+}(0.075\ M) \parallel Pb^{2+}(0.600\ M) \mid Pb(s)$

(a) What is Ecell initially

(b) If the cell is allowed to operate spontaneously, will Ecell increase, decrease, or remain constant with time? Explain 6 Marks

7. (a) Using data available in Appendix, write the disproportionation reaction for $Au^+(aq)$. From the appropriate standard potentials, determine whether Au^+ will disproportionate spontaneously in aqueous solution under standard conditions.

(b) Using data available in Appendix, write the disproportionation reaction for Sn^{2+}. (b) From the appropriate standard potentials, determine whether Sn^{2+} will spontaneously disproportionate in aqueous solution under standard conditions.

8. Use the data in Appendix to calculate the standard potential of the couple $Au^{3+}(aq)/Au^+(aq)$; $Mn^{3+}(aq)/Mn(s)$ 4 Marks

9. For each reaction that is spontaneous under standard condition, write a cell diagram, determine the standard cell emf, and calculate ΔG° for the reaction. [4 Marks] 4 Marks

(a) $2\ NO_3^-(aq) + 8\ H^+(aq) + 6\ Hg(l) \rightarrow 3\ Hg_2^{2+}(aq) + 2\ NO(g) + 4\ H_2O(l)$

(b) $2\ Hg^{2+}(aq) + 2\ Br^-(aq) \rightarrow Hg_2^{2+}(aq) + Br_2(l)$

10 A voltaic cell is constructed from an $Ni^{2+}(aq)/Ni(s)$ half-cell and an $Ag^+(aq)/Ag(s)$ half-cell. The initial concentration of Ni^{2+} in $Ni^{2+}(aq)/Ni(s)$ half-cell is 0.01M. The initial cell voltage is 1.12V. **(a)** By using data in annexure, calculate the standard emf of this voltaic cell. **(b)** Will the concentration of Ni^{2+} increase or decrease as the cell operates? **(c)** What is the initial concentration of Ag^+ in the Ag^+/Ag half-cell? 5 Marks

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NATIONAL INSTITUTE OF TECHNOLOGY GOA

Farmagudi, Ponda, Goa 403 401

1st yr
1st Sem

Programme Name: B.Tech

End Semester Examination, December-2018

Course Name: Chemistry **Course Code: CY150**
Date: 01/12/2018 **Time: 9:30 AM**
Duration: 3 hour 0 Minutes **Max. Marks: 100**

1. Answer all the questions
2. Answer for sub questions has to be labeled properly
3. Find reduction potential data as an annexure

1. Given the following equation for an electrochemical cell reaction — 6 Marks

$H_2(g) + PbSO_4(s) \rightleftharpoons 2H^+(aq) + SO_4^{2-}(aq) + Pb(s)$

Predict the effect of the following changes on the observed cell voltage:

(a) increase in size of Pb(*s*) electrode
(b) decrease in pH of cell electrolyte
(c) dilution of cell electrolyte with water
(d) dissolution of a small amount of NaOH(*s*) in the cell electrolyte

2. The measured voltage at 25°C of a cell in which the reaction described by the equation — 4 Marks

$$Co(s) + Sn^{2+}(aq, 0.18\ M) \rightleftharpoons Sn(s) + Co^{2+}(aq, 0.020\ M)$$

takes place at the concentrations shown is 0.168 V. Calculate the values of $E°$cell and the equilibrium constant (K), for the cell equation.

3. The measured voltage of the cell described by — 4 Marks

$$Pt(s)|H2(g, 1.00\ bar)|H^+(aq)||Ag^+(aq, 0.80\ M)|Ag(s)$$

is 0.915 V at 25°C. What would be the pH of the solution for this condition?

4. Beryllium occurs naturally in the form of beryl. The metal is produced from its ore by electrolysis after the ore has been converted to its oxide and then to the chloride. Calculate the maximum amount of Be(*s*) that can be deposited from a $BeCl_2(l)$ melt by a current of 5.0 amperes that flows for 1.0 hour. — 3 Marks

5. An oxide cell, involving a $Ag_2O(s)|Ag(s)$ cathode is used to power a wristwatch. The cell is estimated to last 1000 hours while drawing a current of only 0.10 mA. Calculate the mass of silver metal that will be produced over the lifetime of the cell. — 4 Marks

6. For the cell — 5 Marks

$Ag(s)|Br^-(aq)|AgBr(s)||Ag^+(aq)|Ag(s)$

write the cell equation and determine the solubility product constant of AgBr(*s*) in water at 25°C.

7. Two electrolytic cells are connected in series. One cell contains a solution of $AgClO_4(aq)$ and the other cell contains a solution of $Cd(ClO_4)_2(aq)$. An electric current is passed through the two cells until 0.876 grams of Ag(*s*) is deposited. How many grams of Cd(*s*) will be deposited in the same time? — 4 Marks

8. Using the data in appendix, determine the standard reduction potential at 25°C for the half-reaction equation — 4 Marks

$Ti^{4+}(aq) + 4e^- \rightarrow Ti(s)$

9. Describe cold soda lime process with proper diagram and chemical equations — 5 Marks

10. Describe zeolite process for water treatment with proper diagram and chemical equations. 5 Marks

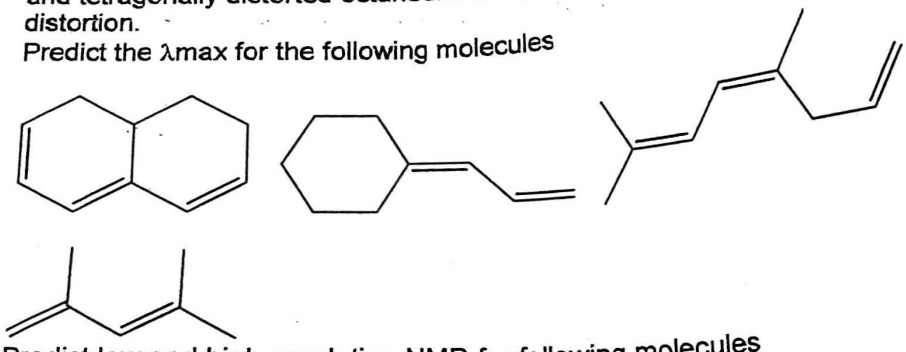
11. 6 ml of wastewater is diluted to 300 ml distilled water in standard BOD bottle. Initial DO in the bottle is determined to be 8.5 mg/l. DO after 5 days is found to be 5 mg/l. Determine BOD of wastewater 3 Marks

12. write the electron pair and predict the molecular structure of each of the following molecules or ions: **(a)** IF_3, **(b)** ClO_3^-, **(c)** I_3^-, **(d)** XeO_4 8 Marks

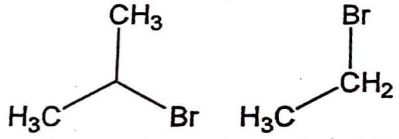
13. Draw the molecular orbital diagram for NO molecule and calculate the bond order and predict the magnetic property 5 Marks

14. Draw the relative energy level diagram of d orbitals in case of octahedral and tetragonally distorted octahedral complexes due to Jahn Teller distortion. 5 Marks

16. Predict the λmax for the following molecules 8 Marks



17. Predict low and high resolution NMR for following molecules 6 Marks

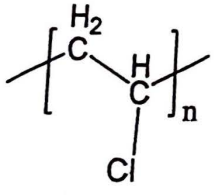


18. Predict the intensity ratio of EPR transition for an hypothetical molecule bearing one unpaired electron and 6 equivalent nuclei having I=1/2 each 3 Marks

19. A solution containing 5.24 mg/100 mL of compound A (MW: 335 g/mol) has a transmittance of 55.2% in a 1.50 cm cell at 425 nm. Calculate the molar absorptivity (ε) of compound A at this wavelength. 5 Marks

20. Describe the synthesis, properties and application of TEFLON 6 Marks

21. Write the free radical mechanism for the addition polymerization of 7 Marks



****ALL THE BEST****

Sem I/CY

Roll no								

NATIONAL INSTITUTE OF TECHNOLOGY GOA

[Goa College of Engineering Campus, Farmagudi, Ponda, Goa - 403 401.

Mid Semester Examination September 2012

Course Name: Chemistry **Course Code: CY100**

Branch: I B.Tech, Section: A, Date: 25/09/2012

Time: 9.30 - 11.00 am Duration: 1.30 min. Max. Marks: 50

Instructions: All questions are compulsory.

1. What is decomposition potential? How is it determined? What is its significance in electrolysis? (1 + 2 + 2) M

2. Explain the principle involved in electrolessplating. What are the advantages? Explain the electrolessplating of copper. (2 + 1 +2) M

3. Construct the following Batteries with detailed explanation.

   a. $Zn / (ZnCl_2), NH_4Cl / MnO_2, C$

   b. $Pb, PbSO_4 / H_2SO_4$ (aq) / PbO_2, Pb (2 + 3) M

4. Set up the electrochemical cell for the following reaction,

   $Fe^{3+}(aq) + Sn^{2+}(aq) \rightarrow Fe^{2+}(aq) + Sn^{4+}(aq)$

   And calculate the equilibrium constant for the reaction.

   $E°_{Fe^{3+}/Fe^{2+}} = 0.771V$, $E°_{Sn^{4+}/Sn^{2+}} = 0.151V$. (1 + 4) M

5. Calculate the potential of the cell Cr / Cr^{3+} (0.1 M) // Fe^{2+} (0.01 M) / Fe

   $E°_{Fe^{2+}/Fe} = -0.447$ V, $E°_{Cr^{3+}/Cr} = -0.744$ V 5M

6. a. Give reason for "Copper equipment should not posses steel bolt".

b. Can we use Aluminium in place of Zinc for cathodic protection of iron from rusting? Why? (Hint. Galvanic series)

c. Why Iron corrodes faster than Aluminium, even though iron is placed below aluminium in the electrochemical series? (2 + 1 + 1) M

7. What are the types of protective coatings? How do protective coatings help in controlling corrosion? (1 + 4) M

8. Write short notes on

a. Priming and Foaming.

b. Phosphate conditioning.

c. Caustic embrittlement (2 + 2 + 2) M

9. a. Describe the demineralization of water by ion-exchange method.

b. Mention the disadvantages of using hard water for any two industries (3 + 2) M

10. a. Differentiate between Lime soda process and Permutit process.

b. A sample of water is found to contain 40.5 mg/L $Ca(HCO_3)_2$, 46.5 mg/L $Mg(HCO_3)_2$, 27.6 mg/L $MgSO_4$, 32.1 mg/L $CaSO_4$ and 22.45 mg/L $CaCl_2$ Calculate the total hardness of water? [At Wt. Ca = 40, Mg = 24, C = 12, S = 32, O = 16, Cl = 35.5, H = 1] (3 + 2) M

--------All The Best--------

NATIONAL INSTITUTE OF TECHNOLOGY GOA

[Goa College of Engineering Campus, Farmagudi, Ponda, Goa - 403 401.

End- Semester Examination November- 2012

CY100: Chemistry

I – Semester, Sec-A **Max. Marks – 100** **Date: 27/11/2012**

Time – 10.00 AM -1.00 PM **Duration – 3hrs.**

Instructions: 1. All the questions are compulsory
2. Use pensile to draw diagram whenever it required.

1. **a)** What is meant by reverse osmosis? Explain the purification of water by reverse osmosis. **b)** Explain the softening of water by zeolite process. (5 + 5) M

2. **a)** Explain Czochralski crystal pulling technique. **b)** Give four important applications each of: **i.** Nano Carbon **ii.** Nano-ZnO **iii.** Nano-TiO_2 (4 +6) M

3. Write the monomers used in making, repeating units and two uses of the following

   a. Teflon **b.** Plexiglass **c.** UF **d.** SBR **e.** Silicone (5 x 2= 10) M

4. **a)** Explain why natural rubber needs Compounding. How is it carried out? **b)** What are the factors affecting Glass transition temperature? (2 + 5 + 3) M

5. **a)** The *e.m.f* of a cell Mg / Mg^{2+} (0.01 M) // Cu^{2+} (C_1) / Cu is measured to be 2.78V at 298K. Calculate the electrode potential of copper (E_{Cu}) electrode. $E°_{Mg^{2+}/Mg}$ = -2.371 V. **b)** Justify that "Zinc displaces hydrogen from acid but Copper does not". (5 + 2) M

6. Write short note on: **a)** Types of Electrodes. **b)** Lead-Acid battery. (4 + 4) M

7. What is electroless plating? Discuss the electroless plating copper on PCB? (2 + 8) M

8. Differentiate the following

   a. Colorimetry and Spectrophotometry.

   b. Qualitative and Quantitative analysis (5 + 5) M

9. Define Cracking. What is the necessity of cracking? Explain fluidized bed catalytic cracking. (1+ 2 + 4) M

10. Write a note on: **a)** Biodiesel **b)** Hydrogen as a source of energy. (4 + 4) M

11. Explain what type of corrosion occurs when **a)** Screw and washer are made of different metals, **b)** Presence of NaOH in mild steel boiler under stress.

    c) Write note on Galvanic series. (3 + 3 + 4) M

--------All The Best--------