**174A3**

**B**

Total Pages: **3**

Register No.: ................................... Name: ...............................................................

## SAINTGITS COLLEGE OF ENGINEERING
## KOTTAYAM, KERALA

(AN AUTONOMOUS COLLEGE AFFILIATED TO
APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY, THIRUVANANTHAPURAM)

### FIRST SEMESTER B.TECH DEGREE EXAMINATION(R), MARCH-APRIL 2021

Course Code:     **20CYT100**

Course Name:     **ENGINEERING CHEMISTRY**

Max. Marks:     **100**
             **Duration:    3 Hours**

### PART A
#### *(Answer all questions. Each question carries 3 marks)*

1. Differentiate between electrochemical & electrolytic cells.

2. Ca metal liberates $H_2$ gas from both acidic & basic solutions whereas Ni metal liberates $H_2$ gas from only acidic solutions. Examine the reasons. $E^0_{Ca} = -2.87$ V, $E^0_{Ni} = -0.25$ V

3. Explain with an example how IR spectroscopy can be used to distinguish between inter-molecular and intra-molecular hydrogen bonding.

4. Find the NMR active nuclei from the following and write the reason:-
   a) $^{14}_6C$     b) $^{15}_7N$     c) $^{24}_{12}Mg$     d) $^{29}_{14}Si$

5. What is retention factor? What are its applications?

6. Write any one method for synthesis of nanomaterials.

7. Sketch the Fischer projection formulae and find the R & S notation for the following compound.
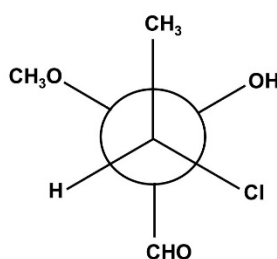


8. Comment on the functioning of OLED with a neat diagram.

9. A sewage water sample contains 60 mg of carbohydrate ($C_6H_{12}O_6$) per litre. Calculate the BOD of the sample.

10. Describe the principle of the method used to purify sea water for domestic purposes.

### PART B
#### *(Answer one full question from each module, each question carries 14 marks)*

#### MODULE I

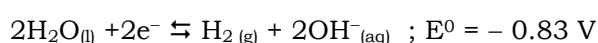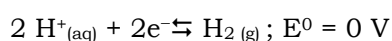11. a) Derive the expression relating EMF of a cell and concentration of electrolytes. A cell   (7) reaction is given by $A_{(s)} + B^{n+}_{(aq)} \leftrightarrows A^{n+}_{(aq)} + B_{(s)}$. Estimate the $E^0_{cell}$ and number of electrons n involved in the cell reaction. Given that concentration ratio of $A^{n+}$ to $B^{n+}$ is 0.2 and the cell shows an EMF of 3.074007 V at 30 °C and 3.074470 V at 40 °C.

b) Explain the working of a Li ion battery providing required chemical reactions. Li ion (7) batteries are not allowed to charge 100%. Summarize the reason.

**OR**

12. a) Differentiate between conductance and conductivity. Explain cell constant. Write (7) the reason for the following observation "alternating current is preferred in conductivity measurements".

b) Describe the chemical reactions occurring in the electrochemical corrosion of Fe in (7) oxygen rich & oxygen deficient acidic & alkaline conditions. "Mg corrodes in both acidic and alkaline oxygen deficient conditions, whereas Fe does not corrode in alkaline oxygen deficient condition". Examine the validity of this statement.

$Mg^{2+}_{(aq)} + 2e^- \leftrightarrows Mg_{(s)}$; $E^0 = -2.37$ V

$Fe^{2+}_{(aq)} + 2e^- \leftrightarrows Fe_{(s)}$; $E^0 = -0.44$ V

$2 H^+_{(aq)} + 2e^- \leftrightarrows H_{2\ (g)}$ ; $E^0 = 0$ V

$2H_2O_{(l)} + 2e^- \leftrightarrows H_{2\ (g)} + 2OH^-_{(aq)}$ ; $E^0 = -0.83$ V

**MODULE II**

13. a) Differentiate between the NMR spectrum of ethanol & 2-propanol. (7)

b) Explain the possible electronic transitions in a molecule giving one example each. (7) Sketch the instrumentation of a UV-Visible spectrometer and label the parts.

**OR**

14. a) Sketch the possible vibrations for $H_2O$. Which of these are IR active and why? $^1H^{19}F$ (7) shows an IR absorption at 4138 cm$^{-1}$. Find the force constant of the molecule. Given that 1 amu = $1.67 \times 10^{-27}$ kg and c = $3 \times 10^{10}$ cm s$^{-1}$.

b) Differentiate between $CH_3COOCH_2CH_3$ and $CH_3CH_2COOCH_3$ on the basis of NMR (7) spectroscopy.

**MODULE III**

15. a) Describe the chromatographic method for separation of a mixture of volatile organic (7) compounds.

b) Explain the principle & instrumentation of Thermo Gravimetric Analysis. How is (7) TGA used to study decomposition of polymers?

**OR**

16. a) Describe the chromatographic method for separation of a mixture of non-volatile (7) organic compounds.

b) Explain the principle & instrumentation of Differential Thermal Analysis. How is (7) DTA used to study decomposition of calcium oxalate monohydrate?

**MODULE IV**

17. a) Sketch the conformations and energy level diagram for n-butane. (7)

b) Describe the classification of conducting polymers and explain the preparation of (7) polyaniline.

**OR**

18. a) Sketch the conformations for 1,3-dimethyl cyclohexane. Compare the stability of (7) these conformers and write reasons.

b) Describe the synthesis of Kevlar. Explain any three exceptional properties of Kevlar (7) on the basis of its structure.

# 174A3

## MODULE V

19. a) Why is $CaCO_3$ chosen as a standard for measuring hardness? Write the formulae to obtain the $CaCO_3$ equivalent of a hardness producing substance. Calculate the temporary and permanent hardness of a water sample containing 160 mg/L calcium ions, 120 mg/L magnesium ions, 244 mg/L bicarbonate ions, 71 mg/L chloride ions and 92 mg/L sodium ions. (7)

   b) What are the steps in sewage water treatment? Compare aerobic and anaerobic treatment methods. (7)

### OR

20. a) Explain the principle of estimation of hardness using EDTA. 7.3 g of EDTA was dissolved in 1L water (calculate molarity of EDTA using molecular weight as 292 g/mol). 100 mL hard water sample required 40 mL of this EDTA and 100 mL of boiled hard water required 25 mL of this EDTA in a titration. Calculate the total and permanent hardness of the water sample. (7)

   b) Explain the method to soften hard water using ion exchange process. Differentiate between cation exchange and anion exchange resins. Explain the chemistry behind regeneration of ion exchange resins. (7)

\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*\*