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## P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

**First Semester, B.E. - Semester End Examination; Dec - 2017/Jan - 2018**

### Engineering Chemistry (Common to all Branches)

Time: 3 hrs

Max. Marks: 100

*Note: Answer FIVE full questions, selecting ONE full question from each unit.*

#### UNIT - I

- 1 a. Define GCV and NCV. Illustrate the determination of calorific value of gaseous fuel using Buoy's calorimetric method. 7
- b. What is knocking? Outline its ill effects and explain the prevention of knocking by leaded and unleaded petrol. 7
- c. Evaluate the GCV and NCV of a solid fuel using the following data : 6
- |   |  |
|---|--|
| i) Mass of fuel taken = $5 \times 10^{-3}$ kg                         | ii) Mass of water taken = 2.5 kg                 |
| iii) Water equivalent of calorimeter = 0.7 kg                         | iv) Raise in temperature = $4.7^{\circ}\text{C}$ |
| v) % of $\text{H}_2$ in a fuel = 3.7%                                 | vi) Latent heat of steam = 587 kcal / kg         |
| vii) Specific heat of water = $4.187 \text{ kJ/kg}^{\circ}\text{C}$ . |  |
- 2 a. State Phase rule. Explain the terms involved in it with example. 7
- b. Draw and illustrate the phase diagram of two component system. 7
- c. Define Octane number and Cetane number. Outline the reformation of petrol. 6

#### UNIT - II

- 3 a. Explain the construction, working and applications of  $\text{Zn-Ag}_2\text{O}$  battery. 7
- b. Outline the limitations of primary reference electrode. Explain the construction and working of calomel electrode. 7
- c. A cell is formed by dipping nickel rod in 0.01 M  $\text{Ni}^{2+}$  solution and lead rod in 0.5 M  $\text{Pb}^{2+}$  solutions. The standard electrode potentials of Ni and Pb are -0.24 V and -0.13 V respectively. Write the cell representation, half cell and net cell reaction and estimate the emf of cell. 6
- 4 a. Characterize the following properties of battery : 7
- |                 |                       |
|-----------------|-----------------------|
| i) Capacity     | ii) Energy efficiency |
| iii) Cycle life | iv) Shelf life.       |
- b. Explain the construction, working and applications of Nickel-Metal hydride battery. 7
- c. Demonstrate the construction, working and applications of  $\text{H}_2\text{-O}_2$  fuel cell. 6

#### UNIT - III

- 5 a. Define corrosion. Discuss the electrochemical theory of corrosion. 7

- b. Outline the following factors affecting the rate of corrosion :
- |                    |                               |   |
|--------------------|-------------------------------|---|
| i) Nature of metal | ii) Anodic and cathodic areas | 7 |
| iii) pH            | iv) Temperature.              |   |
- c. Explain the corrosion prevention by corrosion inhibitors. 6
- 6 a. Examine the electroplating of chromium by sulphate method. 7
- b. Outline the advantages of electroless plating and demonstrate the electroless plating of copper on PCB. 7
- c. What is stress corrosion? Discuss the caustic embrittlement in boilers. 6

#### UNIT - IV

- 7 a. What is glass transition temperature (T<sub>g</sub>)? Outline the factors affecting on T<sub>g</sub> and significance of T<sub>g</sub>. 7
- b. Discuss the synthesis and applications of the following polymers :
- |         |                   |              |   |
|---------|-------------------|--------------|---|
| i) PMMA | ii) Poly-urethane | iii) Kevlar. | 7 |
|---------|-------------------|--------------|---|
- c. Explain the significance of lubricants. 6
- 8 a. What is conducting polymer? Explain the synthesis and mechanism of conduction in P-doped poly acetylene. 7
- b. Define Lubricant. Illustrate the following properties of Lubricant :
- |                    |                 |                 |   |
|--------------------|-----------------|-----------------|---|
| i) Viscosity Index | ii) Cloud point | iii) Pour Point | 7 |
| iv) Flash Point    | v) Oiliness.    |                 |   |
- c. Discuss the synthesis and applications of the following :
- |                 |                  |   |
|-----------------|------------------|---|
| i) Butyl rubber | ii) Epoxy resin. | 6 |
|-----------------|------------------|---|

#### UNIT - V

- 9 a. What are liquid crystals? Summarize the Nematic and Cholesteric mesophases. 7
- b. Justify the applications of liquid crystals in display systems and thermography. 7
- c. Discuss the bottom up and top down approach of synthesis of nano particles. 6
- 10 a. Define boiler scale and sludge. Discuss the prevention of boiler scales by the following internal treatment :
- |                        |                             |   |
|------------------------|-----------------------------|---|
| i) Calgon conditioning | ii) Phosphate conditioning. | 7 |
|------------------------|-----------------------------|---|
- b. What is desalination? Illustrate the desalination of sea water by electro dialysis. 7
- c. Define COD. 25 ml of sewage water reacted with 25 ml of K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> solution and unreacted K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> requires 8.0 ml of 0.25 N FAS. Blank titration requires 15.0 ml of 0.25 N FAS under similar conditions. Evaluate the COD of sewage water. COD is greater than BOD, justify. 6