PRANVEER SINGH INSTITUTE OF TECHNOLOGY, KANPUR

Even Semester   Session: 2021-22   Pre-University

B. Tech. II Semester

Engineering Chemistry (KAS-202T)

CO Number	Course Outcome (Please include all COs of your Course here)
CO1	To define (Knowledge L-1) and to cite (Knowledge L-1) general definitions, terms and laws in engineering chemistry.
CO2	To describe (Comprehension L-2) principle and working of different apparatuses and chemical processes used in engineering.
CO3	To apply (Application L-3) different chemical formulae in order to calculate (Application L-3) the amount or volume of materials required in various chemical processes and to solve (Application L-3) related numerical problems competently by identifying the essential part of a problem and formulating a strategy for solving the problem .
CO4	To analyze (Analysis L-4) different chemistry topics and their relevancy in the engineering field and to differentiate (Analysis L-4) the relative terms used in chemistry.

Time: 03 Hrs.   M. M. 100

Section-A

Q1. Attempt all questions: (2X10 =20 Marks)

a) Find bond order by writing the electronic configuration of O_2^{2+}.   CO1

b) Discuss the polymer blends.   CO2

c) Explain, which one will exhibit higher value of λ_{max} in UV-Visible spectra of CH_3COCH_3 CO2
    and $CH_2=CHCOCH_3$.

d) Calculate the temporary and permanent hardness of water having following dissolved   CO3
    salts: $Ca(HCO_3)_2$= 180 mg/L; $Mg(HCO_3)_2$= 205 mg/L; $CaSO_4$ = 115 mg/L and $MgCl_2$ =
    100 mg/L.

e) Show that Be_2 molecule does not exist on the basis of MOT.   CO1

f) Explain why smectic liquid crystals have lesser flowing properties than nematic liquid   CO2
    crystals?

g) Illustrate the approaches used for the preparation of nanomaterials.   CO4

h) Determine the degree of freedom for decomposition of calcium carbonate.   CO3

i) Explain Why does part of a nail inside the wood undergoes corrosion easily?   CO2

j) Calculate number of calories and centigrade thermal units in 26 British thermal units.   CO3

Section-B

Q2. Attempt all questions.   (10X3 = 30 Marks)

a) Illustrate phase rule and explain the various terms involved in it. Apply phase rule on   CO4
    one component system.

b-(i) Discuss ion exchanger method for the removal of hardness of water with the help of   CO2
    neat sketch; also give the synthesis of ion-exchanger resin. Compare its merits over
    zeolite process.

OR

(ii) Explain the zeolite process for water softening with the help of neat and clean diagram   CO2
    and suitable reactions. Also explain its regeneration along with the advantages and
    disadvantages. An exhausted zeolite softener was regenerated by passing 2500 L of NaCl
    (150 grams per liter) solution. Find the hardness of a water sample, if its 3500 liter can be
    softened by using this zeolite softener till it again get exhausted.

c i) Interpret the quantum theory of Raman spectroscopy and how the Stokes and anti   CO3
    Stokes lines appear in the Raman Spectroscopy? How does it differ from IR
    spectroscopy?

OR

(ii) Interpret various types of electronic transitions involved in UV- visible spectroscopy.
    Explain the absorption and intensity shift in the UV spectroscopy; also give some   CO3
    applications of this technique.

Section-C

(10X5 = 50 Marks)

Q3. Attempt all questions:

a i) Interpret linear combination of atomic orbitals; also draw the MOT diagram of CO   CO3
molecule and O_2^- molecular ion and calculate their bond order and predict magnetic
behavior.

OR

ii) Interpret the structure of graphite; also explain its lubricating and conducting properties   CO3
and tell why carbon-carbon bond length in graphite is intermediate of carbon-carbon
single and double bond length?

CO2

b i) Discuss the synthesis, properties and application of the following polymers
PVC, Teflon, PAN, Terylene, Nylone-6,6.

OR

ii) Discuss construction and working of galvanic cell by giving suitable diagram and   CO2
reactions. The emf of a Weston cell is 1.018 V at 293K. Its temperature coefficient is 2.1
$\times 10^{-5}$ VK^{-1}. Calculate change in enthalpy, change in entropy and change in Gibbs free
energy for this cell.

c i) Articulate Stoichiometric and non-Stoichiometric defects with examples.   CO3

OR

ii) Articulate the liquid crystalline state, classify them and give their important applications.   CO3

d i) Discuss the estimation of carbon, hydrogen and sulphur in ultimate analysis of coal.   CO2
Calculate the weight and volume of air required for complete combustion of 1 Kg of a
coal sample having C= 78%, H= 4%, O= 6% N= 5% and rest is ash.

OR

ii) Discuss electrochemical theory of corrosion by hydrogen evolution and oxygen   CO2
absorption mechanism. Calculate the EMF of the following cell·at 35°C and also write
the cell reactions.

$$Ni(s) / Ni^{2+} (0.01M) \| Cu^{2+} (0.1M) / Cu(s)$$

Given E° of Ni^{2+}/Ni = -0.25 V and Cu^{2+}/Cu = +0.34 V (R = 8.31JK^{-1} mol^{-1}, F= 96500C)

e i) Illustrate biodegradable and conducting polymers on the basis of their synthesis,   CO4
classification and examples.

OR

ii) Illustrate the construction and working of Bomb Calorimeter for the estimation of higher
calorific value of a solid fuel. The following data is obtained in Bomb calorimeter   CO4
experiment: weight of Crucible = 2.65 g, weight of crucible + fuel = 4.55g, water
equivalent of calorimeter 300g, water taken in calorimeter = 4500 g, observed rise in
temperature = 1.4°C, cooling correction= 0.05°C, fuse wire correction =15 cal, cotton
thread correction = 33 cal. Calculate the gross and net calorific value of the sample if the
fuel contains 6% hydrogen. Assume latent heat of condensation of steam is 580 cal/g.

B. Tech. I Semester
Engineering Chemistry (KAS-102T)

CO Number	Course Outcome (Please include all COs of your Course here)
CO1	To define (Knowledge L-1) and to cite (Knowledge L-1) general definitions, terms and laws in engineering chemistry
CO2	To describe (Comprehension L-2) principle and working of different apparatuses and chemical processes used in engineering.
CO3	To apply (Application L-3) different chemical formulae in order to calculate (Application L-3) the amount or volume of materials required in various chemical processes and to solve (Application L-3) related numerical problems competently by identifying the essential part of a problem and formulating a strategy for solving the problem .
CO4	To analyze (Analysis L-4) different chemistry topics and their relevancy in the engineering field and to differentiate (Analysis L-4) the relative terms used in chemistry.

M. M. 100

Time: 03 Hrs.

Section-A
(2X10 =20 Marks)

Q1. Attempt all questions:

a) Show that He_2 molecule does not exist on the basis of MOT.   *large dis*   CO1

b) Discuss the conducting and lubricating property of graphite.   CO2

c) Distinguish ethanol and acetone on the basis of IR spectroscopy.   CO4

d) Calculate the temporary and permanent hardness of water having following dissolved salts present in water sample: $Ca(HCO_3)_2 = 300$ mg/L; $Mg(HCO_3)_2 = 555$ mg/l; $CaSO_4 = 210$ mg/L and $Mg(NO_3)_2 = 100$ mg/L.   CO3

e) Differentiate between GCV and NCV of a fuel.   CO2

f) Find bond order by writing the electronic configuration and of N_2^-.   CO1

g) Discuss the polymerization reaction of Teflon and Terylene.   CO2

h) Differentiate between the thermoplastic and thermosetting polymers.   CO2

i) Explain the importance of salt bridge for a galvanic cell.   CO2

j) Calculate the number of degree French and degree Clarke in 368 calories.   CO3

Section-B
(10X3 = 30 Marks)

Q2. Attempt three questions. Question No 2(a) is compulsory:

a) Illustrate phase rule and define the various terms involved in it. Apply phase rule on water system, also explain meta-stable curve in the diagram.   CO3

b-(i) Discuss linear combination of atomic orbitals, also differentiate between bonding and antibonding molecular orbitals along with sigma and pi bonds.   CO2

OR

(ii) Explain the structure of fullerene. Give its synthesis, properties and application.   CO2

c i) Interpret the various modes of vibrations in IR spectroscopy by considering the examples of AB_2 type molecule also explain various regions of an IR spectrum and give its important applications.   CO3

OR

(ii) Illustrate the basic principle of UV visible spectroscopy; also explain various types of electronic transition and UV-shifts observed in this spectroscopic technique.

a i) Interpret the zeolite process for the removal of hardness of water with the help of neat and clean diagram and suitable reactions. Also give the importance of regeneration along with the advantages and disadvantages of this process. An exhausted zeolite softener was regenerated by passing 3000 L of NaCl (50 grams per liter) solution. Find the total volume of a water sample (550ppm hardness) which can be softened by using this zeolite softener till it again get exhausted.

CO3

OR

ii) Interpret lime soda process for water softening. Calculate the amount of lime(80% pure) and soda(90% pure) required for the softening of 45000L of water with following analysis: $Ca(HCO_3)_2 = 450$ mg/L, $Mg(HCO_3)_2 = 222$, $CaSO_4 = 545$ mg/L, $MgSO_4 = 200$ mg/L, $MgCl_2 = 90$ mg/L, $NaCl = 217$ mg/L, $KCl = 300$ mg/L.

CO3

b i) Discuss the construction and working of Bomb Calorimeter for the estimation of higher calorific value of a solid fuel. The following data is obtained in Bomb calorimeter experiment: Weight of Crucible = 3.649 g, weight of crucible + fuel = 4.678g, water equivalent of calorimeter 505g, water taken in calorimeter = 2303 g, observed rise in temperature = 2.1°C, cooling correction= 0.03°C, acid correction = 23.6 cal, fuse wire correction =28 cal, cotton thread correction = 6 cal. Calculate the gross and net calorific value of the sample if the fuel contains 9% hydrogen. Assume latent heat of condensation of steam is 580 cal/g.

CO2

OR

ii) Discuss the proximate analysis of coal. Calculate the weight and volume of air required for complete combustion of 1 m^3 of a gaseous fuel having following composition by volume; $H_2 = 5\%$; $CH_4 = 25\%$; $C_2H_6 = 10\%$, $C_4H_{10} = 15\%$, $CO = 9\%$; $CO_2 = 8\%$; and rest is nitrogen.

CO2

c i) Articulate the elastomers with examples and explain the stereo-specific structure of natural rubber. Give the drawbacks of natural rubber and how it can be improved by using vulcanization treatment.
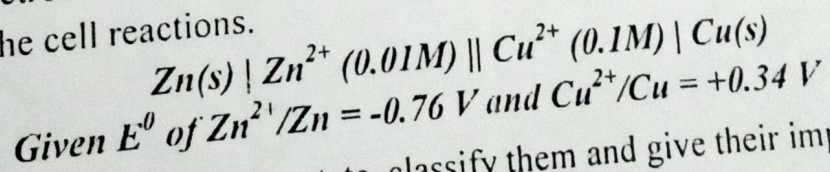
CO

OR

ii) Articulate the conducting and biodegradable polymers on the basis of their synthesis, classification and examples.

C

d i) Discuss the construction and working of lead storage battery by giving suitable reactions during discharging and charging. The emf of a Weston cell is 1.018 V at 293K. Its temperature coefficient is 3.1×10^{-5} VK^{-1}. Calculate change in enthalpy, change in entropy and change in Gibbs free energy for this cell.

OR

ii) Discuss electrochemical theory of corrosion. Calculate the EMF of the following cell and also write the cell reactions.

$$Zn(s) \mid Zn^{2+} (0.01M) \parallel Cu^{2+} (0.1M) \mid Cu(s)$$

Given E^0 of $Zn^{2+}/Zn = -0.76$ V and $Cu^{2+}/Cu = +0.34$ V

e i) Illustrate the liquid crystalline state, classify them and give their important applications.

OR

ii) Illustrate the organometallic compounds. Give their classification and importa applications.

→ Phase h
→ Spectro
→ coo