PRANVEER SINGH INSTITUTE OF TECHNOLOGY, KANPUR

Odd Semester Session 2023-24 CT-I

B. Tech-I Semester

Engineering Chemistry (BAS102)

CO Number	Course Outcome(s)
CO1	To define (Remember L-1) and to cite (Remember L-1) general definitions, terms and laws in engineering chemistry.
CO2	To describe (Understand L-2) principle and working of different apparatuses and chemical processes used in engineering.
CO3	To apply (Apply L-3) different chemical formulae in order to calculate (Apply L-3) the amount or volume of materials required in various chemical processes and to solve (Apply 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: 1.5 Hrs. M. M. 20

Section-A

Q1. Attempt all questions: **(1X5 = 5 Marks)**

a) Show Bonding molecular orbital is more stable than Anti bonding molecular Orbital. CO1

b) Calculate hardness produced by 408 mg/L of $CaSO_4$ in terms of $CaCO_3$ equivalents. CO3

c) State why graphite can be used in the dry cell.? CO1

d) Show that the nature of O_2 is paramagnetic, while as N_2 is diamagnetic. CO2

e) Define scale and sludge produced while treatment of hard water. CO1

Section-B

Q2. Attempt all questions: **(2.5X4 = 10 Marks)**

a i) Discuss the formation of HCl molecule on the basis of molecular orbital theory (MOT). CO2

Or

ii) Discuss the structure, properties and applications of Graphite. CO2

b i) Describe and compare the following in increasing order of their bond order and predict their stabilities: NO, NO^{2+} and CN^- CO2

Or

ii) Describe Linear Combination of Atomic Orbitals (LCAO), also draw the molecular orbital diagrams of CO and O_2 molecules, calculate their bond order and predict magnetic behavior. CO2

c i) Discuss Smectic and Nematic type of liquid crystals and also explain their various technological applications. CO2

Or

ii) Discuss various boiler feed problems of hard water and describe the following; Caustic Embrittlement, priming & foaming caused due to use of hard water in boilers. CO2

d i) Compute various types of alkalinity present in the alkaline water sample in ppm $CaCO_3$ equivalent, if 100 mL of water sample consumed 15 mL of 0.02 N H_2SO_4 in the presence of phenolphthalein indicator. The resulting solution consumed another 35 mL of the same acid in the presence of methyl orange indicator. CO3

Or

ii) Compute temporary and permanent hardness of a water sample which was analyzed as follows; Mg $(HCO_3)_2$ = 251 mg/L, Ca $(HCO_3)_2$ = 355 mg/L, $CaSO_4$ = 165 mg/L and $MgCl_2$ =215 mg/L, NaCl= 155mg/L. CO3

Section-C

Q3. **(5X1 = 5 Marks)**

i) Illustrate deionization of water, how cation and anion exchange resins are used for water softening. Give their structure, process reactions and advantages to remove hardness of water. CO4

Or

ii) Illustrate the Zeolite process for softening of hard water by giving suitable diagram and reactions also give the regeneration, advantage and disadvantages. A zeolite softener was 65% exhausted by removing the hardness completely, when 20,000 L of hard water was passed through it. The exhausted zeolite bed was required 455 L of NaCl solution of strength 255 gr. NaCl/L of solution for regeneration, calculate the hardness of water. CO4