Engineering Chemistry
(CH-101, Dec-07)

Note: Section A is Compulsory. Attempt any five questions from Section B and C taking at least two questions from each Section.

Section-A

1. (a) Iron does not rust when zinc coating is broken in a galvanized iron pipe but rusting occurs if a coating of tin over iron is broken?
   (b) What is Calgon conditioning of boiler feed water?
   (c) What is the importance of IR spectroscopy in finger print region?
   (d) Why is TMS used as an internal standard in NMR spectroscopy?
   (e) What is chemiluminescence? Give examples.
   (f) What are eutectics? Give an example.
   (g) The standard EMF of the Daniell cell involving cell rection
   $Zn(s) + Cu^{+2}(aq) \leftrightarrow Zn^{+2}(aq) + Cu(s)$ is 1.10 volts. Calculate the equilibrium constant of the cell reaction at 25°C.
   (h) What is R_f value in chromatography?
   (i) Why does hard water consumes a lot of soap?
   (j) Why are electronic absorption bands generally broad as compared to infra red?

Section-B

2. (a) Describe the ion exchange process of softening hard water. What are its advantages?
   (b) Calculate the amount of lime (91%pure) and soda (97.2% pure) required for softening one million litres of water containing:
   H^+(free acidity) = 1.5 ppm; HCO^-_3 = 396.5 ppm; Mg^{+2} = 42 ppm; Ca^{+2} = 90 ppm;
   $FeSO_4.7H_2O$ = 14ppm.
   (Given atomic masses of H=1, Ca=40, Mg=24, O=16, C=12, S=32, Fe=56)
3. (a) Describe various methods employed for protection of metals from corrosion.
   (b) explain briefly (i) Galvanic cell corrosion (ii) Pitting corrosion
4. (a) What are various classes of chromatography? Bring out clearly the principles involved in each case.
   (b) Write short notes on (i) Liquid chromatography (ii) Vapor phase chromatography
5. (a) What are secondary cells? Describe the construction of one secondary cell. Write the cell reactions and mentions its uses.
   (b) A cell consists of two hydrogen electrodes. The negative electrode is in contact with a solution of 10^{-6}M hydrogen ions. The EMF of the cell is 0.118V at 25°C. Calculate the concentration of hydrogen ion at the positive electrode.

Section-C

6. (a) Explain photosensitization and quenching by taking suitable examples.
   (b) What are lasers? Explain laser action with reference to a three energy level laser and a four energy level laser. Discuss briefly the practical uses of lasers.
7. (a) State and illustrate with suitable potential energy curves the Franc-Condon principle in the vibronic spectrum of a diatomic molecule.
   (b) A substance when dissolved in water at 10^{-3}M concentration absorbs 10 percent of an incident radiation in a path of 1 cm length. What should be the concentration of the solution in order to absorb 90 percent of the same radiation?
   (c) Define wave number. What are its units?
8. (a) What are the advantages of taking of NMR spectrum at more than one radiofrequency?
   (b) Write brief notes on
   (i) Chemical shift (ii) Spin-spin coupling
   (c) How will you verify that a particular signal in NMR spectrum arises from –OH, -NH or –SH groups?
9. (a) Draw and discuss the phase diagram for carbon dioxide system. In what respect does this system differ from the water system?
   (b) Liquid A and B form and ideal solution obeying Raoult's law. At 50°C the total pressure of a solution containing 1 mole of A and 2 moles of B is 300 torr. When 1 mole of A is added to the solution, the total vapor pressure increases to 400 torr. Calculate the vapor pressure of the pure components.