Engineering Chemistry
(CH-101, May.2007)

Time: 3 Hours Max. Marks: 60

Note: Question No. 1 is compulsory. Attempt five questions from section A and B, taking at least two questions from each section.

Section-A

1. (a) Explain why blocks of magnesium are often stripped to the steel hulls of ocean-going ships?
   (b) What is colloidal conditioning of boiler feed water?
   (c) What is the importance of IR spectroscopy in finger print region?
   (d) How will you verify that a particular signal in NMR spectrum arises from –OH, -NH or –SH groups?
   (e) How does temperature affect rate of photosynthesis in plants?
   (f) A substance Z has its triple point at 18ºC and 0.5 atm., its normal melting and boiling points are 20ºC and 300ºC respectively. Sketch the schematic phase diagram for Z.
   (g) For a cell reaction A(s) + 2B (aq) → A^{2+} (aq) + 2B (s) at 298 K, the equilibrium constant is 1.0 x 10^4. Calculate E^0_{cell}.
   (h) What is R_f value in chromatography?
   (i) Why does $Mg(HCO_3)_2$ require double amount of lime for softening?
   (j) What is UV spectrum? Give various regions associated with UV spectrum.

Section-B

2. (a) What are lime and soda? Compare hot and cold soda lime process for softening of hard water.
   (b) Calculate the amount of lime (84%pure) and soda (92%pure) required for treatment of 20,000 litres of water whose analysis is as follows:
   $Ca(HCO_3)_2$ = 40.5 ppm; $Mg(HCO_3)_2$ = 36.5 ppm; $MgSO_4$ = 30 ppm; $CaSO_4$ = 34 ppm; $CaCl_2$ = 27.75 ppm; NaCl = 10 ppm. Also calculate temporary and permanent hardness of water sample.
   [Given atomic masses of H = 1, Na = 23, Ca = 40, Mg = 24, O = 16, C = 12, S = 32, Cl = 35.5]
   (c) What is demineralized water? How is it different from soft water?
3. (a) Discuss the importance of design and material selection in controlling corrosion.
   (b) Discuss briefly
      (i) Galvanic corrosion
      (ii) Stress corrosion
   (c) Why steel does not rust if covered with ice?
4. (a) What are various classes of chromatography? Bring out clearly the principles involved in each case.
   (b) Write short notes on the following:
      (i) Liquid chromatography
      (ii) Vapour phase chromatography
5. (a) What is Nernst equation? Write its applications.
   (b) The e.m.f. of the cell reaction $3Sn^{4+} + 2Cr \rightarrow 3Sn^{2+} + 2Cr^{3+}$ is 0.89V. Calculate the standard free energy change for the reaction.

Section-C

6. (a) State and explain Einstein's law of photochemical equivalence.
   (b) Describe and discuss Jablonski diagram for depicting various photo processes.
   (c) Write a short note on lasers and their uses.
7. (a) Define the term bath chromic shift and hypsochromic shift. What structural feature may produce bath chromic of a hypsochromic shift in an organic compound?
   (b) In an absorption cell, the transmittance of 0.1M solution of a substance X is 80% and that of 0.1 M solution of another substance Y is 60% at a given wavelength. What is the transmittance of solution that is simultaneously 0.1M in X and 0.1 M in Y.
   (c) Using IR spectroscopy, how will you determine whether the oxygen in an organic compound is present as a carbonyl or hydroxyl group?
8. (a) How will you distinguish primary, secondary and tertiary alcohols on the basis of PMR spectroscopy?
   (b) Write brief notes on the following
   (i) Chemical Shift
   (ii) Spin-spin coupling

(iii) Coupling constant

9. (a) State Gibbs phase rule and explain the terms involved in it.
   (b) Discuss the application of phase rule to potassium iodide-water system. Explain the formation of freezing mixtures by addition of suitable salts to ice.