Ref. No.: Ex/CON/Chem/T/115/2019 (Old)

BACHELOR OF CONSTRUCTION ENGINEERING EXAMINATION, 2019 (Old)

(1st Year, 1st Semester)

CHEMISTRY

Time: Three hours **Full Marks: 100**

(50 marks for each part)

Use a separate answer script for each part

PART – I

Answer Question. no. 1 and any two from the rest.

1.

(a) (i) Create the expression for the electrode potential $\phi_{PbO_2/Pb^{2+}}$ for the reaction

$PbO_2 + 4H^+ + 2e^- \rightarrow Pb^{2+} + 2H_2O$. [Given $\phi^0_{PbO_2/Pb^{2+}} = 1.45$ V]. 3

(ii) What would be the effect of pH on $\phi_{PbO_2/Pb^{2+}}$ during the course of the reaction. 1

(b) (i) What is the value of ΔG for a system at equilibrium? 1

(ii) Derive the Nernst equation for electrode potential from suitable assumptions. 2

(c) Explain why pH is a temperature dependent parameter. 2

(d) Define "Common-ion Effect". The solubility product of CaF_2 is 4×10^{-12}. What will be the solubility of CaF_2 in a 0.1M NaF solution? (1 + 1½)

(e) Why is spectroscopy an essential component of chemical investigations today? 2

(f) Mention some of the informations we get from UV-Vis and IR spectroscopy for a molecule of your choice. 2

(g) Define "Corrosion of metals". Why do metals corrode? (1½ + 1)

2.

(a) Mention the modifications that are required for a proper estimation of Fe^{2+} by $KMnO_4$ in a medium having a high concentration of Cl^-. Why are these modifications not required when the oxidizing agent is $K_2Cr_2O_7$? (3 + 1½)

(b) Define pH, pOH and pK_w. Why were these parameters introduced to express strengths of weak electrolytes? (1½ +1)

(c) With the help of UV-Vis spectroscopy explain how conjugated and isolated double bonds are identified in a molecule. 4

(d) What are alloy steels? Discuss two different types of such steel mentioning their compositions and an application of each. (1 + 2 + 2)

3.

(a) You are provided with electrode potentials, $\phi^0_{Cu^{2+}/Cu^+} = 0.17$ V and $\phi^0_{I_2/I^-} = 0.54$ V. Explain how iodine is liberated when Cu^{2+} reacts with I^- according to the reaction

$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$. [Given: Solubility product of CuI is 1.1×10^{-12}] 2½

(b) Deduce Ostwald dilution law for the dissociation of a weak acid and state its significance. (2 + 1)

(c) With proper energy diagrams discuss different types of electronic transitions possible in a molecule of your choice. Indicate the energies involved and region of the electromagnetic spectrum where it occurs. (1½ + 2)

(d) With proper experimental evidence show that corrosion of metals is an electrochemical process. 2½

(e) Explain any three of the following: (1½ × 3 = 4½)

(i) λ_{max} (ii) Nitriding of Steel (iii) Annealing of Steel (iv) Atmospheric corrosion

4.

(a) Derive the Henderson equation for a basic buffer. Using it explain mechanism of buffer action on a basic buffer when H^+ and OH^- are separately added to it. (2 + 2)

(b) Distinguish clearly between a buffer solution and a solution that is not a buffer? 3

(c) A solution of formic acid is 2% dissociated at 25°C. If K_a is 1.8×10^{-4}, find the molarity of formic acid and concentration of H^+ in solution. What would be the pH of such a solution? (2 + 1½)

(d) Explain the utility of infra-red spectroscopy in chemical analysis. 2½

(e) Briefly explain corrosion due to differential aeration. 3

B. CONS. ENGG. 1ST YR 1ST SEM. EXAM.-2019 (Old)

Subject: Chemistry **Time: Three hours** **Full Marks: 100**

(50 marks for each part)

PART-II

Use a separate Answer script for each part

Answer ***any five*** questions 5×10

1.a) Draw a labeled diagram of a rotary kiln used for the manufacture of Portland cement by wet process, describe the process and discuss the various reactions involved. 10

2. Write notes on 5+5

a) Additive for cement

b) Chemical and Constitutional compounds in cement

3. a) Define and discuss 'setting' and 'hardening' of Portland cement with relevant chemical reactions involved.

b) How can you compute the amounts of constituent compounds in cements? 6+4

4. Match the following 10

Group A	**Group B**
i) ppm	a) Ion exchanger
ii) High alumina cement	b) Lowest ultimate strength
iii)Argillaceous material	c) Superior chemical resistance to sea water
iv) Zeolite	d) Retarder
v) Tricalcium silicate	e) Chalk
vi)Tetracalcium silicate	f) Cement + sand + coarse aggregates
vii) Concrete	g) Complexometric indicator
viii) Gypsum	h) $CaCO_3$ equivalent
ix) Eriochrome Black T	j) Shale
x) Calcareous material	k) Flash set

5. (a) What do you mean by temporary and permanent hardness of water? What is the unit of hardness of water? Give chemical reactions involved during heating hard water.

(b) Calculate temporary and total hardness of a water sample having

$CaSO_4 \equiv 136$ mg/l

$KCl \equiv 512$ mg/l

$NaHCO_3 \equiv 78$ mg/l

$Mg(HCO_3)_2 \equiv 292$ mg/litre

$MgCl_2 \equiv 190$ mg/litre

$Ca(HCO_3)_2 \equiv 324$ mg/litre

Given atomic weight: Ca = 40, Mg =24, Na = 23, K = 24 Cl = 35.5, C = 12, H = 1, O =16, S = 32

5+5

6. a) Discuss elaborately about lime-soda process for softening of water.

b) Write down properties of synthetic ion-exchange resins for effective water treatment.

Discuss about reactions involved in softening of water by ion-exchange method. 4+6