Mid-Term Examination, February 2021

First Semester [B.Tech.]

Applied Chemistry

Time: 1 hour   M.M. 30

Note: Attempt any two questions out of three.

Q1. Attempt **any five** parts:

(a) A good fuel should have high calorific value, moderate ignition temperature and low moisture content. Why?

(b) The ultimate analysis of a coal sample gave the following results: C=84%, H=5.5%, O=8.4% and S= 1.5%. Calculate the gross and net calorific value of this coal sample.

(c) Octane number of cracked gasoline is higher than that of straight run gasoline. Explain why?

(d) Name any two catalysts that can be used to bring about the catalytic cracking of heavy oils. What are some of the advantages offered by catalytic cracking over thermal cracking?

(e) A sample of coal was analysed as follows: 5 g of the sample dried at 110 °C to a constant weight left a moisture free residue of 4.80g. On further heating out of contact with air to about 900 °C, in a crucible with a vented lid to drive off all the volatile matter, a residue of 3.38g of coke was obtained. On heating the crucible strongly in air with an open lid, a residue of 0.075g was obtained. What is the proximate analysis of this coal sample?

(f) 0.5g of a sample of coal was used in a bomb calorimeter. The ash formed was extracted with acid and the acid extract was heated with barium chloride solution. The precipitate formed was filtered, washed and dried. Weight of this precipitate was 0.05g. Calculate the percentage of sulphur in this sample.

(3X 5=15)

Q2. Attempt **any three** parts:

(a) What is the value of P, C and F for these systems:
- Pure crystals of $CuSO_4.5H_2O$
- NH_4Cl being heated alone in a closed vessel
- Pb-Ag system at the Eutectic point

(b) Draw a labelled phase diagram for the Water system and explain why the fusion curve of ice has a negative slope.

(c) With the help of suitable plots explain briefly how the activity of an enzyme varies with the changes in temperature, pH and substrate concentration.

(d) In acid catalyzed reactions, one of the mechanisms involves transfer of a proton from the intermediate to a water molecule. Use the kinetics of this mechanism to derive the two cases of general acid catalysis and specific acid catalysis.

(5 X3= 15)

Q3. Attempt **any three** parts:

(a) A sample of coal was tested for its calorific value using Bomb's calorimeter. Following data was obtained:
Weight of coal burnt = 0.920g
Weight of water taken= 550g
Water equivalent of bomb, calorimeter = 2200g
Rise in the temperature = 2.32 ^{0} C
Fuse wire correction = 10 cal
Acid correction = 50 cal
Cooling correction = 0.007 ^{o}C

Calculate the GCV and NCV of this sample, assuming that the sample contains 6% hydrogen. Latent heat of condensation of steam is 580 cal/g.

(b) Using a neat and labelled diagram explain the recovery of various by-products from the coke oven gas produced in the Otto-Hoffmann's Oven.

(c) A gas has the following composition by volume: H_2 = 30%, CH_4 = 10%, CO = 15%, CO_2= 6%, O_2 = 5% and N_2= 34%. Find the volume of air actually supplied per m^3 of this gas.

(d) With the help of balanced chemical reaction, describe the reaction between potassium permanganate and oxalic acid in acidic medium. What is the role of Mn^{2+} ions in this reaction. Why is it important to maintain acidity of the medium for this reaction?

(5X 3=15)

First/Mid Term Examination
September, 2017

1ˢᵗ Semester (B. Tech.)
Paper Code: ETCH 113
Time: 1: 30 hr.

Sub: Applied Chemistry
Max. Marks: 30

Note: Attempt any three Questions including Question No.1 which is compulsory

1(a) Explain why the fusion curve of ice has a negative slope whereas the sublimation curve has a positive slope in the phase diagram?

(b) Write condensed phase rule and explain why it is used for two component systems.

(c) Calculate the mass and volume of air needed for the combustion of 1 kg of carbon.

(d) 1.56 g of the coal was kjeldahlized and NH_3 gas thus evolved was absorbed in 50.0 mL of 0.1 N H_2SO_4. After absorption, the excess (residual) acid-required 6.25 mL of 0.1 N NaOH for exact neutralization. Calculate the percentage of N in the coal sample.

(e) A sample of coal was found to have the following percentage composition:
C = 75 %; H = 5.2 %; O = 12.1 %; N = 3.2 and ash = 4.5 %
Calculate the HCV and LCV of the coal sample.   [2 × 5]

2(a) How would you determine the calorific value of a coal by Bomb Calorimeter? Explain with the help of a neat diagram.

(b) Describe the Otto-Hoffman's process for preparing coke and mention the by-products recovered in the process.   [5+5]

3 Differentiate between (any two of) the following:
   a) Fixed bed Catalytic Cracking and Moving bed Catalytic Cracking
   b) Liquid phase thermal cracking and vapour phase thermal cracking
   c) Octane number and Cetane number   [5+5]

4 (a) Draw and discuss the phase diagram of lead-silver system. Discuss practical application of this system.

(b) Give a labeled phase diagram of water system and discuss the importance of Triple point.   [5+5]

END TERM EXAMINATION

FIRST SEMESTER [B.TECH] DECEMBER 2017

Paper Code: ETCH 113	**Subject: Applied Chemistry,**
Time : 3 Hours	**Maximum Marks :75**

Note: Attempt any five questions including Q. No. 1 which is compulsory. Select one question from each unit. Assume suitable missing data, if any.

Q1. a) Define: i) Octane and Cetane number   (3x7=21)
ii) Synthetic Petrol and Power alcohol

b) Distinguish between softening and demineralization of water with chemical equations.

c) Name the disinfecting agents of water.

d) What is corrosion? How is it different from erosion?

e) Explain the following terms: i) Tinning   ii) Metal cladding
iii) Electroplating

f) Define: i) Gibb's Phase rule ii) Degree of freedom

g) Draw the phase diagram of water and explain the significance of triple point.

h) Name the catalyst of the following reactions: **(4)**

   i)   Hydrogenation of vegetable oils Pt

   ii) Homogeneous catalysis of alkenes Ni/Pt

   iii) Zeigler- Natta Polymerisation $TiCl_3$

   iv) Haber's Process Fe

Unit-I

Q2. a) Explain the working of Bomb Calorimeter in detail with neat diagram.   **(6)**

b) Calculate the GCV and NCV of a gaseous fuel from the following data: -
Volume gaseous fuel burnt at STP = 0.1 m^3 weight of water used for cooling= 26 kg

      Temperature of inlet = 25ºC
      Temperature of outlet = 35ºC

Weight of water produced by steam condensation= 0.02 kg
Latent heat of steam= 587 kCal/kg.   **(6.5)**

Q3. a) Describe the method of a carbonization of coal to yield coke.   **(6)**

b) Distinguish between proximate and ultimate analysis. Calculate the weight and volume of air required for condensation of 1 kg of carbon.   **(6.5)**

Unit-II

Q4. a) Explain Heterogeneous catalysis with examples. Discuss the elementary steps of heterogeneous catalysis according to Langmuir- Hinshelwood mechanism.   **(6)**

b) Derive the Michaelis-Menten equation for an enzyme catalysed reaction. Discuss the role of inhibilors in catalysis.   **(6.5)**

P.T.O.

ETCH-113
P1/2

Q5. a) What are phase diagrams? Draw the cooling curves for the following:-
   i) Pure substance in molten state.
   ii) Molten mixture of two solids.   **(6.5)**

   Also, define the eutectic point.   **(6)**

   b) Draw and explain the phase diagram of Pb-Ag system.

Unit-III

Q6. a) Discuss the lime-soda process used for removal of calcium and magnesium hardness.   **(6.5)**

   b) Calculate the amount of lime required for softening of 6000 L of hard water containing 90 ppm of $MgSO_4$.   **(6)**

Q7. a) What is alkalinity of water and explain a method for its determination using methyl orange and phenolphthalein indicators.   **(6.5)**

   b) 100 ml of a sample required 10 ml of $\frac{N}{50}$ Hcl using methyl organge as indicator. Another 100 ml of sample required 4 ml of $\frac{N}{50}$ Hcl using phenolphthalein as indicator. Express the alkalinities in terms of mg of $CaCO_3$ per litre.   **(6)**

Unit-IV

Q8. a) What are factors influencing corrosion?   **(6.5)**
    b) Define the following terms: **(6)**
       i)   Cathodic Protection
       ii)   Galvanization
       iii) Sheradising

Q9. a) Discuss the mechanism of the following: **(6)**
       i)   Oxidation Corrosion
       ii)   Electrochemical or wet corrosion
    b) Discuss in detail the protective measures used against corrosion. **(6.5)**

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ETCH-113

P2/2

END TERM EXAMINATION

FIRST SEMESTER [B.TECH] NOVEMBER-DECEMBER 2018

Paper Code: ETCH 113

Subject: Applied Chemistry

Maximum Marks :75

Time : 3 Hours

Note: Attempt any five questions including Q. No. 1 which is compulsory. Select one question from each unit.

Q1. a) What is a fuel? State the features of a good fuel.   (5x5=25)

   b) Draw the phase diagram of water. Explain the terms-critical point and triple point.

   c) What is a catalyst? Describe its characteristics features.

   d) Describe what is water softening by internal treatment.

   e) Discuss in detail the factors influencing corrosion.
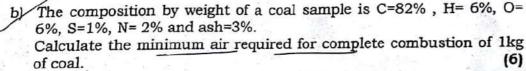
Unit-I

Q2. a) What is cracking?   Differentiate between thermal & catalytic cracking.   (6.5)

   b) Explain knocking and anti knocking agents.   What is cetane and octane number of a fuel?   (6)

Q3. a) Draw a Labelled diagram and explain the working of Otto-Hoffmann's by-product oven for the manufacturing of metallurgical coke.   (6.5)

   b) The composition by weight of a coal sample is C=82% , H= 6%, O= 6%, S=1%, N= 2% and ash=3%.
   Calculate the minimum air required for complete combustion of 1kg of coal.   (6)

Unit-II

Q4. a) State Gibb's Phase rule.   Also, find the degree of freedom of the following systems:

   i) $NH_4 Cl(s)$ $NH_3(g) + HCl(g)$
   ii) Aquous solution of NaCl and Na_2CO_3.
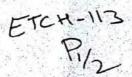   iii) Water (liquid)   water (vapour).   (6)

   b) Draw the cooling curve of a pure substance and clearly identify the eutectic point in it.   (6.5)

Q5. a) Differentiate between congruent and Incongruent melting compound by giving suitable examples.   (6)

   b) Draw and explain the phase diagram of Lead-Silver System.   (6.5)

P.T.O.

ETCH-113

P1/2

Unit-III

Q6. a) Describe in detail the EDTA method of determining the hardness of water. (6.5)

b) Explain the use of catalyst in Industrially important processes. Give examples. (6)

Q7. a) Discuss the lime-soda process used for external treatment for water softening. (6.5)

b) A water sample has the following dissolved salts (mg/L). Calculate its temporary and permanent hardness in ppm of $CaCO_3$.
$Mg(HCO_3)_2$= 80, $MgSO_4$= 110, $CaSO_4$=85, $Mg Cl_2$=94, $CaCl_2$=84, NaCl=50. (6)

Unit-IV

Q8. a) Explain what is Soil Corrosion? How it is affecting the fertility of soil? How it can be prevented? (6.5)

b) What is Cathodic protection and sacrificial Anodic protection? (6)

Q9. What happens and why?

a) A piece of iron is kept in Saline water. (3)

b) A steel pipe is connected to copper plumbing. (3)

c) A zinc plate is fixed below the ship. (3)

d) Iron next/ washers/ valves are cleaned and packed with zinc dust and rotated. (3.5)

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ETCH-113
P2/2

END TERM EXAMINATION

FIRST SEMESTER [B.TECH.] DEC.-2019

Paper Code: ETCH113	Subject: Applied Chemistry
Time: 3 Hours	Maximum Marks: 75

Note: Attempt five questions in all including Q. No. 1 which is compulsory. Select one question from each unit. Assume suitable missing data if any.

Q1   (2.5 x 10 = 25)

a) Why is Net Calorific value less than Gross Calorific value of a fuel? Under what condition NCV=GCV?

b) What is reforming of petrol? How does reforming increase Octane number?

c) Explain Auto catalyst with an example.

d) Why rough surface of a catalyst is more effective than smooth surface? Explain.

e) Define Degree of Freedom. Why Degree of Freedom, F=0 at triple point?

f) Define Break Point Chlorination with the help of a curve plotted between added chlorine and residual chlorine.

g) Explain Electrochemical Corrosion.

h) Differentiate between Galvanization and Tinning. Why Galvanized utensils cannot be used for storing acidic food stuffs?

i) Write a short note on Caustic embrittlement.

j) Write down the colour of the following species--
   (i) Metal-EDTA Complex
   (ii) Metal-EBT Complex
   (iii)Unionized EBT
   (iv)Ionized EBT at pH 8-11
   (v) NH_3-NH_4Cl Buffer solution

UNIT I

Q2. (a) With the help of a neat diagram, explain how the Calorific value of a gaseous fuel can be determined by BOY's Calorimeter?   **(6.5)**

(b) A sample of coal was found to have the following percentage composition by weight C=70%, H=6.0%, O=16%, N=3.5% and Ash=4.5%.   **(6)**

Calculate
i) Minimum amount of oxygen and air required for complete combustion of 1kg of coal.
ii) Gross and Net Calorific values of given sample using Dulong's formula.

                                                 (6)

Q3.(a) Differentiate between the following
   i) High and Low Temperature Carbonization.
   ii) Thermal and Catalytical Cracking.
   iii) Proximate and Ultimate Analysis of coal.

(b) 2.5 gm of a coal sample was analyzed under ultimate analysis. The NH_3 gas thus evolved was absorbed in 50mL of 0.1N H_2SO_4. After absorption, the excess acid required 9.5mL of NaOH for exact neutralization.
Another 2.5 gm of the same sample gave 1.5gm of $BaSO_4$ precipitate.
Calculate the % of N and S in the given sample of coal.   **(6.5)**

                                                     [P.T.O.]

UNIT II

Q4. a) Define Gibb's Phase Rule. Discuss The Water System with the help of a well labelled phase diagram. **(6.5)**
   b) Give well labelled reason why? **(4)**

   i) Eutectic Mixture has a definite composition and a sharp melting point, yet it is not a compound.
   ii) $F = C - P + 1$, Condensed Phase Rule is applicable to Two Component System.
   c) Calculate no. of phases and no. of components in the following system- **(2)**

   i) $H_2O(s)$ $\quad$ $H_2(g) + H_2O(g)$
   ii) $I_2(s)$ $\quad\quad$ $I_2(g)$

Q5. a) Explain the kinetics of Enzyme Catalyzed reactions and derive the Michaelis. Menten equation. **(6)**
   b) i) Discuss the Negative Catalyst with an example. **(6.5)**
      ii) State a condition under which a catalyst loses its influence over a reaction.
      iii) Why promoters are added along catalyst?

UNIT III

Q6. (a) 100mL of a water sample consumed 25mL of centi molar EDTA for titration using EBT as an indicator. After boiling water sample consumed 5mL of the same EDTA solution for titration. **(6.5)**
   Calculate total, permanent and temporary hardness in ppm.
   (b) Discuss the type and extent of Alkalinity for a water sample if-- **(6)**
      a) $P = \frac{1}{2} M$
      b) $P < \frac{1}{2} M$
      c) $P > \frac{1}{2} M$

Q7. (a) Calculate the amount of time (92.0%) pure and soda (98.0%) pure required to soften 10 litres of water per day for a year containing the following—
   $Ca^{2+} = 80$ ppm, $Mg^{2+} = 36$ ppm, $HCO_3^- = 244$ ppm and added as a coagulant $FeSO_4.7H_2O = 73.5$ ppm. **(6.5)**
   (b) Describe the process of demineralization for water softening using ion-exchange resin. Also give necessary reactions involved. **(6)**

UNIT IV

Q8. (a) Explain the Theory and Mechanism of Chemical or Dry Corrosion in Detailed. **(6.5)**
   (b) Explain the following factors influencing the rate of corrosion. **(6)**
      i) Temperature
      ii) Nature of the Metal
      iii) pH

Q9. (a) Describe various protective measures used against corrosion. **(6.5)**
   (b) Define the following: **(6)**
      i) Passivity
      ii) Pilling-Bedworth Rule
      iii) Electroplating

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