THE OPEN UNIVERSITY OF SRI LANKA
B.Sc. DEGREE PROGRAMME – Level 5
INDUSTRIAL CHEMISTRY - CHU 3237
FINAL EXAMINATION 2011/ 2012
3 hours

Date: December 23rd 2011 **Time: 9.30 a.m. – 12.30 p.m.**

- This question paper consists of two sections. **Part I(Short questions)** and **Part II (Structured type)**
- **Part I** consists of **15** short questions; recommended time to complete this part is one hour.
- **Part II** consists of **six** questions; you are expected to answer four questions including **one compulsory question** to be answered out of six. Recommended time to complete this part is two hours.

Part I (40 marks)

Index Number..... **Staff signature**.....

Answer all questions

1. Write down the raw material used for the extraction of the following metals. Indicate the process involved.

	Raw materials	process
Iron	.....	.....
Aluminium	.....	.....

(02 marks)

2. Write **three** important features of the Ellingham diagram for oxides of elements.

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(03 marks)

3. State the main reason for the use of transition metal compounds in the glass mixture for the preparation of colored glass.

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(03 marks)

4. What important property should be there in a clay to be used as a refractory clay?

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(03 marks)

5. Distinguish between 'flash set' and 'false set' in relation to cement.

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(02 marks)

6. Defining the term, 'corrosion', write an equation to illustrate corrosion.

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(03 marks)

7. A piece of metal (atomic weight = 102) weighing 1.123 g was dipped in an aqueous solution; the metal dissolves into the solution as M^{2+}. After 2 hours, the dried piece of the metal weighed 1.02 g. Calculate the corrosion current. [F= 96,485 $Cmol^{-1}$]

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(04 marks)

8. Write a method for the production of iodine from natural I^- bearing brine.

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(02 marks)

9. Draw a flow diagram for the production of free- flowing table salt.

(03 marks)

10. What are the major components of the essential oils derived from the following

Nutmeg .....

Ginger .....

Tumeric .....

(03 marks)

11. Name **three** spices used for oleoresin manufacture in Sri Lanka.

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(03 marks)

12. Distinguish between cracking and reforming.

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(02 marks)

13. State product(s) formed in each of the following reactions.

(i)

$$H_2C{=}CH_2 \xrightarrow[(2)\ 500\ ^0C]{(1)\ Cl_2\ /FeCl_3} \ ?$$

(ii)

$$\text{Propylene} \xrightarrow[CO\ ,\ H_2]{Ni\ /\ Co} \ ?$$

(03 marks)

14. Define the term 'Saponification value.'

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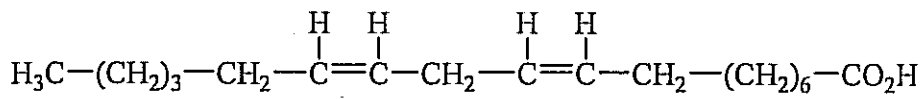
(02 marks)

15. Write down the IUPAC name and short hand notation (using system) of the following fatty acid.



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(02 marks)

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Part II (60 marks)

Answer **four** questions including **compulsory question number one** out of six.

1. a. '(i) Using equations, briefly describe the manufacture of sulphuric acid in the process, *homogeneous catalysis.*
(ii) Briefly explain the importance of H_2SO_4 in chemical industries.
(30 marks)

b. (i) Using chemical equations, show how normal superphosphate (NSP) and triple superphosphate (TSP) can be produced from the mineral fluorapatite, [3 $Ca_3(PO_4)_2$. CaF_2].
(ii) State <u>one</u> problem associated with the use of apatite ore in agriculture.
(30 marks)

c. Briefly describing what is meant by 'metal finishing', write <u>three</u> types of metal finishing.
(20 marks)

d. "Lead compounds are often incorporated to glass mixtures for value addition". Comment on the above statement by considering a suitable example.
(20 marks)

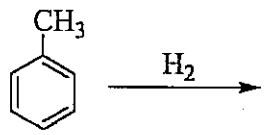
2. a (i) What type of bonding is present in Boron nitride?
(ii) How does the bonding in Boron Nitride differ from that of graphite?
(iii) It is said that at high temperatures and pressures Boron nitride will change its phase to a cubic structure? Explain one consequence of this phase change.
(30 marks)

b. (i) What is meant by polymorphism in clay minerals? Name two polymorphic varieties of kaoline.
(ii) Explain what is meant by "ion exchange capacity of clays".
(20 marks)

c. (i) State the function of a ball mill in ceramic industry. Why is the said function important?
(ii) What will be the nature of a glass mixture (a) at glass transition temperature? (b) above glass transition temperature?
(30 marks)

d. (i) Distinguish between cement and mortar.
(ii) Write <u>two</u> important differences between the dry process and wet process of manufacture of Portland cement.
(20 marks)

3. a. (i) What is meant by catalytic reforming?
(ii) What are the factors that affect the rate of efficiency of catalytic reforming?
(iii) What is the product of the following reaction and how would you call this reaction?



(40 marks)

b. (i) What do you mean by "Naphtha" in the petrochemical industry?
(ii) What is the use of the naphtha fraction of petroleum?

(20 marks)

c. (i) What is meant by octane number?
(ii) Give three chemicals/ additives that can increase octane rating.

(20 marks)

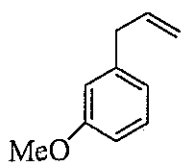
d. (i) List the two main purpose of cracking of petroleum.
(ii) What do you mean by the term visbreaking in petroleum industry?
(iii) Write its purposes.

(20 marks)

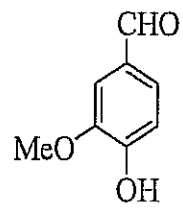
4. a. (i) What are the chief coloring matters in the following spices?
Cinnamon bark , Turmeric and Chillie.
(ii) What do you mean by pungent principles? What are the pungent principles of ginger and chillie?

(20 marks)

b. (i) How would you isolate Eugenol from cinnamon leaf oil?
(ii) How would you obtain Vanillin from Eugenol?



Eugenol



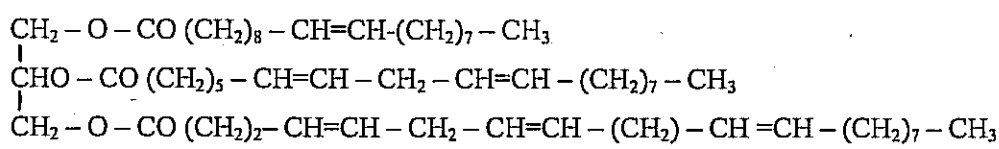
Vanillin

(20 marks)

c. Value addition is an important area in the essential oil industry today.
   (i) What is meant by 'value addition'?
   (ii) Give an account of value –added products from citral and their uses.
   (30 marks)

d. (i) What are rosins?
   (ii) Give three industrial applications of rosin
   (iii) Draw and label simple flow diagram to show production of rosin from pine tree.
   (30 marks)

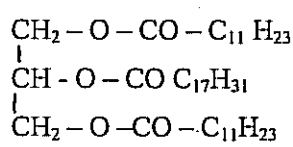
5.a. (i) Define iodine number of an oil.
   (ii) Find the iodine value for the following compound.



[Relative atomic mass C = 12; O = 16; H = 1; I = 127]

   (iii) What are the factors that affect the melting point of fats?
   (30 marks)

b. An oil contains the following triglyceride as the main ingredient.



   (i) Write down the products that are formed during the splitting reaction of the above oil.
   (ii) What would be the product/s when the above mentioned compound undergoes an interesterification reaction?
   (iii) Briefly describe a chromatographic method for the analysis of an oil
   (50 marks)

c. (i) Give the conditions necessary for hydrogenation of oil.
   (ii) What is the purpose of hydrogenating oil?
   (20 marks)

6.a. (i) Draw the flow chart for the dry process of manufacture of Portland cement.
   (ii) Briefly describe the process of hydration of the crystalline phase, C_3S.

(iii) Identify the crystalline phase(s) responsible for initial set, early strength and long- term strength.

(50 marks)

b. 'Soda ash is obtained from underground deposits of *trona* as well as manufactured in the Solvay process.

(i) Write the equation for the production of soda ash from trona.

(ii) Writing equations, outline the steps involved in the manufacture of soda ash in the Solvay process.

(iii) Give one limitation of this method.

(iv) One hundred brass spheres, each of 5.0 mm in radius, are plated with silver to a thickness of 0.020 mm. How many grams of silver (atomic weight = 107.9) are required to plate the spheres? The density of silver is 10.5 g cm^{-3}.

(v) What is the minimum current required to carry out the silver plating in 5 hours?

(50 marks)