Roll No…….. **Total no. of pages: 1**

Mid Term (Sec:B, Branch: CSE)

B.Tech. II Sem.2017-18 (Common to all Branches) **24.04.2018**

Time: 1 hr. **Maximum marks: 20**

Instruction to Candidates: Attempt any ***five questions***, including **Question no. 1 which is compulsory.** Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/ calculated must be stated clearly.

Q.1 Compulsory, Answer for each sub-question be given in about 25 words- **[4x2=8]**

(a) Define Cloud and Pour point of lubricating oil and its significance.

(b) Define the Principle of Galvanization. How it is useful to minimize the corrosion of iron.

(c) What is Polymer? Write the names monomers of Kevlar or Bakelite.

(d) Give the name and reactions of two methods by which petrol can be synthesized chemically.

Q.2 What is glass? Write the manufacturing steps of ordinary glass **[3]**

OR

Write short notes on any three type of glass.

Q.3 What are refractories? What are the main characteristics of good refractory? **[3]**

OR

Write short notes on RUL test and Seger Cone test.

Q.4 Define Corrosion. Give the detailed mechanism of Wet/Electrochemical Corrosion **[3]**

Q.5 Give the detailed classification of Lubricants with examples. **[3]**

Q.6 The % composition by weight of a coal sample was found to be as : C- 81%, H- 5%, O – 8.5%, S- 1%, N-1% and ash 3.5%.Calculate the minimum amount of O_2 and air required for complete combustion of 1 kg of this coal. **[3]**

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ANSWERS

Ans:1 (a) Cloud Point is the temperature at which oil becomes cloudy/hazy in appearance while the pour point is the temperature at which the complete freezing of lubricating oil takes place or in other words the flow of lubricating oil is completely ceased. The knowledge of cloud and pour point especially useful for the selection of oil working under cold/cryogenic conditions. The lower the value of cloud and pour point it will be more suitable.

Ans:1 (b) In Galvanization the base metal (which is to be protected from corrosion viz. Fe) is coated with the more reactive metal i.e. more oxidizing than base metal say Zn. Here Zn will act as an anode and undergo oxidation. If any scratch/pores/discontinuity occur in such an anodic coating, a galvanic cell is formed between the coating metal(Zn) and the exposed part of base metal(Fe). It results in corrosion of coating metal. In this manner Zn metal act as sacrificial manner.

Ans:1 (c) Polymers are macromolecules which are made up of large number of repeating units. These repeating units are called monomers. The monomers of Bakelite are: Formaldehyde (HCHO) + Phenol (C_6H_5OH). The monomers of Kevlar are: 1,4-phenylenediamine + terephthaloyl chloride

Ans:1 (d) Polymerization –

CH_3-CH=CH_2 + CH_3- CH_2 -CH=CH_2 ⟶ CH_3- CH_2 (CH_3)-CH_2 -CH=CH_2

Propene 1-Butene 5-Methyl- 1- Hexene

Fischer Tropsch Process –

n CO + 2n H_2 ⟶ C_nH_{2n} + H_2O

Water Gas Olefins

n CO + (2n+2) H_2 ⟶ C_nH_{2n+2} + H_2O

Water Gas Paraffins

Ans:2 A glass is an inorganic substance, hard, brittle, amorphous mixture of silicates of calcium, sodium and other metals. Ordinary glass is Sodium Calcium Silicate i.e. $Na_2O.CaO.6SiO_2$.

Manufacturing of Glass involve the following steps: (1) Melting, (2)Shaping, (3) Annealing, (4) Finishing

Each operation is being discussed briefly as follows:

1. Melting. The ingredients called *batch materials* are mixed in the appropriate proportion and heated to fusion in a furnace. Many designs of glass furnace are in use. The two most commonly used furnaces are: (i) Pot furnace and *(ii)* Tank furnace.

i. **Pot Furnace**. In this furnace, the charge is fused in fire clay pots. The pots may be opened or closed. The closed pots are used when the-glass is to be protected from the products of combustion.

Pot furnace is employed for the production of high quality glass, since the charge remains protected from the products of combustion.

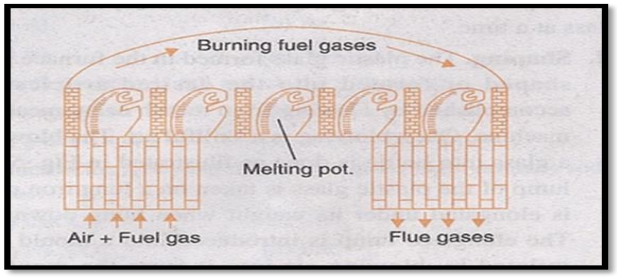


Fig. **Pot furnace**

(ii) **Tank Furnace**. It consists of a large rectangular tank built of fire clay blocks. The batch materials are fed into the tank and producer gas is used as a fuel in the furnace.

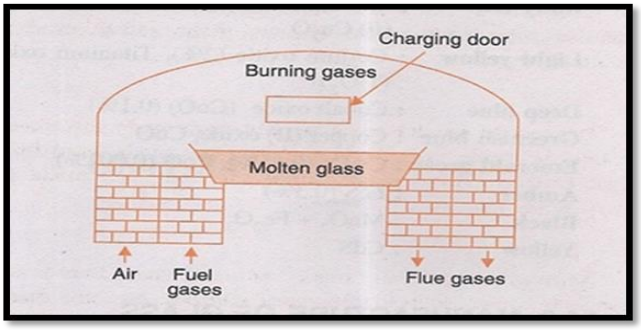


Fig. Tank Furnace

The charge is heated at 1400°- 1500°C for 10-12 hours. The chemical reactions involved in both the furnaces are:

$$Na_2CO_3 + SiO_2 \rightarrow Na_2SiO_3 + CO_2$$

$$2Na_2SO_4 + 2SiO_2 \rightarrow 2Na_2SiO_3 + O_2 + 2SO_2$$

$$CaCO_3 + SiO_2 \rightarrow CaSiO_3 + CO_2$$

At 1400°C silica also in silicates of calcium and sodium

$$Na_2SiO_3 + CaSiO_3 + 4SiO_2 \rightarrow Na_2SiO_3.CaSiO_3 .4SiO_2$$

Glass

During the melting lot of frothing is caused owing to the evolution of the gases like CO_2, SO_2, O_2, etc. When the frothing suppressed, the temperature is raised and the molten glass is allowed to stand for some time. This is called refining, and its objective is to form a homogeneous mass free from gas bubbles and bits of undissolved material or batch stones.

Tank furnace is *a continuous process* and usually employed for the production of large quantities of only one variety of glass at a time.

2. Shaping. The plastic glass formed in the furnace is next shaped or formed into the desired articles. It is accomplished by *blowing* from mouth or by means of a machine. A lump of the plastic glass is taken on a long iron pipe. It is elongated under its weight when hung downwards. The elongated lump is introduced into a mould and is inflated by blowing air into it from the mouth. On cooling, the bottle is taken out by removing the two-halves of the mould.

3. Annealing. It is a process of cooling slowly the newly shaped articles. If they are cooled quickly they become brittle on account of the high internal strain. Annealing allows the molecules to arrange themselves in such a way that there is no internal strain when the mass is cooled. **Annealing is done in a tunnel like oven called *lehr*** which is 50 to 60 feet long. At one end the temperature is a little below the softening point of glass, *i.e.*, 500-600°C and it gradually falls along the length of the oven. At the other end the temperature is almost the same as the room temperature. Immediately after shaping, the articles are introduced into the ***lehr*** at the hotter end and travel towards the cooler end by means of a moving belt. It takes a few hours for the articles to move along through the tunnel. Some high quality glasses require long annealing.

4. Finishing. The articles obtained from the **lehr** are subjected to a number of operations such as cleaning, polishing, grinding, rounding edges, etc., for bringing them to a useable form.

OR

The following is a list of the three more common types of silicate glasses and their ingredients, properties, and applications:

1. **Fused quartz**, also called fused-silica glass, vitreous-silica glass: silica (SiO_2) in vitreous, or glass, form (i.e., its molecules are disordered and random, without crystalline structure). It has very low thermal expansion, is very hard, and resists high temperatures (1000–1500 °C). It is also the most resistant against weathering (caused in other glasses by alkali ions leaching out of the glass, while staining it). Fused quartz is used for high-temperature applications such as furnace tubes, lighting tubes, melting crucibles, etc.
2. **Soda-lime-silica glass, window glass:** silica + sodium oxide (Na_2O) + lime (CaO) + magnesia (MgO) + alumina (Al_2O_3). It is transparent and most suitable for window glass (see flat glass). It has a high thermal expansion and poor resistance to heat[15] (500–600 °C). It is used for windows, some low-temperature incandescent light bulbs, and tableware. Container glass is a soda-lime glass that is a slight variation on flat glass, which uses more alumina and calcium, and less sodium and magnesium, which are more water-soluble. This makes it less susceptible to water erosion.
3. **Sodium borosilicate glass, Pyrex**: silica + boron trioxide (B_2O_3) + soda (Na_2O) + alumina (Al_2O_3). Stands heat expansion much better than window glass. Used for chemical glassware, cooking glass, car head lamps, etc. Borosilicate glasses (e.g. Pyrex, Duran) have as main constituents silica and boron trioxide. They have fairly low coefficients of thermal expansion (7740 Pyrex CTE is $3.25\times10-6/°C$ as compared to about $9\times10-6/°C$ for a typical soda-lime glass), making them more dimensionally stable. The lower coefficient of thermal expansion (CTE) also makes them less subject to stress caused by thermal expansion, thus less vulnerable to cracking from thermal shock. They are commonly used for reagent bottles, optical components and household cookware.

Ans :3 Refractory: Refractories are ceramic materials that can withstand high temperature as well as abrasive and corrosion action of molten metals slags and gases without suffering deformation in their shape. The following are the characteristics of refractory:

(1) **Fusion Temperature**: It should possess high fusion temperature and should be infusible at the temperature to which it is liable to be exposed.
(2) **Heat Resistance**: A good refractory material should confine heat i.e. to resist loss of heat.
(3) **Coefficient of expansion**: It should possess low thermal coefficient of expansion and should expand-contract uniformly with increase and decrease of temperatures.
(4) **Load Bearing Capacity**: It should be able to withstand very high load at operating temperatures.
(5) **Inertness:** It should be chemically inert towards corrosion action of molten metals, gases, slags etc.
(6) **Dimensional Stability:** They exhibit a dimensional stability without any change in the volume due to action of high temperature.
(7) **Imperviousness:** It should be impervious to material inside the furnace.
(8) **Spalling Resistance:** It should possess good spalling resistance i.e. resistance towards peeling, chemical or mechanical attack.
(9) **Electrical Conductivity:** Furnace material should be low electrical conductivity.
(10) **Thermal Conductivity and porosity:** Thermal conductivity depends upon porosity of refractory material. Generally low porosity has higher thermal conductivity compared to high porosity material. High porosity material are usually highly insulating due to high volume of air entrapped into the pores and air is poor thermal conductor.

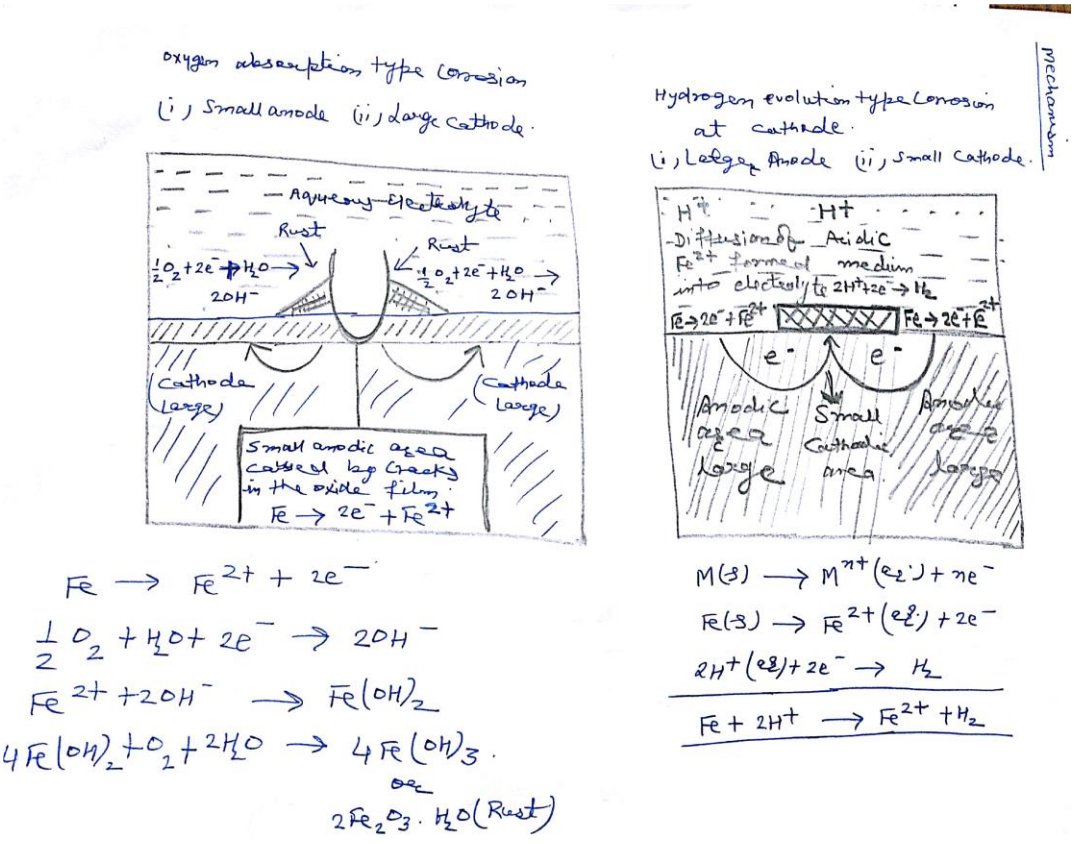
OR

Refractoriness under load(RUL) test: Temperature resistance and load bearing capacity are two essential qualities of refractory. Seger Cone test is not applicable for measurement of strength because some refractories under appreciable load collapse far below their true fusion temperature. Thus for good results RUL test is performed by applying the load of $1.75Kg/cm^2$ to refractory specimen of the size 5 cm^2 base and 75 cm height. The sample is taken inside the carbon resistance

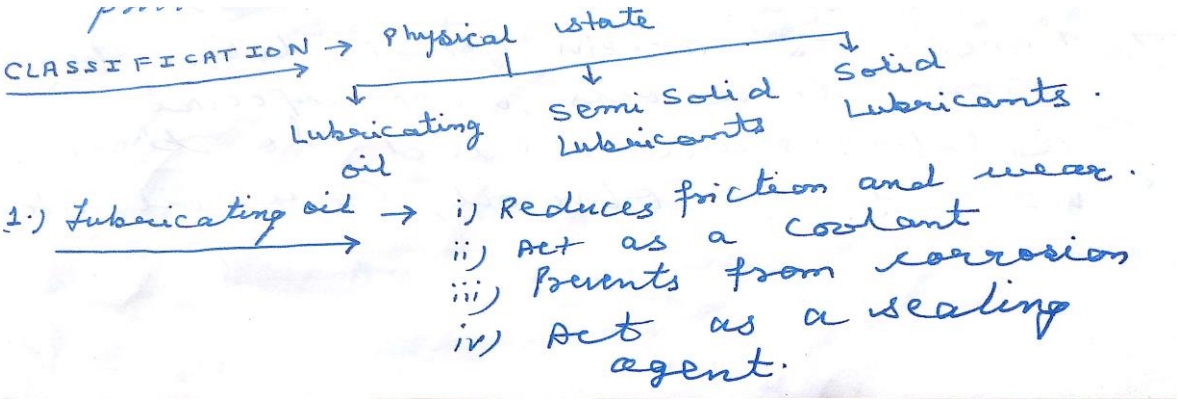
Furnace and heating is done at the rate of 10^0C/min. “The height of specimen v/s temperature is plotted and RUL is expressed as the temperature at which 10% deformation take place. Based on RUL test the refractory materials are classified as High Duty, Intermediate duty and Moderate heat duty.

Seger Cone Test: In this test fusion temperature is measured as reference refractory. The test refractory is kept along side several standard cones of similar size (38mm height & 19mm base size) in the form of cones and all are heated uniformily at the rate of 20^0C/hr., 100^0C/hr., 150^0C/hr. Each standard cone is made up of different refractory material of different softening temperature. These cones are assigned ascending Seger Cone Number assigned with increasing softening temperatures.

Ans: 4 Mechanism of wet/Electrochemical Corrosion



Ans: 5



d) Synthetic oil → which are ... plants & refineries by chemical reaction or polymerization e.g. Poly glycol ethers, silicones, fluoro chloro hydrocarbons etc.

Some Imp. Synthetic Lubricating oils & their applications

1.	Halogenated hydrocarbons	Low inflammability, chemically & thermally stable, high viscosity index	used in submarines
2.	organo phosphate esters	Inherent, chemically stable, good fire resistance properties	used in aircraft
3.	Silicones	High Viscosity Index, not oxidized upto 200°C.	moisture repellent, dielectric lubricants for clocks, timers & other elect devices.
	Dibasic esters	Non Corrosive, excellent V.I, low volatile nature, high thermal stability.	used in gas turbin turbojets etc.

Semi Solid lubricants (Grease)

The most important semisolid lubricants are greases & vaselines. Greases are employed in situations where:

→ oil cannot be maintained in position due to high load & low speed.

→ In machines preparing paper, textile articles & In situation where lubricants are also required to act as a seal against the entry of dust, moisture etc.

→ A grease is a semisolid lubricant obtained by thickening of a lubricant oil by the addition of a metallic soap. Important functions of a soap in grease are:

(i) It act as a thickener

(ii) It enables the grease to stick to metal surface firmly.

(iii) The nature of soap determines t temprature upto which the grease can be used.

Generally soaps used in the fo of greases are Li/Na/Ca salts of high fatty acids.

Ans: 6

Composition of 1 kg coal (gm)	Combustion reaction	Wt. of O2 required (g)	Wt. of dry products (g)
C = 810	$C+O_2 \longrightarrow CO_2$	810*(32/12) = 2160	810*(44/12)=2970
S = 10	$S+O_2 \longrightarrow SO_2$	10*(32/32) = 10	10*(64/32) = 20
H = 50	$H_2 + ½\ O_2 \longrightarrow H_2O$	50*(16/2)= 400	--
O = 85	--	--	--
N = 10	--	--	--
Ash = 35	--	--	--

(a) Net O_2 required for combustion is = Total O_2 required for combustion - O_2 Present in fuel

Net O_2 required for combustion is = 2571-85 = 2475 g. = **2.475** kg.
Net air is required for complete combustion of 1 kg of coal = Net O2 required * (100/23)
Net air is required for complete combustion of 1 kg of coal= 2475*(100/23) = 10760.8 g = **10.76 kg.**