RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. THIRD SEMESTER EXAMINATION, DECEMBER 2013

SECOND YEAR

Date : 14/12/2013 **INDUSTRIAL CHEMISTRY (Honours)**

Time : 11 am – 3 pm Paper : III Full Marks : 75

[Use a Separate Answer Book for each group]

Group – A

1. Answer **any five** questions : [5×2]
   a) Draw (110) & $(\bar{1}\bar{1}1)$ plane inside a cubic unit cell. Determine the Miller indices of the direction that is common to both these plane.
   b) Prove that the theoretical shear strength (τ_m) of a perfect crystal is approximately equal to the shear modulus (G) divided by 2π.
   c) Explain Peierls – Nabarro force.
   d) What is strain hardenning of a single crystal?
   e) What is APF? What is the value of APF for Face centred cubic lattice or BCC?
   f) Why nanomaterial is so important? Give some use of any nano-metal.
   g) Derive the general expression melting of nanomateial.
   h) Give example of making any nano metal useful as catalyst.

Group – B

Answer **any three** of the following :

2. Define the term 'glass' from physical and chemical view point. Why glass articles are Annealed or heat treated just after shaping from molten glass? Write what do you know about 'Tempered glass'. [2+1+2]

3. Describe with neat sketch the process of manufacture of optical glass in a Fuel Fired Pot Furnace. How does optical glass differs from opthalmic glass? What is the use of Selenium and Cullet in a glass Factory? [4+1]

4. A day Tank Furnace is charged with an intimately ground mixture of 1200 kg Quartz Powder, 880 Kg Lime Stone Powder, 240 Kg Potash Feldspar ($K_2O.\ Al_2O_3.\ 6SiO_2$) and 420 kg soda Ash. Calculate the quantity of glass Produced and its composition in % oxides basis. (Si – 28, Ca – 40, Al – 27, K – 39, C – 12, Na – 23, O – 16) [5]

5. Describe with neat sketch the dry process of manufacture of Portland Cement. How the dry process differs from Wet Process? [4+1]

6. Write short notes on blended cements
   a) PSC (Portland-Blast Furnace Slag cement)
   b) PPC (Portland Pozzolona (Fly Ash) cement) [2½+2½]

Group – C

Answer **any three** questions :

7. A furnace wall of consisting of 0·25m of fire clay (k = 1·13 W/m); 0·20 m of kaolin (k = 1·45 W/m) and 0·1 m outer layer of masonry brick (k = 0·66 W/m). It expose to furnace gas at 1370°K with air at 300°K adjacent to the outer wall. The inside and outside connective heat transfer coefficients are 115 and 23 W/m^2 respectively. Determine the heat loss per square metre of wall and the temperature of the outside wall surface at steady state condition? Mention some important properties of refractory? [5]

8. a) How the flexural strength of solid is determined and what is its importance? [3]

b) Briefly discuss the drying behaviour of clay. [2]

9. a) Why 20% Al_2O_3 remaining SiO_2 is avoided for refractory manufacturing? [2·5]
   b) What are the advantages of monolithic refractories than the shaped one? [2·5]

10. a) What is drain casting and how it differs from solid casting? [2·5]
    b) Explain PCE or RUL refractory material. [2·5]

11. a) What is glaze and why Pb presently is not being used in glaze composition? [2·5]
    b) What are the differences between Porcelain and Bone China? [2·5]

Group – D

Answer **any four** questions : [4×5]

12. Briefly explain the process of continuous casting of steel with suitable sketch.

13. a) What are the Major Raw Materials for : Iron, Copper, Aluminium, Zinc, Lead
    b) Briefly write the equations for getting the base metal from above raw materials.

14. Calculate the tonage of oxygen required to reduce carbon content from 2·5% to 0·2% per ton of steel.

15. Draw iron-carbon phase diagram and write some use of the same.

16. What is ausform steel or case hardened steel or S.G. Steel?

17. Can you suggest production of steel with Hydrogen reduction?

Group – E

Answer **any three** questions :

18. Distinguish between low temperature and high temperature process of coal carbonization. Mention yields of Tar and gas per ton of coking coal.
    Mention boiling Range of Middle and green oil and their pincipal constituents. State two use of coal tarzpitch. [2½+1½+1]

19. Describe with a neat sketch the method of production of producer gas and chemistry involved. What is its calorific value? What is the normal percentage of CO in it? [5]

20. Modified Mazumdar's Formula (Prox analysis) is : $C_G = 91{\cdot}7\ F + 75{\cdot}6\ (V - 0{\cdot}1A) - 60M$; $M < 2\%$

    Dulong Formula (ultimate analysis) is : $C_G = 80{\cdot}8C + 345\left(H - \frac{O}{8}\right) + 22{\cdot}2S$

    A sample of coal was analysed at CFRI laboratory with following results :

Prox analysis (air dried) %				ultimate analysis % dmmf				
Moisture	ASn	Vm	FC	C	H	S	N	O
1·3	16·0	30·1	52·6	86·52	5·27	0·64	2·37	5·20

    From above data—
    a) Calculate ev(gross) by Modified Mazumdar equation (air dried basis)
    b) Calculate ev (gross) by Dulong eqution (d mmf basis)
    c) Derive ev (gross) air dried from Dulong equation and comment whether results are comparable. [5]

21. Mention advantages of Electrical Furnace over gaseous Fuel Fired Furnace.
    Describe with neat sketch the operation of a resistance Furnace.
    Graphite, Silicon Carbide (SiC), Calcium Carbide (CaC_2), Alundum (Al_2O_3) are all manufactured in Electrical Furnace. The temperature of which chemical reaches 3000°C and takes about 23 days time from loading to unloading? [2+2+1]

22. Write short notes : Proximate Analysis, Ultimate Analysis [5]