4TH SEM ./ METALLURGY/ 2023(S)

Th-1 Material Testing

Full Marks: 80 Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10

a. Which indenter is used in Vickers hardness test?

b. What is the basic difference between destructive and non-destructive testing?

c. What is proof stress of a material?

d. Write the empirical relationship between hardness with strength.

e. Write two application of eddy current testing method.

f. Give two real life examples of impact loading condition.

g. Define endurance limit.

h. What is equcohesive temperature?

i. Write the sequence of operation in dye penetrant test.

j. What is an optical pyrometer?

2. Answer **Any Six** Questions 6 x 5

a. Derive the relationship between true stress and engineering stress.

b. Explain rebound hardness test, mention its application.

c. Discuss Magnetic Particle Inspection technique and mention its demerit.

d. Define brittle failure. Differentiate between Charpy and Izod impact test.

e. What is the significance of transition temperature? Explain the factors that affect transition temperature.

f. Briefly explain the various type of stress cycles in Fatigue.

	g	What is the basic principle of pyrometry? Give examples of pyrometer and their application.	
3		How S-N curve is plotted? Briefly explain the factors that affect fatigue strength of a metal.	10
4		With the help of schematic diagram explain various types of Ultrasonic Flaw Detection method and mention the precautions to be taken during the test.	10
5		How stress rupture test is different than creep test? Explain creep deformation with reference to Andrade's concept.	10
6		What is Luder band? Draw a neat engineering stress-strain plot for a low carbon steel and show the followings on the plot: elastic limit, lower yield point, upper yield point, UTS and yield point elongation.	10
7		Write short note on:	10
		(a) X-Ray Radiography (b) Thermocouples	

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TH-2 Physical Metallurgy

Full Marks: 80 Time- 3 Hrs

Answer any five Questions including Q No.1& 2
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1. Answer **All** questions 2 x 10

a. Draw the unit cell of alpha iron & find the effective no of atoms in alpha iron unit cell.
b. Define degree of freedom & find the degree of freedom at eutectic point of Fe-Fe_3C system.
c. Draw the cooling curve of a solid solution and an eutectic alloy.
d. Differentiate between iron, steel & cast iron from carbon point of view.
e. In what way metallurgical microscope differs from biological microscope.
f. Write the Miller indices of all the six planes of a cube.
g. What is size factor compound?
h. Difference between cast iron & pig iron.
i. What is eutectoid reaction. Give an example.
j. Define critical size of nucleus.

2. Answer **Any Six** Questions 6 x 5

a. Define packing factor. Find the packing factor of BCC crystal.
b. What is grain? Describe the factors that helps fine grain formation.
c. Draw the phase diagram where the two metals are completely soluble in liquid state but partially insoluble in solid state & level it, comment on the type of the diagram & give an example.
d. What is Lever Rule? Applying lever rule calculate the % of different phases in pearlite.
e. Difference between interstitial compound & interstitial solid solution.
f. Difference between nodular cast iron& white cast iron explain.

	g	Explain magnifying power & resolving power of metallurgical microscope.	
3		Define crystal defect & dimension wise mention all the crystal defects. Explain all types of points defects with suitable sketch.	10
4		What is solid solution & what are their types? Copper can dissolve any amount of Nickel in solid state & vice-versa. Justify the above statement with the help of Hume Rothery Rule.	10
5		Difference between phase diagram & equilibrium diagram with help of Example. Draw neatly Fe-Fe_3C phase diagram & level it and describe the invariant reactions of Fe-Fe_3C system.	10
6		Classify cast iron. Describe graphitisation & its role in cast iron.	10
7		Difference between (i) Homogeneous Nucleation & Heterogeneous Nucleation. (ii) Phase Rule & Lever Rule.	10

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Th -3 Principle of Extractive Metallurgy

Full Marks: 80 Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10
   a. What is speiss?
   b. Differentiate between calcination & roasting with example.
   c. What is dead roasting?
   d. What is pyro metallurgy? Mention two important metals which can be extracted using pyro metallurgical route.
   e. What is agglomeration? Mention the names of various agglomeration processes used in iron and steel industries.
   f. State Zeroth Law of Thermodynamics and explain.
   g. Differentiate between enthalpy and entropy.
   h. Mention the basic steps of hydrometallurgy.
   i. State the conditions of feasibility of a chemical reaction.
   j. Define order of reaction.

2. Answer **Any Six** Questions 6 x 5
   a. Discuss the significance of Predominance area diagram in metallurgy.
   b. Describe the advantages and disadvantages of hydrometallurgy.
   c. Short note on Zone Refining.
   d. What is the role of flux in extraction process? Classify various types of flux with example.
   e. State and explain Henry's Law.
   f. Derive an expression for rate constant for the reaction of first order.
   g Difference between electro winning and electro refining.

3 State the laws of thermodynamics and deduce the relationship of free energy change with change in entropy and enthalpy. 10

4 What is sintering? Explain various stages of sintering considering Dwight Lloyd sintering machine. 10

5 State and explain Faraday's law of electrolysis and their application in metallurgy. 10

6 Describe flash roasting in detail with neat sketch. What are the advantages of flash roasting over hearth roasting? 10

7 Short note on 10
   (i) EMF series (ii)Distillation

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TH-4 SPONGE IRON AND FERRO ALLOYS

Full Marks: 80 Time- 3 Hrs

Answer any five Questions including Q No.1& 2
Figures in the right hand margin indicates marks

1. Answer **All** questions 2 x 10

a. What are the raw material used for sponge iron making.
b. Differentiate between SL/RN & OSIL process.
c. What do you mean by reforming of natural gas.
d. Define reaction kinetics.
e. Write the different types of ferro alloys.
f. What is fugitive dust generation.
g. What do you mean by Acceretion formation.
h. Define the term Abrasion & Porosity.
i. Write the use of DRI in Iron making.
j. What is proximate analysis of coal.

2. Answer **Any Six** Questions 5 x6

a. Make a difference between BF route & Sponge iron route of Iron making. Write the advantages of DR process.
b. Discuss the CODIR Process of sponge iron making.
c. Discuss the factors that influence the reducibility of iron making.
d. What are the different types of pollution takes place due to DRI Plant.
e. Compare between ACCAR & Krupp Rein process
f. Explain the chemical analysis of Iron ore & Coal in details.
g Write short notes on (i) Boudourd reaction
(ii)Carbon deposition

3 Define ferroalloys & write their use. Explain the principle & production of ferrochrome in details. 10

4 Discuss the different operational Abnormalities in DRI process & their remedies. 10

5 Briefly explain the different process parameter that affect the sponge iron production. How the quality of raw material affect the production. 10

6 What are the various Gas based process of sponge iron making. Discuss the HYL-III process in details with neat sketch. 10

7 What is the principle of Reduction reaction? Discuss the reaction performed by CO, H2 & C during sponge iron making. 10