

COLLEGE OF ENGINEERING PUNE
End Semester Exam
MT206: Metallurgical Thermodynamics

Class: S.Y.B.Tech. (Met.Engg)

Time: 3 hours
Marks: 50

Instructions:

- a) Q1 is compulsory and solve any Four from remaining questions
- b) Assume suitable data if necessary.
- c) Use of calculators is allowed.
- d) Assumptions and Figures will carry marks

Q1 State True or False and Justify to the point.

2 x5

- a. Entropy at subzero cannot be estimated for metallic materials.
- b. Raoult's law has limited application to binary system.
- c. Integral free energy of mixing for binary alloy at constant temperature and pressure can be worked out with respect to ideal solution.
- d. In an electrochemical cell, free energy of the solution can be calculated from the activity of the ionic species.
- e. According to Le-Chatelier principle, the system does not move under the influence of external parameter.

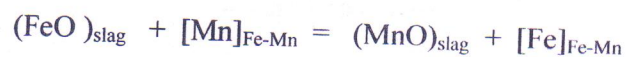
Q2 Chromium plates are bright annealed at 727°C in a wet hydrogen atmosphere. The pressure of wet hydrogen is 1 atm (101325 N/m²). 10

- (i) Calculate the permissible water content in the hydrogen if there is to be no oxidation at 727°C.
 - (ii) Will annealed chromium plates be oxidised when cooled to 227°C in the furnace atmosphere, as calculated in (i) ?
- Neglect the possibility of dissolution of hydrogen in chromium.



$$\Delta G^\circ = - 380\,953 + 95.4 T \text{ J}$$

Q3a The liquid solutions of MnO in FeO and of Mn in Fe are virtually ideal at 1600°C. Calculate the concentration of manganese in iron in wt% which is in equilibrium with a slag containing 40%MnO and 60% FeO at this temperature 5



$$\Delta G^0 = -121,671 + 15.35 T \text{ J}$$

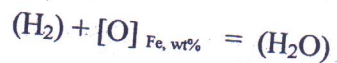
Atomic weights of Fe = 56 and Mn = 55 respectively.

Q3b At 1 atm pressure and 1500°C, 150 g plain carbon steel containing 0.1% carbon dissolves 40 CC of hydrogen measured at S.T.P. Under the similar condition, 150 g of above steel dissolves 40 CC of nitrogen. How much gas will 150 g of the above steel dissolve at 1500°C at 1 atm pressure under an atmosphere which consists of (i) 40% N₂ and 60% H₂, and (ii) 30%N₂, 40%H₂ and 30%Argon? Assume that argon is insoluble in the liquid. 5

Q4 Suggest whether the decomposition of NbC by Nb₂O₅ at 1 atm pressure is possible at 1500°C. 10

$$\begin{aligned} \Delta G_{1773}^0 < Nb_2O_5 > &= -1125 \text{ KJ / mol,} \\ \Delta G_{1773}^0 < NbC > &= -129 \text{ KJ / mol,} \\ \Delta G_{1773}^0 (CO) &= -268 \text{ KJ / mol} \end{aligned}$$

Q5 An iron-chromium alloy is brought to equilibrium with a H₂-H₂O mixture in which P_{H₂O/H₂} = 0.00353, in a pure alumina crucible at 1700°C. The alloy at equilibrium contains Cr = 1.90%, Al = 0.013%, and O = 0.0032% by weight. The equilibrium is represented by 10



The values of interaction parameters are

$$e_o^o = 0, \quad e_o^{Cr} = -0.058, \quad e_o^{Al} = -3.15$$

Calculate the free energy change of the above reaction at 1700°C.

Q6 An electrolytic cell has pure liquid cadmium as one electrode and a liquid cadmium-lead alloy as the other, and the electrolyte consists of a fused salt mixture containing cadmium ions (Cd⁺⁺). When the atom fraction of cadmium in the alloy electrode is 0.4, the reversible e.m.f of the cell is found to be 14.35x 10⁻³ V at 500°C. Calculate 10

- the activity, activity coefficient, and the partial molar free energy of cadmium in the alloy electrode w.r.t. pure cadmium as standard state.
- Free energy of mixing of Cd-Pb
- Excess free energy for Cd

$$\text{Faraday (F)} = 96487 \text{ J/V/g-equivalent}$$

-----The End-----

College of Engineering, Pune.
(End-Semester Examination)
MA 225 Engineering Mathematics IV
(S.Y.B.Tech. Metallurgy)

Max. Time: 180 minutes.
Max. Marks: 50.

Date: / /2011

Instructions:

1. Write Section-I & Section-II on separate answer sheets.
2. All questions are compulsory.
3. Figures to right indicates full marks.
4. All symbols have their usual meanings.

Section-I

1. NUMERICAL METHODS

Q-1. Attempt the following.

- (1) Prove that $E = e^{hD}$ where E is shift operator and $D = \frac{d}{dx}$. [02]
- (2) Find $\int_0^{0.6} e^{-x^2} dx$ by using Simpson's $\frac{1}{3}$ rule. (take $h = 0.1$). [02]

Q-2. Attempt any **TWO** of the following. [06]

- (1) Perform four iterations to find the root of the equation $f(x) = x^3 - 5x + 1$ lie in the interval $[0, 1]$.
- (2) Given $\frac{dy}{dx} = x^2 + y$, $y(0) = 1$.
Determine $y(0.02)$, using Euler's modified method (take $h = 0.01$).
- (3) Use 4th order Runge-Kutta method to find $y(0.2)$ where, $\frac{dy}{dx} = \frac{y^2 - x^2}{y^2 + x^2}$
with $y(0) = 1$ (take $h = 0.1$).

2. STATISTICS

Q-3. Attempt the following.

- (1) Fill in the blanks: [2]
 - (a) The cardinality of the set of outcomes when a coin is tossed until a head or 3 tails appear is
 - (b) If X is a continuous random variable with CDF $F(x)$ then $F(x) = \dots\dots$
- (2) Six independent space missions to the moon are planned. The estimated probability of success on each mission is 0.95. What is the probability that atleast five of the six missions will be successful? [3]
- (3) (a) If $P(\chi_n^2 \leq 4.594) = 0.2$ then find n , the degrees of freedom of Chi-square r.v. [1]
(b) A soft drink dispensing machine is said to be out of control if the variance of the contents exceeds 1.15 deciliters. If a random sample of 25 drinks from this machine has a variance of 2.03 deciliters, does this indicate at 0.05 level of significance that the machine is out of control? Assume that the contents are approximately normally distributed. Mention all the steps including figure. [3]

OR

The following data was collected to determine the relationship between pressure and the corresponding scale reading for the purpose of calibration.

Pressure, x (lb/sq.in.)	10	10	10	10	10	50	50	50	50	50
Scale reading, y	13	18	16	15	20	86	90	88	88	92

Find the equation of regression line and hence find the pressure for a scale reading of 54.

- (4) It is claimed that an automobile is driven on the average more than 20000 k.ms per year. To test this claim, a random sample of 100 automobile owners are asked to keep a record of the kilometers they travel. Would you agree with this claim if the sample showed an average of 23500 k.m. and a standard deviation of 3900 k.m.? Use 4 percent level of significance.

OR

Compute the correlation coefficient for the following grades of 6 students selected at random:

MathsGrade	70	92	80	74	65	83
EnglishGrade	74	84	63	87	78	90

Interpret your result.

- (5) If Z is a standard normal r.v. with $P(Z \geq k) = 0.057$ then find k .

[4]
[2]

Section -II

- Write the output for following SCILAB programs,
 - ```
--> r = 1 <enter>
--> for j = 1:2:10, r = r+k, end <enter>
```
  - ```
--> for j = 1:10, disp(j), if j > 5 then break, end, end <enter>
```
- Explain the use of Conditional Statements with Syntax & one example, in 'C' and SCILAB both. 4
- Write the command line, for SCILAB, to enter following Matrices 3
 - $$A = \begin{bmatrix} 1 & 2 & -1 \\ -2 & -6 & 4 \\ -1 & -3 & 3 \end{bmatrix}$$
 - $$Y = \begin{bmatrix} -1 \\ 2 \\ 2 \end{bmatrix}$$
 - $$B = \begin{bmatrix} T & T \\ F & F \end{bmatrix}$$
- Write the commands to plot the graphs of following variables, 2
 - a two dimensional Graph of x, y
 - a three dimensional Graph of A, B and C .
- What is the use of 'diary' and 'exec' command in SCILAB. 4
- State True or False and Justify. 2
 - C variable can start with a **number**.
 - All Functions should be executed in the same order as they are declared.
- Write a 'C' program to determine, Tensile Strength (TS) & %Elongation (E). Program should use separate functions for TS and E each. 6

Given: Inputs will be,

Tensile Load (P),

Area of cross Section (A),

Initial Length (Li),

Final Length (Lf).

Output will be Values of TS and E.

College of Engineering, Pune
(An Autonomous Institute of Government of Maharashtra)
(MT207) PRINCIPLES OF METAL WORKING
END SEMESTER EXAMINATION

Year: S.Y.B-Tech

Academic Year: 2010-11

Duration: 3 hrs.

Branch: Metallurgy

Date: 3 May 2011

Max. Marks: 50

Instruction to candidates:

1. All questions are compulsory.
2. Assume suitable, data if necessary.

- Q1 A** Because of corrosion, the thickness of a thin cylindrical shell is reduced by 3mm. As the effect of this reduction, the hoop stress is increased by 12 % under the same internal pressure. Find the original thickness of shell. [2]
- B** A steel rod 25 mm in diameter and 250 mm long is heated through 150 K and at the same time, subjected to a pull P. If the total extension of the rod is 0.5 mm, what should be the magnitude of P? Take $\alpha_{\text{steel}} = 12 \times 10^{-6} / \text{K}$ and $E = 215 \text{ GPa}$. [3]
- C** For the state of stress given below, find the principal stress and direction : [5]
 $\sigma_x = 6 \quad \sigma_y = 3 \quad \sigma_z = 3 \quad \tau_{xy}(\tau_{yx}) = -2 \quad \tau_{yz}(\tau_{zy}) = 2 \quad \tau_{zx}(\tau_{xz}) = -1$
(values in MPa)
- Q.2 A.** Draw the self explanatory sketches of rolling mill for following applications: [5]
i. reduction of slab into strip
ii. reduction of sheet into foil.
- B.** State the different parameters which control recrystallisation temperature. Differentiate between hot rolling and cold rolling process (eight important points). [5]
- Q.3 A.** Differentiate between direct, indirect and hydrostatic extrusion process. [6]
- B.** If toothpaste tubes are manufactured by impact extrusion process, then explain the different stages involved in manufacturing. [4]
- Q.4 A.** Suggest suitable manufacturing process for following applications and justify your answer: [4]
i. rails
ii. seamless pipe
iii. aluminium sliding window frame
iv. soft drink cans
- B.** With the help of suitable example, explain the important steps in close die forging process. [4]

C. State the role of flash in close die forging. Explain the reason for the variation of extrusion pressure in close die forging. [2]

Q.5 A. What is the difference between rod and wire? Draw the neat sketch of wire drawing die, explain the function of each section. [5]

B. A point is subjected to a tensile stress of 250 MPa in the horizontal direction and another tensile stress of 100 MPa in the vertical direction. The point is also subjected to a simple shear stress of 25 MPa, such that when it is associated with the major tensile stress, it tends to rotate the element in the clockwise direction. What is the magnitude of normal and shear stress inclined on a section at an angle of 20° with the major tensile stress? (Solve this example by Graphical Method –Mohr's Circle) [5]

College of Engineering, Pune
End Semester Examination
(MT 210) - (Material Analysis)
Semester – II

Year: S.Y.B-Tech
Academic Year: 2010-11
Duration: 3 Hours

Branch: Metallurgy
Date: 26 April 2011
Max Marks: 50

Instruction to candidates:

1. All questions are compulsory.
2. Marks given to the right indicate full marks.

- Q1 a. Explain how a concentration cell works. Derive the relevant expression of E.M.F. [5]
- b. A solution formed by dissolving 0.25 gram of iron ore in HCl was titrated and took 28 ml of 0.0995 N KMnO_4 solution. Calculate the percentage of iron in the ore. [5]
- Q.2. a. The reagents $\text{K}_2\text{Cr}_2\text{O}_7$ and KMnO_4 have overlapping absorption spectra in 1 M H_2SO_4 . $\text{K}_2\text{Cr}_2\text{O}_7$ has an absorption maximum at 440 nm and KMnO_4 has a band at 545 nm. A mixture is analyzed by measuring the absorbance at these two wavelengths with the following results. $A_{440} = 0.405$, $A_{545} = 0.712$ in 1 cm cell. [6]
- The absorbance of pure solutions of $\text{K}_2\text{Cr}_2\text{O}_7$ (1×10^{-3}) and KMnO_4 (2×10^{-4}) in one mole H_2SO_4 using the same cell gave the following results. $A_{\text{Cr}, 440} = 0.374$, $A_{\text{Cr}, 545} = 0.009$, $A_{\text{Mn}, 440} = 0.019$, $A_{\text{Mn}, 545} = 0.475$. Calculate the concentrations of dichromate and permanganate in the sample solution.
- b. Explain X-ray fluorescence method of analysis. How does it help in Qualitative & Quantitative analysis of alloys? [4]
- Q.3. a. Explain the steps in analysis of Chromium in En 24, by using Atomic Absorption Spectroscopy. [6]
- b. Explain the methods of Carbon estimation. Which is best suitable method for analysis of Medium carbon steel? Justify your answer. [4]
- Q.4. a. What are Complexometric titrations? Explain with an example. [6]
- b. Find the solubility of $\text{Sn}(\text{OH})_2$ at pH=4 and also of $\text{Zn}(\text{OH})_2$ at pH=6. The Solubility Product values are 3.2×10^{-26} and 2×10^{-17} respectively. [4]
- Q.5. a. Explain how the pH of a solution of Weak Acid and Strong Alkali during titration can be calculated. [5]
- b. a) If 30 ml of 0.09 M acetic acid ($K_a = 1.8 \times 10^{-5}$) diluted to 100 ml. [5]
b) then 15 ml 0.1 M NaOH added.
c) then 12 ml more of the same for equivalence point.
d) Finally total 32 ml added.
Find the pH at every stage.

*****THE END*****

College of Engineering, Pune
End Semester Examination
(MT 209) - (Geology and Ore Dressing)
Semester – II

Year: S.Y.B-Tech
Academic Year: 2010-11
Duration: 3 Hours

Branch: Metallurgy
Date: 05 May 2011
Max Marks: 50

Instruction to candidates:

1. All questions are compulsory.
2. Marks given to the right side indicate full marks.

- Q.1. Write a detailed note on the Conservation and Utilization of Industrial Minerals with the existing Indian scenario. [10]
- Q.2. Explain the term-“Ore Genesis Processes” with suitable Indian Example. [10]
- Q.3. What is the difference between classification and concentration? Explain the process of concentration in a Magnetic separator and Wilfley Table with the help of neat diagram. [10]
- Q.4. a) Explain the terms – frother, collector, conditioner, roughing cell, cleaning cell as used in flotation. [5]
- b) In a sink-and- float operation treating crude iron ore, the following results were obtained : [5]

Product	Tons	Assay, %Fe
Cone feed	146000	54 .0
Concentrate	106,000	58.0
Tailing	40,000	42.0

Calculate the Recovery and Ratio of Concentration.

- Q.5. a) Differentiate between Rittingers law and Stoke’s Law. [5]
- b) What is the angle of nip in a Roll crusher? State one benefit and one disadvantage of using a Roll crusher. [5]

***** The End *****