INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date..... FN / AN Time : 2 / 3 Hrs. Full Marks 100 No. of Students 120

Autumn / Spring Semester, ... Deptt. Mechanical Engineering Sub. No. ME 30605

3rd Yr. B.Tech. (H) / ~~B.Arch. (H) / M.Sc.~~ Sub. Name Casting - Forming - Welding

Instruction .....

Casting (33 marks)

1. Classify different types of casting. What is continuous casting and mention the basic features of this process with figure? How continuous casting is different from ingot casting? **[11]**

2. How sand grain size affects casting? Calculate the AFS-grain fineness number and screen number from the following data (Table-1) obtained from sieve analysis of 50 gram base sand. **[11]**

Table-1 Sieve analysis data from 50 gm sand

Sieve no. (*MF)	6 (3)	12 (5)	20 (10)	30 (20)	40 (30)	50 (40)	70 (50)	100 (70)	140 (100)	200 (140)	270 (200)	Pan (300)
Weight retained (gm)	-	-	-	2.0	4.7	7.3	14.8	16.2	3.4	1.1	0.2	0.1

*MF- multiplying factor

3. Fig.1 below shows Al-Si phase diagram. How many eutectic points are there in the phase diagram? You are considering making a shape casting from two alloys, one containing 2% Si and the other containing eutectic composition. Show the temperature-time curve (freezing curve) for both the alloy and which alloy composition will be more prone to segregation and why? **[11]**

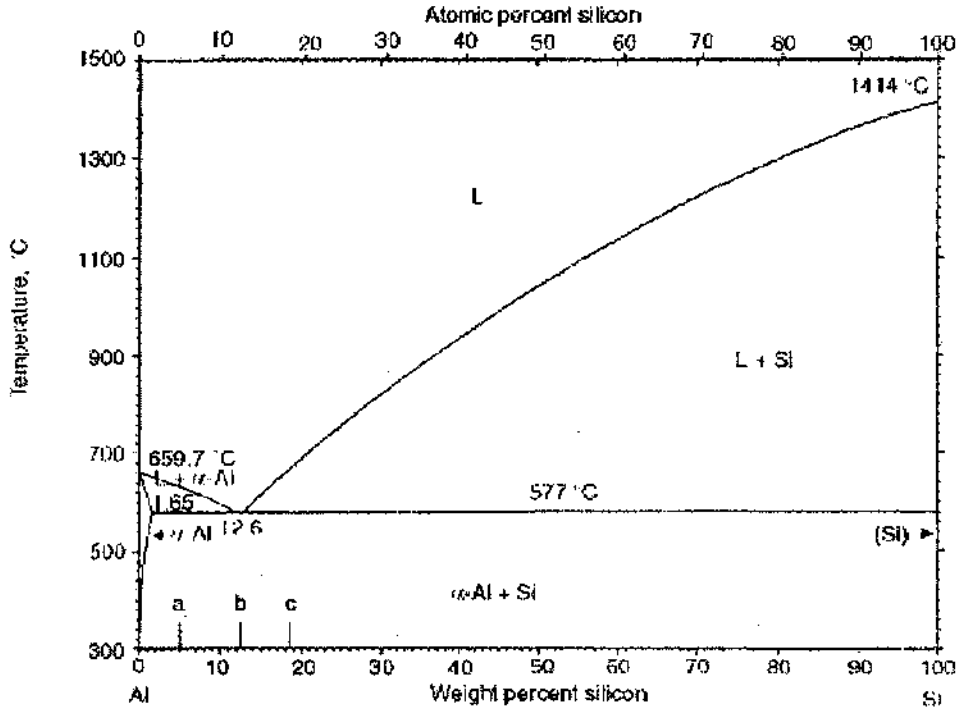

Fig. 1 Al-Si phase diagram.

Forming (34 marks)

4.(a) Find out the effective number of atoms and packing factors for BCC, FCC crystal structures? **[2+2=4]**
(b) Draw the Fe-Fe_3C phase equilibrium diagram. **[6]**

5. (a) Find out the location of the neutral point in a single stand strip rolling process considering no front and back tension. **[10]**
(b) A 6 mm-thick aluminium alloy strip is rolled to a thickness of 3 mm, using steel rollers of radius 130 mm. The tensile yield stress of aluminium is 0.35 kN/mm^2. Determine (i) minimum coefficient of friction (μ_{min}) between the workpiece and the rolls for an unaided bite to be possible, (ii) the angle subtended at the contact zone of the roll centre, (iii) the location of the neutral point with $\mu = \mu_{min}$. No front and back tension applied.
[3+3+4=10]

6. Write short notes on: **[2+2=4]**
(a) Plane-strain deformation ?
(b) Spin-flame hardening

Welding (33 marks)

7. Calculate the flux basicity index of a SMAW welding electrode having the following composition: **[5]**

CaO	MnO	SiO_2	Al_2O_3
28	12	25	8

8. The arc characteristics of three welding processes are described in the following table. Compute the power densities at anode and cathode if the corresponding spot sizes are 3.0mm and 2.0mm, respectively.**[12]**

Heat Source (DC)	Current (A)	Voltage (V)	Efficiency (%)	Anode (W/mm^2)	Cathode (W/mm^2)
GMAWArc	250	30	85		
GTAW Arc	120	15	65		
SAW Arc	450	35	95		

9. An alloy steel plate is having the following composition in percent. Determine the carbon equivalent (CE_{IIW}).**[6]**

C	Mn	Ni	Cu	Cr	Mo	V
0.23	0.40	0.30	0.25	1.5	0.45	0.05

10. Write notes on: **[10]**
(a) Drooping character of power source and its advantages
(b) Positions in arc welding
(c) Shielding gases used in arc welding processes
(d) Advantages of SAW process