

PART-A:: CASTING (33 Marks)

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| C1 | What are the functions of riser? State all the seven feeding rules used while designing the riser (with schematic figures wherever necessary)? | 10 |
| C2 | What do you mean by fluidity? How does the characteristic of alloy solidification influence the fluidity of metal during casting? Interpret with a suitable sketch of a phase diagram? | 5 |
| (a) | | |
| (b) | A metal with melting temperature of 700 °C is poured into the sand mold that is initially at 30 °C. How thick must a mold to be considered semi-infinite for times of 1 min and 15 min after pouring the metal? [Note- Properties of sand mold given are: specific heat=1.16 J/g.°C, thermal conductivity=0.6 W/m.°C and density=1.5 g/cm ³ , and erf(2)=0.995]. | 7 |
| C3 | A spherical casting of diameter 10 cm has a cylindrical top riser 5 cm in diameter and 10 cm high. Will the riser prevent macroporosity in the casting? | 4 |
| (a) | | |
| (b) | Figure 1 below shows a method of strip casting of 0.25 in thick, 48 in wide aluminium plate that is subsequently rolled into aluminium foil. The liquid aluminium is introduced between two large steel rolls that slowly turn. We want the aluminium to be completely solidified by the rolls just as the plate emerges from the machine. The counter rotating rolls with diameter 60 in. act as a permanent mold with a mold constant B of about 5 min/in ² when the aluminium is poured at the proper superheat. Calculate the contact angle, contact length, RPM and surface velocity the rolls required for this process to be feasible. | 7 |

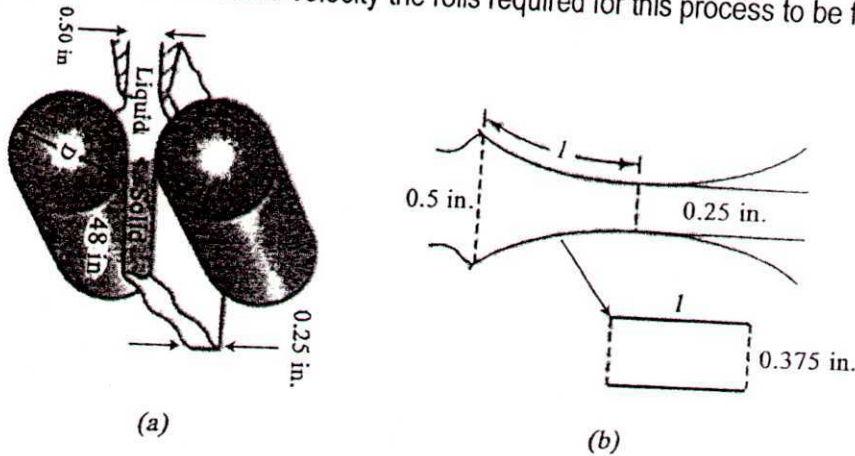


FIGURE 1: Strip casting of plate: (a) schematic of the process using two counter rotating rolls and (b) element of liquid metal in touch with rolls.

PART-B:: FORMING (34 Marks)

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| 1 | Derive the force requirement for an open-die forging process of a circular disc by using two flat platens. Bottom platen is stationary while the upper platens moves. Consider the stick-slip frictional condition between the workpiece and the die. Use any yield suitable yield criterion. | 10 |
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F2	An industry is producing long seamless tubes of circular cross-section, from short hollow members of circular cross-section by using a stationary die and a stationary cylindrical plug. It is a close-pass tube drawing operation. The die is conical in shape and does not have any "land" portion. The coefficients of friction between the die and the work-material, and, between the plug and the work-material are same. Consider the same amount of pressure is being exerted by both the die and the stationary plug to the work-material. Derive the force required to draw the seamless tube, following the above mentioned condition. No back-pull is applied.	10
F3	Write short notes on:	
(a)	Explosive forming	5
(b)	Different powder manufacturing methods	5
(c)	Draw the variation of ram pressure with its travel in a forward extrusion process. Show the breakthrough pressure.	4

PART-C:: WELDING (33 Marks)

W1	Briefly explain the desired characteristics of a DC power source to compensate the arc length variations so as to achieve a near uniform metal deposition rate in a typical arc welding process.	8
W2	In a typical arc welding process, discuss how the following parameters influence the shape & size of fusion zone and thereby the weld quality. Explain the mechanism of tear drop formation. (i) Weld velocity (ii) Thermal conductivity of the material and (iii) Thickness of the plates to be joined	9

W3 A 60 mm diameter rod through a 30 mm thick plate acting as a lever on a shaft, as shown in the figure. The rod is fillet welded to the plate on both sides.

What weld size is required if the throat stress is not to exceed 120 N/mm²?

W4	The introduction of hydrogen into construction steels during welding has major deleterious effects. In this context, discuss (i) Hydrogen embrittlement, (ii) Hydrogen porosity, and (iii) Hydrogen cracking. How to characterize these defects via destructive/Non-destructive testing?	9
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Best wishes from the course instructors