MID-SEMESTER EXAMINATION: September 2012

ME31007: CASTING FORMING WELDING

3rd Yr BTech Students

Total Number of students: 174; Full Marks: 100; Time: 2 Hours

Instruction: Assume any data which is required; but not mentioned.

PART : CASTING (33 Marks)

C1. (a) Chaplets are used to support a sand core inside a sand mold cavity. The projected core print area is 2 in^2 for each end of the cylindrical sand core to support. The design of the caplets and the manner in which they are placed in the mold cavity surface allows each caplet to sustain a force of 10 lbs. If the volume of the core = 500 $in.^3$, and the metal poured is brass, determine the minimum number of caplets that should be placed (a) beneath the core, and (b) above the core. (Density of sand core and brass are 0.058 and 0.313 lb/in^3 respectively, and the green sand strength is 2.5 lb/in^2)

(b) A ladle with a circular cross-section (diameter 2.0 m) contains 70×10^3 kg molten steel. The steel is teemed through a circular hole in the bottom of ladle. The diameter of the hole is 3.0 cm. Calculate the time required to empty the ladle. (Density of steel is 7.8×10^3 kg/m^3)

[5+6=11]

C2. (a) Derive following differential equation of pipe defect prediction in ingot casting with no hot top.

$\left(\frac{1-\beta}{\beta}\right)\frac{dZ}{dx}=\frac{2(x_0+y_0-4\Delta x)(z_0-C\Delta x-Z)}{(x_0-2\Delta x)(y_0-2\Delta x)}+C$, where all the symbols have their usual meaning.

(b) A 2.6 ton ingot is to be cast in a chill-mold with 60 cm X 60 cm square section and 98 cm height. Calculate the concave profile of the pipe as a function of the distance to the chill-mold wall. Determine the maximum depth of the pipe. The solidification shrinkage is 0.05.

(Note- The analytical solution of the above differential equation when $x_0=y_0$ and C=1 is:

$$Z=z_0-\frac{x_0}{2}-\frac{3\beta}{1-5\beta}(x_0-2\Delta x)+\left(\frac{3\beta x_0}{1-5\beta}-z_0+\frac{x_0}{2}\right)\left(\frac{x_0-2\Delta x}{x_0}\right)^{\frac{4\beta}{1-\beta}}$$)

[6+6=12]

C3. Answer the following questions in one sentence.

(a) Which teeming practice is characterized by a low rising speed of the steel in the mold so as to reduce cracks and surface defects in ingot casting?

(b) What are the factors influencing the permeability of molding sand (name at least three factors)?

(c) How liquid, solidification and solid shrinkages are taken care in sand casting process?

(d) During solidification of a Cu-Ni alloy (35% Ni) in a casting process, the composition of the solid phase is 46% Ni and liquid phase is 32% Ni due to partitioning. Determine the fraction of solid phase present in the above solid-liquid mixture.

(e) What are the functions of tundish in continuous casting process?

[2*5=10]

Question continues

PART : FORMING (33 Marks)

F1 (a).Find out the relation between *true strain* and *engineering strain.* [5]

(b). Determine the true strains in length (ε_l), width (ε_w), and thickness (ε_t) directions of a sheet metal test specimen if it is elongated to 140% of its original length, and because of anisotropy, the ratio of $\varepsilon_w/\varepsilon_t$ is 1.65. Also determine the percentage decrease in area of cross-section.

[3+2=5]

(c) The yield strength (σ_f) of a material is defined as $\sigma_f=\sigma_o(1+B\varepsilon)^n$, where σ_o, B, n are material properties, and ε is true strain. Determine the percentage increase in yield strength of annealed material bar if it is elongated from 190 mm to 230 mm. Consider σ_o=46 MPa, B=54 and n=0.202.

[5]

F2. (a) Find out the pressure at the neutral point for a single stage rolling operation without front and back tensions. [6+4=10]

(b) A strip with a cross-section of 140 mm x 8 mm is being rolled with 25% reduction of area, using 450 mm diameter steel rolls. Before and after rolling, the shear yield stress of the material is 0.32 kN/mm^2, and 0.42 kN/mm^2, respectively. Find out location of the neutral point. No front and back tensions. Coefficient of friction is 0.12. [5]

(c) What would be the effect on rolling load if [3]

(i) roll diameter reduces

(ii) rolling is done with front and back tensions

Show the *friction hill* for the above cases.

PART : WELDING (33 Marks)

W1. (a) The microstructures formed in the weld and the HAZ determines the properties of the weld. Name any three methods to control or improve the metallurgical properties of the weld.

(b) Explain the 3 types of flames in oxy-acetylene gas welding

(c) Name any three factors which influence the plasma temperature in an arc welding process

(d) Define the term "Arc blow" in welding

(e) Plot the variation of potential (voltage drop) across the space between the cathode and anode (electrode & work piece) in a typical arc welding process which uses an inert shielding gas

[5*3=15]

W2. (a) Differentiate between fusion welding and solid state welding. Give examples.

(b) Explain the micro structural features of the welded zone in the case of fusion welding and solid state welding

(c) How lattice continuity is achieved in fusion welding and solid state welding? Briefly describe the mechanisms.

[3*6=18]

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1 mark for neatly written answer script

Best wishes from the course instructors