ME 323
Instructor: Ramesh Singh
HW#1

Date assigned: 16.08.2025
Date due: 24.08.2025

1. You are designing cylindrical risers for a gear housing that will be sand cast from aluminum alloy (This is an insulating mold). The risers are coated with an insulating sleeve so that their heat transfer rate is 2.5 times lower than the sand mold. If the characteristic dimension for heat transfer for the casting is 25 mm (V/A), determine the diameter of the risers. Assume there is no heat loss from the top surface of the risers.
2. You are designing a sprue/runner/gate system to sand cast a component. The top of the sprue is 6 cm above the gate (h_t), and has a pouring basin 1.5 cm deep (h_b). The diameter of the top of the sprue is 2.5 cm. The molten metal has viscosity 2.0×10^{-3} N·s/m² and density 2700 kg/m³. The mold is top-gated.
   - Use appropriate Reynolds number for gating design and comment on whether the flow is laminar or turbulent, and the possible implications for the casting quality.
   - Determine a plausible diameter of the runner to avoid aspiration.

3. Determine the solidification time of the following two iron castings when both are poured with no superheats into sand molds at initial temperature of 28^0C.

   - A slab shaped casting 10 cm thick (h =10 cm) (Hint: Assume l, b >> h)
   - A sphere 10 cm in diameter

4. While casting an L section, a shrinkage cavity is formed as shown in Figure 1. Explain physically why the shrinkage cavity is avoided in (b) and (c) in Figure 1.

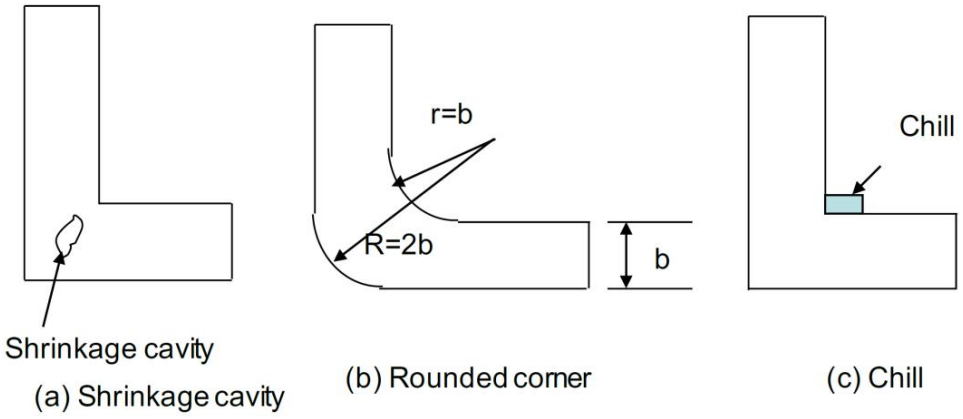

Fig. 1. Casting of L-section

5.

- Find the cycle time for casting one part in a sand mold shown in Figure 1. The initial setup time to prepare the mold and melt (molten metal) and transport the melt to the pouring basin is 30 minutes. The post casting time for cooling, breaking and finishing is another 20 minutes. Assume liquid metal level at X-X is constant and the time to fill the runner and vent is negligible. The cross-section of the mold is shown in Figure 1 and the depth (into the page) of the mold is 1.0 m. Assume that the iron is poured at melting temperature and ambient temperature is 25^0C. [15]
- If the top of the riser is insulated and there is 10% liquid volume shrinkage over the total volume, design a cylindrical riser for this casting. [10]

Properties:
For Iron,
$T_m = 1540^0$C, $H_f = 272$ KJ/kg, $\rho_{casting} = 7850$ kg/m^3, $k_{casting} = 83$ W/mK
For sand mold,
$c_m = 1.17$ KJ/kg.K, $k_m = 0.8655$ W/mK, $\rho_m = 1600$ kg/m^3

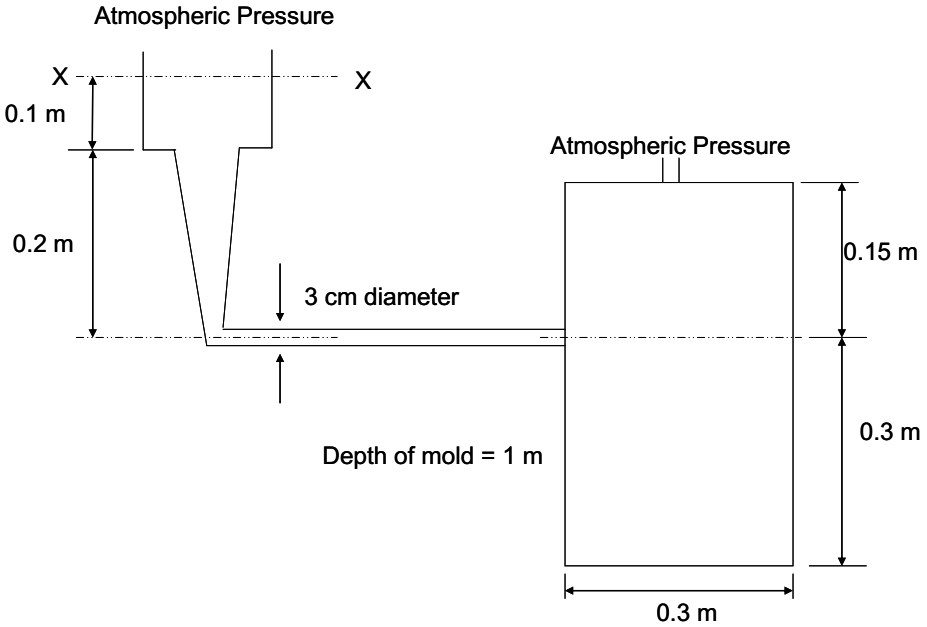

Figure 2: Cross-section of the mold