Ref. No. : Ex/PG/MET/PE/T/113B/2025

M.E. METALLURGICAL AND MATERIAL ENGINEERING FIRST YEAR 1ST SEMESTER – 2025

M.TECH. METALLURGICAL AND MATERIAL ENGINEERING FIRST YEAR 1ST SEMESTER – 2025

Subject: CASTING TECHNOLOGY

Time: 3hrs. **Full Marks: 100**

Instructions: Answer each group following the instruction

CO I (Answer any one question from CO I)

1. a) Why casting process is more important than other shaping process? b) Explain the green sand-casting process.
   b) Define general properties of the molding sand: i) Hot strength, ii) Thermal stability, iii) Collapsibility.
   c) Explain the metallurgical advantages of castings in comparison to other products. 5+5+9+6

2. a) What is the effect of moisture and clay content on green compressive strength of sands? Explain. How green compression test can be performed?
   b) What are the metallurgical drawbacks in the casting process? What alternative steps are taken to overcome the drawbacks? 8+6+6+5=25

CO II (Answer any one question from CO II)

3. a) Why is wood so commonly used for patternmaking? How can stability of timber be improved?
What is the role of a patternmaker in casting production? What metals and alloys are suitable for foundry patterns?
   b) Write short notes on (i) Loose pieces (ii) Stop-offs 4+4+5+4+8=25

4. a) Explain the steps involved in the preparation of epoxy patterns and polyester patterns. In what way are they superior to wooden patterns?
   b) What are the various types of pattern waxes? How are they used for investment casting? Give their salient properties and uses. 5+5+5+5+5=25

CO III (Answer all the questions from CO III)

5. **compulsory -Answer any five question.** 5x2= 10

i) Constitutional Super cooling ii) Cell structure iii) Coring, iv) Critical Nucleus, v) Furnace vi) Dendrite. Vii) A foundry cannot function without a furnace.

6 **Answer any one question.** 1x8=8

a. In case of pure metal solidification deduce from first the principle the critical nucleus size and volume free energy relations with under cooling. Explain- why heterogeneous nucleation is common. 5+3=8

b. Describe Cast iron microstructures for different cast irons, with the associated relations of mechanical properties due to C, Si, S and Mg. How will you design a suitable grain refiner for Al-Si Alloy? 5+3=8

7. Discuss the following terms: **Answer any one question** 1x7=7
   i. Directional solidification.
   ii. Metallic glass solidification.

[Turn over

CO IV (Answer any one question from CO IV)

8. a) Differentiate between gray and nodular cast iron with respect to its microstructure, properties and applications. What is white cast iron? What is ADI? Explain the advantages of ADI.

b) Molten metal can be poured into the pouring cup of a sand mold at a steady rate of 1000 cm3/s. The molten metal overflows the pouring cup and flows into the downsprue. The cross-section of the sprue is round, with a diameter at the top = 3.4 cm. If the sprue is 25cm long, determine the proper diameter at its base so as to maintain the same volume flow rate. 7+4+3+5+6=25

9. a) Describe microstructures of different cast irons, with the associated relations of mechanical properties due to C, Si, S and Mg. How will you design a suitable grain refiner for Al-Si Alloy?

b) During pouring into a sand mold, the molten metal can be poured into the downsprue at a constant flow rate during the time it takes to fill the mold. At the end of pouring the sprue is filled and there is negligible metal in the pouring cup. The downsprue is 15 cm long. Its cross-sectional area at the top = 5 cm^2 and at the base = 3.75 cm^2. The cross-sectional area of the runner leading from the sprue also = 3.75 cm^2, and it is 20 cm long before leading into the mold cavity, whose volume = 1015 cm^3. The volume of the riser located along the runner near the mold cavity = 390 cm^3. It takes a total of 3.0 sec to fill the entire mold (including cavity, riser, runner, and sprue). This is more than the theoretical time required, indicating a loss of velocity due to friction in the sprue and runner.

Find: (i) the theoretical velocity and flow rate at the base of the downsprue; (ii) the total volume of the mold; (iii) the actual velocity and flow rate at the base of the sprue; and (iv) the loss of head in the gating system due to friction.

8+5+12=25