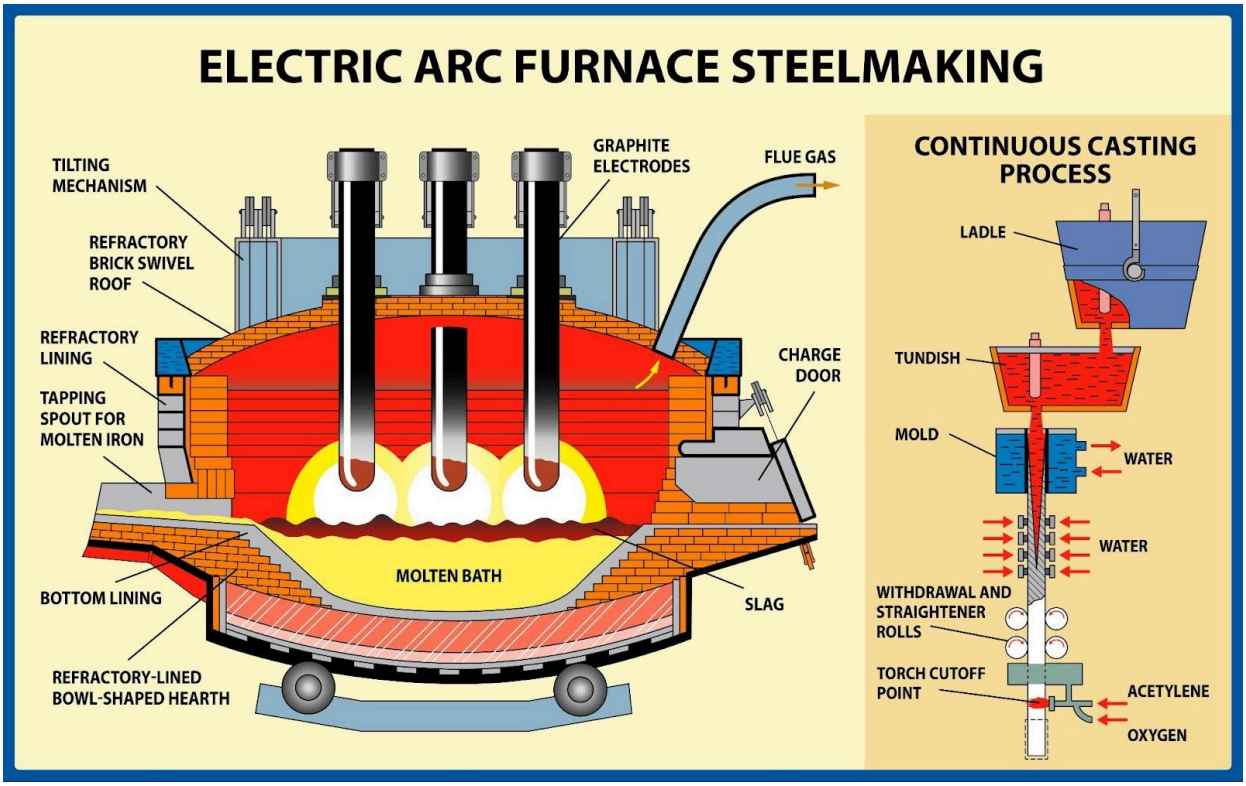
Assignment: Manufacturing Techniques and Metal Joining Processes

Course: Mechanical Engineering Science (UE25ME141A/B)
Unit 3: Manufacturing Techniques and Metal Joining Processes

1. **Define** the primary function of a Riser and a Gate in a typical sand casting mould assembly.
2. **List** the five main classifications of manufacturing processes as discussed in the unit (e.g., Primary Shaping, Machining, etc.).
3. **State** the critical temperature criterion (in ${}^\circ \text{C}$) that distinguishes the filler metal used in Brazing from the filler metal used in Soldering.
4. **Identify** two specific characteristics of the product manufactured using the Die Casting process.
5. **What** is the key difference between Hot Rolling and Cold Rolling in terms of processing temperature relative to the material's properties?
6. **Explain** why Investment Casting (Lost Wax process) is often preferred over Sand Casting for the manufacture of complex aerospace or turbine components, focusing on the resulting dimensional accuracy and surface finish.
7. **Describe** the mechanism of heat generation in Resistance Spot Welding and explain why no filler material is typically required.
8. **Differentiate** between Direct Extrusion and Indirect Extrusion, outlining the motion of the die and the billet in each process.
9. **Summarize** the role of **Flux** in both Arc Welding (SMAW) and Brazing processes.
10. **Problem:** A mechanical component requires a very high strength-to-weight ratio and a refined grain structure. If the initial component geometry is simple (e.g., a simple shaft), **Suggest** the most appropriate primary shaping process (Casting, Rolling, or Forging) and **Justify** your choice based on the resulting material properties.
11. **Scenario:** A fabrication shop needs to join two thin aluminum sheets. The process must be clean, precise, and result in minimal thermal distortion. **Determine** whether Shielded Metal Arc Welding (SMAW) or Gas Tungsten Arc Welding (GTAW/TIG) is the better choice and **Illustrate** the specific setup required for the selected process.
12. **Procedure:** A designer has created a detailed pattern for sand casting. **Outline** the complete sequence of steps required to successfully produce the final cast component, starting from the molding process and ending with the cleaning process.



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13. **Compare and Contrast** the process, advantages, and limitations of **Brazing** and **Fusion Welding** (like SMAW) across the following criteria: Base Metal melting, Joint Strength, Heat Input, and suitability for Dissimilar Metals.
14. **Analyze** the effect of **Cold Working** (such as Cold Rolling) on the following three material properties: Yield Strength, Ductility, and Surface Finish. Explain the microstructural reason for the change in each property.
15. **Investigate** why large, complex castings made of metals with high melting points are rarely manufactured using the Hot Chamber Die Casting process. What is the fundamental limitation of the equipment in this scenario?
16. **Critique** the statement: "Forging is always the superior manufacturing process because it guarantees maximum material strength." Provide a counter-argument by discussing scenarios (e.g., component size, complexity, or material cost) where another process (like Investment Casting or Machining) would be a more efficient or cost-effective choice.
17. **Justify** the use of **Oxy-Acetylene** as a heat source for Gas Welding and Torch Brazing, but explain why it is typically considered an inefficient or outdated method for heavy structural steel welding compared to modern arc welding techniques.
18. **Assess** the suitability of using Soldering for joining two structural steel beams that will bear a heavy tensile load. **Propose** an alternative joining method from the unit and **Evaluate** the benefits of the proposed alternative over soldering.
19. **Design a Process Plan:** A client needs 50,000 units of small, intricate gearbox components made of aluminum alloy, requiring tight dimensional tolerances and an excellent surface finish for assembly. **Develop** a step-by-step manufacturing process

plan, selecting the most appropriate casting method (Sand, Die, or Investment) and **Create** a workflow diagram showing the stages from raw material to finished part.

20. **Propose a Novel Application:** Consider the unique properties of the **Extrusion** process (uniform cross-section, refined grain flow). **Generate** a proposal for a new product, not traditionally associated with extrusion, that could benefit significantly from being manufactured using this technique. Detail the chosen material, the product's cross-section, and the resulting advantages.