

M.E. MECHANICAL ENGINEERING FIRST YEAR SECOND SEMESTER – 2018
ADVANCED MANUFACTURING SCIENCE

Time: 3 hr

Full Marks: 100

Answer any five questions.

Assume suitable data if necessary.

1. a) Discuss the factors that affect the strength and other mechanical properties of adhesive joint.
- b) A lap joint is made between two aluminium sheets of 1.2 mm thickness with an adhesive thickness of 0.025 mm the overlap length is 12 mm. Given $E_{Al} = 703 \text{ N-mm}^{-2}$, $G_a = 11.9 \text{ N-mm}^{-2}$ and the ultimate shear stress of the adhesive = 0.6 N-mm^{-2} . Determine the maximum shear the lap joint can withstand. The symbols carry usual meaning.
- c) Discuss the different modes of metal transfer in arc welding. 7 + 5 + 8

2. a) In a butt welding process using arc welding, the arc power is found to be 2.5 kVA. The process is used to weld to steel plates each of 3 mm thickness and having 60° edge preparations. Determine the maximum possible welding speed. It is assume that the metal transfer is a short circuit type with arc is on for the 80% of the total time. Given
 Thermal diffusivity of steel = $1.2 \times 10^{-5} \text{ m}^2 \text{ s}^{-1}$,
 Thermal conductivity of steel = $43.6 \text{ Wm}^{-1} \text{ }^\circ\text{C}^{-1}$,
 Melting point of steel = $1525 \text{ }^\circ\text{C}$,
 Ambient temperature = $28 \text{ }^\circ\text{C}$.
- b) Discuss about contact resistance heat source. Also determine an expression of contact resistance per unit area. State the assumptions for this purpose. 10 + 10

3. a) A strip of lead with initial dimensions 24 mm X 24 mm X 150 mm is forged between two flat dies to a final size of 6 mm X 96 mm X 150 mm. If the coefficient of friction between the job and the dies is 0.25, determine the maximum forging force. The average yield stress of lead in tension is 7 N-mm^{-2} .
- b) Discuss about the distortion-energy criterion and maximum-shear stress criterion in metal forming techniques. 10 + 10

4. a) Derive an expression of rolling load in cold rolling process.
- b) A 300 mm wide aluminium alloy strip is hot rolled from thickness 20 mm to 15 mm. The rolls are 1 m in diameter and operate at 100 rpm. The uniaxial through stress for the aluminium alloy can be expressed $\sigma = 140\epsilon^{0.2} \text{ MPa}$. Determine the rolling load and the power required for this hot reduction. 12 + 8

5. a) Calculate the size of a cylindrical riser (height and diameter equal) necessary to feed a steel slab casting of dimensions 30 cm X 30 cm X 6 cm with a side riser, casting poured horizontally into the mould.
 Given: Constants for Chvorinov's equation for steel
 $a = 0.10$, $b = 0.03$ and $c = 1.00$
 a , b and c have got usual meanings.
- b) What is the directional solidification? Explain it with the help of a diagram. 12+8
6. a) What is meant by "precision investment casting"?
 b) With a neat sketch describe "Lost- wax method".
 c) Sketch and describe various sand mould casting defects. (only 4 types) 4 + 8 + 8
7. a) "Although sand casting is the most widely used process judging from the tonnage of castings produced, there are instances where one would choose die-casting in preference to sand casting"- Discuss.
 b) With a neat sketch describe centrifugal casting.
 c) With neat sketches discuss various types of cores used in sand casting. 5 + 10 + 5
8. a) "The risers of casting are made with a high volume to surface ratio"- Explain.
 b) With a neat sketch describe cold chamber die- casting process.
 c) Copper- Nickel phase diagram has no eutectic – why? Explain it with its phase diagram. 6 + 8 + 6