Ref. No.: *Ex/PG/ME/T/128K/2017*

ME MECHANICAL ENGINEERING 1st YEAR 2nd SEMESTER EXAMINATION, 2017.

ADVANCED MANUFACTURING SCIENCE

Time: Three hours

Full Marks: 100

Answer any ***five*** questions, taking at least two from any group.

Assume suitable data if necessary.

Use separate answer script for each part.

PART-I

1. a) Calculate the temperature of a point (-50, 15, 0) mm with respect to the arc as origin for laying a single weld bead on a wide steel plate by GTAW process using 200 A and 18 V at a welding speed of 125 mm/min. Assume thermal conductivity of steel (K) = 55 kcal/m.hr.°C and diffusivity (α) = 0.0625 m^2/hr. Consider the plate of an infinite thickness (semi-infinite plate).

   b) Discuss about the different types of coating of coated electrode used for MMAW.

12 + 8

2. a) In a butt welding process using arc welding the arc power is found to be 2.4 kVA. The process is used to weld two 3 mm steel plates. Determine the maximum possible welding speed. The metal transfer is of short circuit type and the arc is on for the 80% of the total time. A 60° edge preparation is used. Given $\alpha_{steel} = 1.2 \times 10^{-5}$ m^2s^{-1} and k_{steel} = 43.6 W/m-°C. The melting point of steel is 1530°C and the ambient temperature is 25°C.

   b) Discuss the principle of solid phase welding.

12 + 8

3. a) A circular disc of lead of radius 150 mm and thickness 50 mm is reduced to a thickness of 25 mm by open die forging. If the coefficient of friction between the job and the die is 0.25, determine the maximum forging force. The average shear yield stress of lead can be taken as 4 N/mm^2.

   b) Derive the formulae used for solving the above problem.

6 + 14

4. a) Stress analysis of a space craft structural member gives the state of stress shown in Fig. 1. If the part is made from 7075-T6 aluminium alloy with σ_0= 500 MPa, will it exhibit yielding? If not, what is the safety factor?

b) Explain Tresca's maximum shear energy criterion and von Mises' maximum distortion energy criterion. Also establish the relationship between tensile and shear yield stresses.

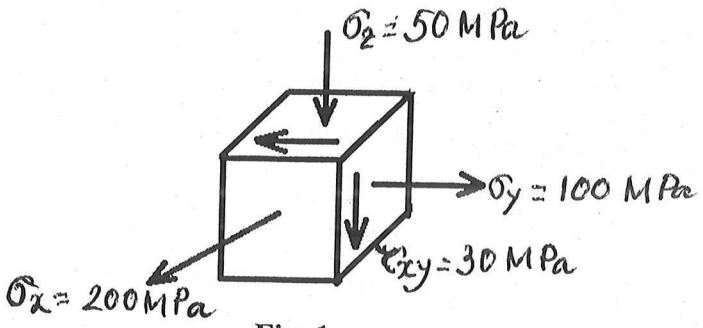


Fig. 1

10 + 10

PART-II

5. a) Steel can be cast, cast iron can be cast very easily. But in most of the cases we prefer cast iron for casting, but not for steel – Why?
   b) Internal corners are more prone to solidification shrinkage than external corner – Explain.
   c) Explain why the sprue should be tapered.
   d) Why the risers should be made with a high volume/surface area ratio?

5 X 4 = 20

6. a) What is directional solidification? Explain it with the help of a diagram.
   b) Explain the use of chills with an example.
   c) Calculate the size of a cylindrical riser (height & diameter equal) necessary to feed a steel slab casting of dimensions 25 X 25 X 5 cm with a side riser, casting poured horizontally into the mould.

   Given: constants for Caine's equation for the steel are:

   a = 0.10, b = 0.03, c = 1.00

6 + 6 + 8 = 20

7. a) Why it is necessary to use unpressurised gating system for non-ferrous metal?
   b) Describe the cold chamber die-casting process with a neat sketch.
   c) Compare the solidification times for the casting of three different shapes of same volume: Cube, Sphere and Cylinder (height equal to its diameter).

5 + 10 + 5 = 20

8. a) What is centre-line feeding resistance?

b) With a neat sketch describe centrifugal casting process.

c) Describe how inspection of casting can be carried out.

5 + 8 + 7 = 20

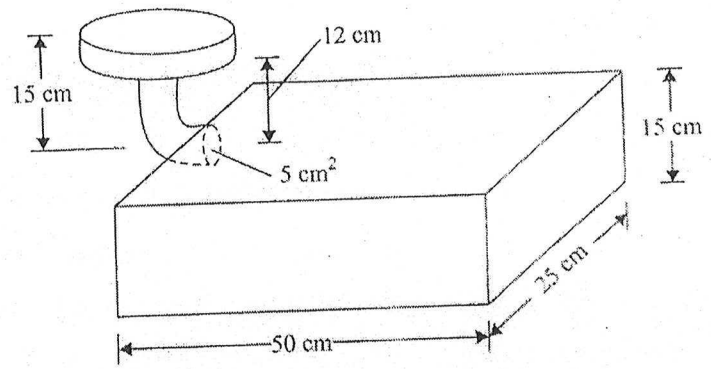
or

a) What is Aspiration effect?

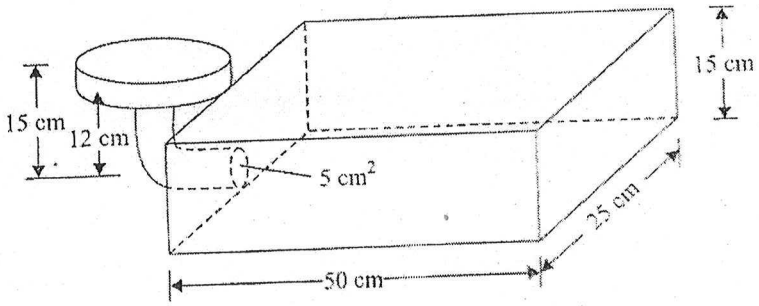
b) What are the various defects which are likely to be caused in sand casting because of higher pouring temperature?

c) Two gating designs for a mould of 50 cm X 25 cm X 15 cm are shown in Fig. 2. The cross-sectional area of the gate is 5 cm^2. Determine the filling time for both the designs.

5 + 7 + 8 = 20



(a) Top gating



(b) Bottom gating

Top and bottom gating designs.

Fig. 2