Name : ……………………………………………………………

Roll No. : ……………………………………………………………

Invigilator's Signature : ………………………………………

CS/M.TECH (PE) /SEM-1/PEM-101/2009-10
2009
ADVANCED IN FORMING & JOINING PROCESSES

Time Allotted : 3 Hours   Full Marks : 70

The figures in the margin indicate full marks.

Candidates are required to give their answers in their own words as far as practicable.

Answer any *five* questions taking at least *one* from each Group.

GROUP – A

1. a) A 3D strain field is given by

    $V = i (2xyz) + j (2x^2 + yz) + k (x^2 y + y^2 z)$.

    Find the strain tensor at point (1, 2, 1).   3

   b) Write equilibrium equation for three dimensional stress taking body forces in consideration.   3

   c) Prove $\nabla^2 (\sigma_x + \sigma_y) = 0$ for two dimensional plane stress situation.   6

   d) A 2D stress tensor is given by

    $\tau_{ij} = \begin{bmatrix} 100 & 60 \\ 60 & 50 \end{bmatrix}$ MPa.

    Find the radius of Mohr's circle.   2

200045   [Turn over

2. a) State von Mises and Tresca's criterion for three dimensional stress situation. 6

   b) Prove that the angle between two slip lines of one family at points where they are cut by a slip line of the other family is constant along their lengths. 5

   c) State lower bound theorem with mathematical expression. 3

3. a) An aluminium cap of inside radius 40 mm and thickness 5 mm is to be drawn from a blank with a diameter of 50 mm. The shear yield stress and the maximum allowable stress in the material can be taken as 14 N/mm^2 and 80 N/mm^2 respectively. Determine

   i) the drawing force

   ii) the maximum possible radius of the cap which can be drawn from the given blank without causing a fracture.

   Given μ = 0·1 and β = 0·05. 6

   b) Deduce the relationships you use for the above problem. 8

4. a) A strip of lead with initial dimensions of

   24 mm × 24 mm × 150 mm is forged between two flat dies to a final size of 6 mm × 96 mm × 150 mm. If the coefficient of friction between the job and the die is 0·25. Determine the maximum forging force. The average yield stress of lead in tension is 7 N/mm^2 . 6

   b) Deduce the relationships those are required for the above problem. 8

GROUP – B

5. a) What is meant by resistance welding ? Show the variation of temperature along the thickness of parent metal in case of resistance spot welding.

   b) What is material of the electrode and its size in resistance spot welding ? Draw possible shapes of the electrode for the said welding.

   c) Two steel sheets, 1·5 mm thick, are to be spot welded by passing 10000 A current for 0·1 s. The maximum allowable indentation is 10% of the sheet thickness. The denity of the spot weld nugget is 8 g/c.c. If 1380 J are required to melt one gram of steel, find

      i) the percent of heat actually utilised in making the spot weld.

      ii) the diameter of the cylindrical electrode if the truncated cone angle is 150° and the tapered length is 30 mm.

      Take the resistance = 200 $\mu\Omega$. Use the relationship

      $d_n = 6\sqrt{t}$ to find nugget diameter where t = sheet thickness. 4 + 5 + 5

6. a) In detail, discuss the different forces responsible for metal transfer in arc welding process.

   b) What are the different modes of metal transfer in arc welding process ? Explain them with suitable sketches.

   8 + 6

7. a) Briefly discuss about the method of welding of plastics.

   b) What is meant by 60% duty cycle of a power source for arc welding ? Can it be used for 100% duty cycle ? If yes, how is it possible ?

   c) What is optimum arc length ? Explain with necessary sketch.

   d) Classify welding process on the basis of filler material used. Explain them with proper examples.

   6 + 2 + 2 + 4

GROUP – C

8. a) Give in details wih reasons, the beginning and finishing temperature of metal working operationn.   5

    b) Show schematically the effect of temperature, pressure and strain rate on the allowable working range.   5

    c) What is warm working ? When is it applied. Give examples.   4

9. a) Give a list of different forging equipments and their velocity ranges.   4

    b) Indicate the forging equipments required for making bolts, rivets and gear blank.   2

    c) What is impression die forging ?   2

    d) Explain the function of flash.   2

    e) Give a neat flow diagram for CAD and CAM systems applied to closed die forging.   4

10. a) Describe briefly the rapid solidification techniques.   8

    b) What is the difference between Rheo casting and Thixo moulding ?   4

    c) Why is squeeze casting called liquid forging ?   2

11. a) Write short notes on any *three* of the following :

    3×4

    i)   Stereolithography

    ii)   Selective laser sintering (SLS)

    iii) Pattern making using rapid tooling

    iv)   Use of CMM and slicing in RP-RT process.

    b) Why is RP-RT process difficult for implementing in metallic components ?   2

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