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ME—403

B. TECH.

FOURTH SEMESTER EXAMINATION, 2002-2003

MANUFACTURING SCIENCE – I

Time : 3 Hours

Total Marks : 100

Note : (1) Attempt **ALL** the questions.

Marks are shown against each.

(2) Symbols have their usual meaning. Assume any missing data, if so required.

(3) Weightage will be given to brief and to-the-point answers duly illustrated by suitable sketches.

1. Answer the following :—**(2×10=20)**

(a) (i) Indicate the carbon percentage in gray cast-iron.

(ii) Indicate the AC_1 temperature for steel (lower critical temperature)

(b) What is the material for

(i) Twist drills,

(ii) flexible hose pipe used in gardens.

(c) Name the processes of manufacture for

(i) Tungsten carbide tool-tips,

(ii) Crank-shaft for I.C. engines.

(d) What is the typical composition of

(i) H.S.S.,

(ii) Duralumin.

- (e) Write down the expanded forms of
- (i) L & T (which is an industry)
 - (ii) N.D.T. (which relates to testing)
- (f) Fill in the blanks :
- (i) Foundry sand should be able to withstand high temperature. It should have the property called -----.
 - (ii) Foundry sand should be porous to allow passage for gases etc. This property is called -----.
- (g) State whether the following statements are 'true' or 'false' :—
- (i) In blanking operation of press-work, clearance is given on punch.
 - (ii) Solidification time for castings is proportional to $\left(\frac{\text{Volume}}{\text{Area}}\right)^2$.
- (h) Write the full name of
- (i) an explosive
 - (ii) Teflon-plastic
- (i) Write the name of
- (i) the common furnace used for melting cast-iron,
 - (ii) the bricks used for lining the furnace-walls.
- (j) Name the metal forming processes in which following defects may occur :—
- (i) Crocodile cracks
 - (ii) Centre-burst

- (a) Briefly describe (i) Tresca's and (ii) Mixs' yield criteria. Compare the two and show that the relationship between shear yield stress K and tensile yield stress σ_y for these two criteria are

$$\text{given by } K = \frac{\sigma_y}{2} \text{ and } K = \frac{\sigma_y}{\sqrt{3}}$$

respectively.

- (b) Draw neat freehand sketches of (i) Anvil (ii) Swage block and (iii) Tongs used in smithy. Also, compare hot working and cold working processes indicating advantages and disadvantages of each.
- (c) Derive the following expression for pressure distribution in forging of a rectangular block of size $b \times h \times w$ under "sticking friction"

condition $\frac{p}{2K} = 1 - \frac{1}{h} \left(x - \frac{b}{2} \right)$, where p is the pressure at a distance x from centre, K is the shear yield stress of the material of the block, h is the height of the block and b is the breadth in the xy plane.

3. Answer any TWO of the following :— (8×2=16)

- (a) Derive the following expression for drawing stress σ_{xa} for wire drawing :—

$$\frac{\sigma_{xa}}{2K} = \frac{1+\beta}{\beta} \left[1 - \left(\frac{D_a}{D_b} \right)^{2\beta} \right], \text{ where } \beta = \mu \cot \alpha,$$

μ being the coefficient of friction and

α semi-die angle, and K is the shear strength of wire material and D_a and D_b are diameters of the wire at exit and inlet of the die respectively.

- (b) A flat strip of thickness $h_1 = 5$ mm is to be reduced to $h_2 = 4$ mm. Taking $\mu = 0.1$ and considering this friction to be enough for rolling, find the roll-radius R .

Also ascertain (i) the mean roll pressure

$$\left[= 2 K \left\{ 1 + \frac{\mu L}{(h_1 + h_2)} \right\} \right], L \text{ being the roll}$$

contact length, and (ii) Power required for rolling. Take roll rpm as 6, roll width as 20 mm and shear strength of strip, K as 200 N/mm².

- (c) Describe some common rolling and extrusion defects. Also, indicate remedial measures. Give a few examples of rolled and extruded products.

4. Answer any TWO of the following :— (8×2=16)

- (a) Draw a neat sketch of die-punch assembly with accessory parts/components. Also, explain how cutting operations such as blanking or piercing differ from deep drawing operation.
- (b) A cup of 105 mm diameter and 90 mm depth is to be drawn from a sheet of $t = 1$ mm thickness. Determine the blank diameter D . Whether it is possible to draw the cup without fracture from blank dia D to a cup

of diameter 'd' can be checked with the help of the following empirical relationship :—

If $\frac{D}{d} \leq 1.2 + 1.6 \frac{t}{D} \times 100$, cup can be drawn without fracture, otherwise not.

Using this relationship, check if it is possible to draw the cup in one draw or not. If not, how many draws are needed? For subsequent draw, take D as previous cup dia 'd'.

- (c) Briefly describe the process for
- (i) making a washer with the help of progressive and compound dies, and
 - (ii) bending a strip making allowance for its spring back.

5. Answer any TWO of the following :— (8×2=16)

- (a) Describe the principle and process of
- (i) Electro-hydraulic forming and
 - (ii) Electromagnetic forming.
- (b) Describe the processes of (i) Injection moulding, and (ii) Extrusion of plastics.
- (c) Differentiate between jigs and fixtures. Why are they used? Draw sketches of one jig and one fixture and describe how they will be used.

6. Answer any TWO of the following :— (8×2=16)

- (a) Describe the various kinds of patterns in use. What are the allowances provided, when making a pattern? How do the patterns differ from the casting required?

(b) What are the common defects found in castings? What causes them and what measures can be taken to avoid defects from occurring?

(c) Write short notes on any TWO of the following :—

- (i) Manufacture of components by powder-metallurgy process
- (ii) Investment casting
- (iii) Cupola furnace and its operation
- (iv) Solidification of castings