

Bengal Engineering and Science University, Shibpur
B. E. (Mechanical) Part II 4th Semester Final Examination, 2013

Subject: Engineering Materials & Processes (ME-403)

Time: 3 Hours

Full Marks: 70

Answer SIX questions taking THREE from each half

All questions carry equal marks, two marks in each half is reserved for overall quality.

FIRST HALF

1. (a) Explain why 'yield stress' is replaced by 'flow stress' for estimating the power requirement of a metal forming operation?
(b) What is impression die forging? Why flash is necessary in such forging?
(c) Evaluate the press capacity for forging a part of dimension $300 \times 300 \times 500$ (l x b x h, in mm) to reduce its height by 20% from its original height, keeping a square cross-section (of changed dimensions). Assume coefficient of friction = 0.3 and flow stress for the process = 140 MPa. Also calculate the maximum pressure. [2+3+6]
2. (a) Explain, with diagram, the requirement of temperature distribution across the different points of the electrodes and workpieces for resistance welding also highlight how such distribution can be well maintained.
(b) The unit melting energy for a certain sheet metal to be spot-welded is $U_m = 10.0 \text{ J/mm}^3$. Maximum current possible for the machine = 10000A. To achieve required strength, it is desired to form a weld-nugget that is 5.0 mm in diameter and t mm thick. Assume that $t = 70\%$ of the total thickness of the sheets to be joined. The weld duration is set at 0.1 sec. It is assumed that the total electrical resistance between the surfaces = 100 micro-ohms and that only 30% of the electrical energy will be utilized to form the nugget. Determine the maximum possible sheet thickness (single sheet) for the operation. [4+7]
3. (a) Explain the difference between constant current and constant voltage welding machine, highlighting their characteristics and applications.
(b) What is overhead welding? What is the requirement of such welding? Why?
(c) What is HAZ? Explain its importance.
(d) What is short-circuit and open-circuit of a welding machine setting? [3+2+3+3]
4. (a) Make a labeled diagram of continuous casting process.
(b) Explain how the rotational speed is calculated for true centrifugal casting. Derive the expression and explain with actual example, take $D = 400 \text{ mm}$ and $G\text{-factor} = 60$.
(c) What is the difference between true centrifugal and semi-centrifugal casting. [4+5+2]
5. Write short notes on:
(a) Types of extrusion process
(b) Green strength and dry strength of moulding sand.
(c) Cold chamber die casting [4+3+4]

Second Half

6. (a) What is flow stress? How it relates to the strain hardening property of the material?
(b) Draw the true-stress versus true strain diagram for the stainless steel specimen in a tensile test.

Given that. Initial area, $A_0 = 0.35 \text{ cm}^2$, Initial length, $l_0 = 5 \text{ cm}$ and area at the fracture point, $A_f = 0.105 \text{ cm}^2$

Load (kg)	Extension (cm)
800	0
1250	0.05
1500	0.22
1800	0.52
2100	1.2
2250	1.5
2300	2.25
1650	fracture

7. (a) What useful information does a phase diagram provide? Draw the Iron-Carbon Equilibrium diagram showing all important points.
(b) Explain Eutectic and Eutectoid reactions and find percentage of solid phases present in pearlitic steel at room temperature.
8. (a) Define hardness, toughness and creep of a material. Addition of carbon in a ductile material affects on the stress-strain diagram - justify? Write a few applications of creep material.
(b) Write the characteristics and applications of the following heat treatment processes:
(i) Iso-thermal annealing and normalizing
(ii) Surface hardening
(iii) Process annealing
9. (a) What happens if austenite steel is allowed to cool isothermally below lower critical temperature? Write the applications of the following materials:
Stainless steel, Phosphor bronze and Ceramic materials
(b) A 0.83% C in eutectoid plain-carbon steel is slowly cooled from 760°C to a temperature just slightly below 723°C . Assuming that the austenite is completely transformed to ferrite and cementite, calculate the weight percentage of ferrite and cementite formed at eutectoid point.
10. Write short notes on the followings:
(a) Tool and Die material
(b) Hardening and Tempering
(c) Composite materials and their applications