Total No. of Pages : 02

B.Tech. (Mechanical Engineering) (Sem.–4)
MATERIALS ENGINEERING
Subject Code : BTME404-18
M.Code : 77549
Date of Examination : 03-01-2025

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :

1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

SECTION-A

1. Write briefly :

   a. What are four quantum numbers?

   b. Explain the difference between electropositive and electronegative elements.

   c. Explain metallic bonding.

   d. What do you mean by amorphous materials? Give one example.

   e. Explain the difference between steady state and non-steady state diffusion.

   f. What useful information can be derived from phase diagrams?

   g. Why hardening is always followed by tempering treatment?

   h. Explain the term hardenability.

   i. What is stainless steel?

   j. In the context of alloy steels, discuss the role of carbide forming elements.

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SECTION-B

2. What are interfacial defects? Using appropriate sketch, explain twin boundaries.

3. Stating the assumptions made, derive the following form of second law of diffusion : $\frac{\partial c}{\partial t} = D\frac{\partial^2 C}{\partial X^2}$, where D, C, x and t are diffusion coefficient, concentration, distance and time, respectively.

4. Sketch Fe-Fe$_3$C diagram for plain carbon steel and explain the phases appearing in this system.

5. Differentiate between full hardening and surface hardening of steels.

6. Explain the following heat-treatment defects:

   a) Decarburization

   b) Quench Cracking.

SECTION-C

7. a) What is TTT diagram? Discuss its limitations.

   b) Discuss the process and objectives of cyaniding.

8. Explain the objectives of alloying of steels. Discuss the effects of adding Cr and Mo on the properties of steels.

9. a) Use suitable diagrams, discuss the mechanism of plastic deformation by dislocation motion.

   b) Explain Jominy end-quench test of measuring hardenability of steel.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.

B.Tech. (Mechanical Engineering) (Sem.–4)
STRENGTH OF MATERIALS-II
Subject Code : BTME-403-18

M.Code : 77548

Date of Examination : 22-12-2024

Time : 3 Hrs.

Max. Marks : 60

INSTRUCTIONS TO CANDIDATES :
1. SECTION-A is COMPULSORY consisting of TEN questions carrying TWO marks each.
2. SECTION-B contains FIVE questions carrying FIVE marks each and students have to attempt any FOUR questions.
3. SECTION-C contains THREE questions carrying TEN marks each and students have to attempt any TWO questions.

SECTION-A

1. Write briefly :

   a. Define modulus of resilience.

   b. What is shear strain energy?

   c. Express mathematical form of maximum strain energy theory of failure.

   d. Differentiate between close coiled and open coiled helical spring.

   e. Explain the significance of Wahl's correction factor for springs.

   f. Why cross section of a crane hook is generally trapezoidal?

   g. In the context of thin cylinder, define efficiency of the joint.

   h. Why compounding of thick cylinder is carried out?

   i. What is shear centre of a beam?

   j. Explain collapse speed of a rotating disc.

SECTION-B

2. State and prove Castigliano's first theorem.

3. Explain the maximum shear stress theory of failure. Compare it graphically with maximum principal stress theory.

4. The length of the largest plate of a semi-elliptical laminated spring is 800 mm. The central load is 6 kN and the central deflection is 20 mm. The allowable bending stress is 210 MPa and the width of the plates is 10 times the thickness. Determine: (a) thickness and width of plates, and (b) number of plates. Assume E = 200 GPa.

5. A 20 m diameter spherical tank is to be used to store gas. The shell plating is 10 mm thick and the working stress of the material is 125 MPa. What is the maximum permissible gas pressure p?

6. A flywheel rim with a mean diameter of 6 m rotates at a speed such that the hoop stress in the material is 10 MPa. The density of the material of the rim is 7000 kg/m^3. Determine the limiting speed of the flywheel, ignoring the effect of arms.

SECTION-C

7. A crane hook having a trapezoidal horizontal cross section is 50 mm wide at inside and 25 mm wide at outside. Thickness of the section is 50 mm. The crane hook carries a vertical load of 10 kN whose line of action is 38 mm from the inside edge of the section. The centre of curvature is 50 mm from the inside edge. Determine the maximum tensile and compressive stresses in the section.

8. Stating the assumptions made, deduce the general equations for circumferential and radial stresses developed in thick cylinders.

9. A 200 mm wide and 250 mm deep T-sectional beam has a web and flanges thickness of 50 mm. It is subjected to a vertical shear force of 100 kN. Determine the shear stress at the junction of the web and the flange. Also find the shear stress at the neutral axis. Moment of inertia about the horizontal neutral axis is 113.4×10^6 mm^4.