

1

a) Define the following properties of a material:

- a. Ductility
- b. Toughness
- c. Hardness and
- d. Creep.

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OR

b) A cylindrical shaft made of steel of yield strength 700 MPa is subjected to static loads consisting of bending moment 10kN-m and a torsional moment of 30kN-m. Determine the diameter of shaft using any two theories of failure and assuming a factor of safety of 2. Take $E = 210 \text{ GPa}$ and Poisson's ratio = 0.25.

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= 0.25.

2

a) Explain the significance of Goodman's line, Soderberg line and modified Goodman line in

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design of members subjected to reversal of stresses?

OR

b) A solid circular shaft, 20 mm in diameter, is subjected to torsional shear stress, which varies from 0 to 35 N/mm² and at the same time, is subjected to an axial stress that varies from -15 to +30 N/mm². The frequency of variation of these stresses is equal to the shaft speed. The shaft is made of steel FeE 400 ($\sigma_u = 540$ N/mm² and $\sigma_y = 400$ N/mm² and the corrected endurance limit of the shaft is 200 N/mm². Determine the factor of safety.

3

a) How do you classify the riveted joints?

OR

b) Design a double riveted butt joint with two cover plates for the longitudinal seam of a boiler shell 1.5 m in diameter subjected to a steam pressure of 0.95 N/mm². Assume joint efficiency as 75%, allowable tensile stress in the plate 90MPa, compressive stress 140 MPa and shear stress in the rivet is 56 MPa. pg no 305

1	<p>a) What are the general considerations in designing machine members? Discuss in detail.</p> <p>pg no 2</p>
	<p>OR</p>
	<p>b) A mild steel shaft of 50 mm diameter is subjected to a bending moment of 2000 Nm and a torque T. If the yield point of the steel in tension is 200 MPa, find the maximum value of this torque without causing yielding of the shaft according to (a) the maximum principal stress (b) the maximum distortion strain energy theory of yielding.</p> <p>pg no 158</p>
2	<p>a) A machine component is subjected to a flexural stress which fluctuates between + 300 MN/m² and - 150 MN/m². Determine the value of minimum ultimate strength according to (a) Gerber relation (b) Modified Goodman relation (c) Soderberg relation. Take yield strength = 0.55 Ultimate strength, endurance strength = 0.5 Ultimate strength and factor of safety = 2.</p> <p>pg no 201</p>

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OR

b) Explain the modified Goodman diagram for bending stresses.

3 a) A double riveted, chain lap joint is to be made for joining two plates of 10 mm thick. The allowable stresses are 60 MPa in tension, 80 MPa in crushing and 50 MPa in shear. Determine the rivet diameter

1	<p>In simple tensile test, when maximum principle stress reaches the value of yield point, the material subjected to complex stresses fail. This theory is called as _____.</p> <p>a. Coulumb's theory b. Rankine's theory c. Venant's theory d. Von Mises theory</p>
2	<p>When a material is subjected to fatigue loading, the ratio of the endurance limit to the ultimate tensile strength is</p> <p>a 0.20 b 0.35 c 0.50 d 0.65</p>
3	<p>If compressive yield stress and tensile yield stress are equivalent, then region of safety from maximum principal stress theory is of which shape?</p> <p>a) Rectangle b) Square c) Circle d) Ellipse</p>
4	<p>Which of the following Isn't a main part of rivet?</p> <p>a) Head b) Shank c) Point d) Thread</p>

5	<p>The surface finish factor for a mirror polished material is</p> <p>a 0.45</p> <p>b 0.65</p> <p>c 0.85</p> <p>d 1</p>
6	<p>Which of the following always provides a positive clearance between the hole and the shaft over the entire range of tolerances_____</p> <p>Text</p> <p>Clearance</p>
7	<p>Stress concentration factor is defined as the_____</p> <p>the ratio of the highest stress to a nominal stress of the gross cross-section</p>
8	<p>The amount by which the two rods to be joined are drawn together</p>

	Is called as <u>draw</u>
9	Distortion energy theory also known as <u>hencky and von mises theory</u>
10	The yield strength of steel shaft is twice its endurance limit. Which of the following torque fluctuations represent the most critical situation according to soderberg criterion <u>-T to +T</u>

Part-B (Descriptive Paper)

Answer All the following questions.

Marks: $5M \times 3 = 15M$

1	a) What are theories of failure? Explain any two theories of elastic failure for bi-axial loading system with the help of equations. pg no 152,153
	OR
	b) A cantilever cold drawn steel bar 20 mm diameter and 100 mm length is loaded by a transverse force of 0.55 kN., an axial load of 8 kN. and a torque of 30 Nm. The yield tensile and compressive strength are 165 MPa and 190MPa. Compute factor of safety based on Maximum shear stress theory and Maximum distortion energy theory.

2

a) A simply supported beam has a point load at the centre which fluctuates from a value F to $4F$. Length of beam is 500 mm and cross section is circular with a diameter of 60 mm. Ultimate, yield stresses are 700 MPa and 500 MPa respectively. Endurance limit in reverse bending is 330 MPa. Factor of safety desired is 1.3. Assume size factor 0.83, Surface finish factor 0.9, reliability factor 1.0. Find the maximum value of F .

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I

OR

b) Explain the significance of Goodman's line, Soderberg line and modified Goodman line in design of members subjected to reversal of stresses?

3	<p>1. a) A triple riveted lap joint is to be made between 6 mm plates. If the safe working stresses are $f_t = 84$ MPa, $f_s = 60$ MPa and $f_c = 120$ MPa, calculate the rivet diameter, rivet pitch and distance between rows of rivets for the joint. chain riveting is to be used. State how the joint will fail.</p>
	OR
	<p>b). Explain the various ways in which a riveted joint may fail.</p>

1	<p>According to principal stress theory, which option represents the correct relation between yield strength in shear (YSS) and the yield strength in tension (YST)?</p> <p>a) $YSS=0.5YST$</p> <p>b) $YSS=0.577YST$</p> <p>c) $YST=0.5YSS$</p> <p>d) $YST=0.577YSS$</p>
2	<p>Line joining S_y (yield strength of the material) on mean stress axis and S_e (endurance limit of the component) on stress amplitude axis is called as _____</p> <p>a. Goodman line</p> <p>b. Soderberg line</p> <p>c. Gerber line</p> <p>d. Endurance limit</p>
3	<p>Which of the following parameters can be obtained by tension test of a standard specimen?</p> <p>a) Proportional Limit</p> <p>b) Yield Strength</p>

	<p>c) Percentage Reduction in area</p> <p>d) upper limit</p>
4	<p>The stress which vary from a minimum value to maximum value of the same nature (tensile or compressive) is called</p> <p>a Repeated streeses</p> <p>b yield streeses</p> <p><input checked="" type="checkbox"/> c fluctuating stresses</p> <p>d alternating stresses</p>
5	<p>Which of the following parameters can be obtained by tension test of a standard specimen?</p> <p><input checked="" type="checkbox"/> a) Proportional Limit</p> <p>b) Yield Strength</p> <p>c) Percentage Reduction in area</p> <p>d) upper limit</p>
6	<p>When a material is subjected to fatigue loading, the ratio of the endurance limit to the ultimate tensile strength is <u>0.50</u></p>
7	<p>A line joining the centers of rivets and parallel to the edge of the plates is known as <u>I marginal pitch</u></p>
8	<p>The resistance to fatigue of a material is measured by <u>endurance limit</u></p>
9	<p>Modulus of resilience is defined as <u>the maximum energy that can be absorbed per unit volume without creating a permanent distortion</u></p>
10	<p>Guest's theory also known as <u>Maximum shear stress Theory.</u></p>

1

a) An electric motor weighing 500N is mounted on a short cantilever beam of uniform rectangular cross section. The weight of motor acts at a distance of 300mm from the support. The depth of the section is twice the width. Determine the cross section of the beam. The allowable stress in the beam is 40N/mm².

OR

b) A 50mm diameter steel shaft is supported on bearings 1.5m apart and carries a fly wheel

weighing 'W'. The allowable bending stress for the shaft material and the maximum deflection are limited to 100MPa and 2 mm respectively. The young's modulus for the shaft material is 210GPa. Determine the Maximum permissible weight of the flywheel.

2

- a) Define
I. Pitch
II. Back Pitch
iii. Diagonal Pitch
iv. Margin or marginal Pitch
v. Strength of a riveted joint

OR

b) A single riveted, chain lap joint is to be made for joining two plates of 15 mm thick. The allowable stresses are 120 MPa in tension, 160 MPa in crushing and 90 MPa in shear. Determine the rivet diameter, pitch of the rivets and row pitch. Also find the efficiency of the joint.

3

a) Explain the following terms

i. Endurance limit

ii. Notch sensitivity factor

iii. Stress concentration factor.

OR

1. b) A transmission shaft of cold drawn steel 27Mn2 ($S_{ut} = 500 \text{ N/mm}^2$ and $S_{yt} = 30 \text{ N/mm}^2$) is subjected to a fluctuating torque which varies from -100 N-m to $+400 \text{ N-m}$. The factor of safety is 2 and the expected reliability is 0%. Neglecting the effect of stress concentration, determine the diameter of the shaft. Assume the distortion energy theory of failure.