

KATHMANDU UNIVERSITY
End Semester Examination
July/August, 2024

Marks Scored:

Level : B.E.

Year : III

Exam Roll No. :

Time: 30 mins.

Registration No.:

Course : MEEG 315

Semester : I

F. M. : 20

Date : 01 AUG 2024

SECTION "A"

[20 Q. × 1 = 20 marks]

Use of a Data Book is NOT allowed for the objective questions. Choose the most appropriate answer and mark [X].

1. A higher the value of spring index for a constant wire diameter means the spring is
 more stiffer and smaller more stiffer and bigger
 less stiffer and smaller less stiffer and bigger

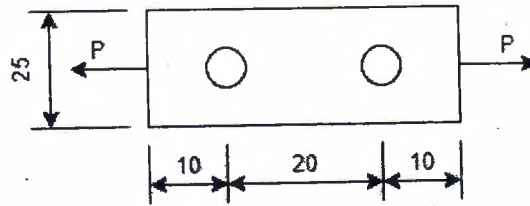
2. The ____ (a) ____ is a measure of the material's response to ____ (b) ____ caused by ____ (c) ____.
 stress concentration / notch sensitivity / notches
 stress concentration / notches / notch sensitivity
 notch sensitivity / notches / stress concentration
 notch sensitivity / stress concentration / notches

3. In the design and manufacturing of boilers and pressure vessels, the selection of rivet heads is critical for ensuring both structural integrity and pressure containment. Identify the most appropriate type of rivet head commonly used in these applications, considering factors such as ease of inspection, strength, and sealing capabilities.
 Snap head Countersunk head
 Flat head Half countersunk head

4. The outer diameter of the 6201 series bearing is ____ to that of the 6301 series bearing.
 Smaller Larger Equal Not applicable

5. During plastic deformation _____
 applied load and induced load are equal
 applied load is greater than the induced load
 applied load is smaller than the induced load
 depends on the cross-section area

6. Consider the material is 4 mm thick with two 10 mm holes and applied load as 10kN. The rivet and the plate are made of the same material. All dimensions are in mm. $S_t = 90\text{MPa}$, $S_s = 60\text{MPa}$ $S_c = 120\text{MPa}$.



What is your anticipation of how the joint shown in the picture will fail?

- Plate tear
 Rivets get crushed
 Rivet Shear
 Fail from margin
7. Petroff's law is a fundamental concept in the study of hydrodynamic lubrication in sliding contact bearings. It relates to the calculation of frictional torque and power loss in journal bearings operating under specific conditions. According to Petroff's law, which of the following factors does not directly influence the frictional torque in a journal-bearing?
- viscosity of the lubricant
 Length of the bearing
 Speed of the journal
 Radial clearance of the bearing
8. Concentric helical springs should be wound
- in the same helix hand
 in any direction
 in opposite helix hands
 depending on the load
9. The transverse fillet welds are designed for
- tensile strength
 bending strength
 shear strength
 compressive strength
10. In eccentrically loaded riveted joints, what is the primary effect of the eccentric load on the rivets?
- It causes uniform shear stress in all rivets.
 It induces both direct shear and bending stresses in the rivets.
 It results in only compressive stress on the rivets.
 It leads to a uniform tensile stress across the joint.
11. The objective of caulking and fullering is to make the riveted joint
- free from residual stress
 stronger
 leakproof
 permanent
12. What type of spring is commonly used to absorb and release energy in mechanical watches?
- helical extension spring
 spiral spring
 multi-leaf spring
 helical torsion spring
13. The maximum shear stress in spring wire is induced at
- inner surface of the coil
 central surface of the coil
 outer surface of the coil
 end of the coils

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01 AUG 2024

Course : MEEG 315
Semester : I
F. M. : 55

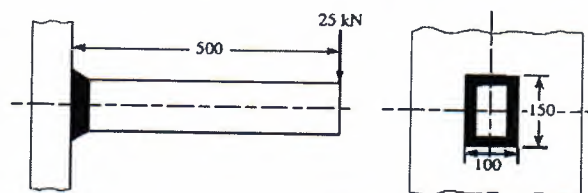
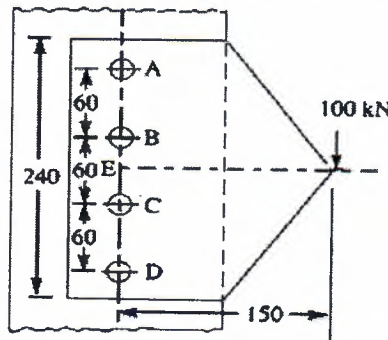
SECTION "B"

[5 Q. × 11 = 55 marks]

Attempt ALL questions. Use of Data Book is ALLOWED for this examination. Assume and/or select suitable data if not specified.

1.

- a. A bracket in the form of a plate 10 mm thick is fitted to a column through four rivets A, B, C, and D in the same vertical line, as shown in Fig. 1 AB = BC = CD = 60 mm. E is the mid-point of BC. A load of 100 kN is applied to the bracket at a point F which is at a horizontal distance of 150 mm from E. Determine the diameter of the rivets which are made of steel having a yield stress in shear of 240 MPa. Take a factor of safety of 1.5. All dimensions are in mm. [4]
- b. Keeping everything else the same, if the load acts at an angle of 30° to the horizontal (counterclockwise) instead of vertically, identify and discuss the changes that will occur in the diameter of the rivet due to the load acting in angle. [3]



All dimensions in mm

Figure 1

Figure 2

- c. A steam boiler is to be designed for a working pressure of 2.5 N/mm² with an inside diameter 1.6 m. Give the design calculations for the circumferential joints for the following working stresses for steel plates and rivets: In tension = 75 MPa; In shear = 60 MPa; In crushing = 125 MPa. [4]

P.T.O.

2.

- a. A bearing is labeled with the number 6205. Explain what the first digit '6', the following two digits '20', and the last digit '5' represent in this bearing's designation. Describe how each part of the number relates to the bearing's type, dimensions, and specifications. [3]
- b. A rectangular cross-section bar is welded to a support using fillet welds as shown in figure 2. Determine the size of the welds, if the permissible shear stress in the weld is limited to 75 MPa. [4]
- c. A steel plate is welded to a supporting structure using a double parallel and single transverse fillet weld. The plate is subjected to a tensile force of 100 kN. The weld material has a tensile strength of 250 MPa and a shear strength of 150 MPa. The plate thickness is 10 mm, and the leg length of the fillet weld is 8 mm.

Determine:

- i. The length of the double parallel weld required to safely carry the load.
- ii. The length of the single transverse weld required.
- iii. The minimum required throat thickness for the welds. [4]

3.

- a. Disc springs are stacked in three different ways as shown in the picture below. Discuss the effects that can be seen due to these differences in the spring. [3]



Parallel Stack

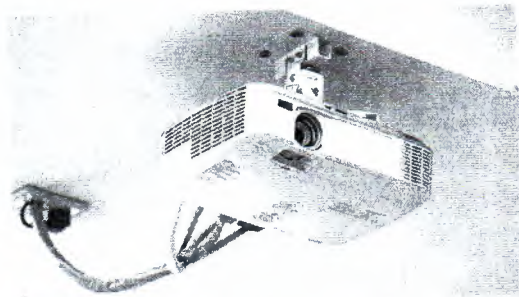


Series Stack



Parallel-Series Stack

- b. For a projector to be fixed on a ceiling as shown in the picture below, what would you use among studs, cap screws or set screws? Explain your choice. [3]



- c. A power screw is used to lift a load of 2000 kg. The screw has a single square thread with a mean diameter of 25 mm and a pitch of 5 mm. The coefficient of friction between the screw and the nut is 0.15.

Determine:

- i. The torque required to raise the load
- ii. The efficiency of the power screw. [5]

4.

- a. "The pressure necessary to sustain the load is generated through a combination of the bearing's motion and geometry, in conjunction with the rheological properties of the lubricant." Elaborate on the statement relating to sliding contact bearing. [3]
- b. You are designing a deep groove ball bearing for a motor application. The bearing must support a radial load of 5000 N and an axial load of 2000 N. The bearing operates at a rotational speed of 3000 rpm. The application requires a minimum life expectancy of 20,000 hours. [4]
- c. A journal bearing is designed to support a load of 10 kN at a rotational speed of 1500 rpm. The bearing has a diameter of 50 mm and a length of 75 mm. The lubricant used has a viscosity of 0.02 Pa·s. Assuming a clearance ratio (c/R) of 0.001 and that the load is uniformly distributed, design the journal bearing. [4]

5.

- a. In a new design for battery casing in the remote controller, the conical spring to hold the batteries and maintain electrical contact was replaced with a helical compression spring of the same stiffness and material. If you were to evaluate this design change, what would be your thoughts? [2]
- b. A helical compression spring is required to support a load of 500 N with a maximum deflection of 50 mm. The spring is made of steel with a shear modulus G of 80 GPa. The spring index (ratio of mean coil diameter to wire diameter) is 8. Determine:
 - i. The wire diameter
 - ii. The mean coil diameter
 - iii. The number of active coils [4]
- c. A composite spring system consists of two springs in series. Spring A has a stiffness of 150 N/m, and Spring B has a stiffness of 250 N/m. A load of 100 N is applied to the system.
 - i. Calculate the equivalent stiffness of the composite spring system.
 - ii. Determine the total deflection of the system under the applied load.
 - iii. Find the individual deflections of Springs A and B.

Show all calculations and explain the steps involved in determining the equivalent stiffness, total deflection, and individual deflections." [5]

