BRAINWARE UNIVERSITY

Term End Examination 2024-2025
Programme – Dip.ME-2022
Course Name – Design of Machine Elements
Course Code - DMEPC601
(Semester VI)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) The common cause of stress concentration is _____.
   a) Uniform cross-section b) Smooth surface finish
   c) Sharp notches or grooves d) Gradual change in cross-section

(ii) In a stress-strain diagram,name the point at which permanent deformation begins.
   a) Ultimate strength point b) Yield point
   c) Proportional limit d) Fracture point

(iii) In the design of a helical compression spring, the surge phenomenon refers to_____.
   a) Sudden buckling b) Progressive failure
   c) Resonant vibration d) Gradual relaxation

(iv) Choose the primary function of a bearing in machinery.
   a) Transmit power between shafts b) Reduce friction between moving parts
   c) Increase rotational speed d) Support axial loads only

(v) Name the component that holds the eye and fork together in a knuckle joint.
   a) Bolt b) Cotter
   c) Pin d) Key

(vi) Select the type of stress experienced by the cotter pin in a cotter joint.
   a) Shear and bending stress b) Only tensile stress
   c) Only bending stress d) Only shear stress

(vii) Identify the primary failure mode of a knuckle pin.
   a) Bending b) Torsion
   c) Shear d) Fatigue

(viii) Select the correct difference between a cotter joint and a knuckle joint.
   a) Cotter joint allows axial force, knuckle joint allows angular movement b) Cotter joint uses a pin, knuckle joint uses a cotter
   c) Cotter joint is used for rotating shafts, knuckle joint for stationary rods d) Cotter joints are weaker than knuckle joints

(ix) Name the factor that determines the thickness of a cotter.

a) Shaft diameter
b) Cotter material
c) Applied torque
d) Fatigue life

(x) Select the main goal of ergonomics in machine design.

a) Increase aesthetics
b) Improve user comfort and efficiency
c) Reduce cost
d) Make the machine heavier

(xi) Identify the factor that influences the ergonomics of a machine.

a) Shape and size
b) Color scheme
c) Material composition
d) Weight distribution

(xii) Select the correct reason why color is used in machine design for ergonomics.

a) Improve mechanical strength
b) Enhance surface finish
c) Improve visibility and safety
d) Reduce production cost

(xiii) Name the design modification that reduces bending stress in high-power gears.

a) Decrease pressure angle
b) Increase face width
c) Reduce gear ratio
d) Increase root fillet radius

(xiv) Select the correct reason for using an involute tooth profile in spur gears.

a) Reduces bending stress
b) Simplifies manufacturing
c) Increases friction
d) Reduces contact ratio

(xv) Select the factor that increases power transmission without increasing bending stress.

a) Higher face width
b) Smaller pitch diameter
c) Higher gear ratio
d) Decreased tooth thickness

Group-B

(Short Answer Type Questions) 3 x 5=15

2. State the applications of a Knuckle joint. (3)
3. Write a short note on Creep. (3)
4. State the factors to be considered while designing any mechanical element. (3)
5. State Lewis Equation for Static Beam Strength of Spur Gear Teeth. (3)
6. Explain the advantages of rolling contact bearings over sliding contact bearings. (3)

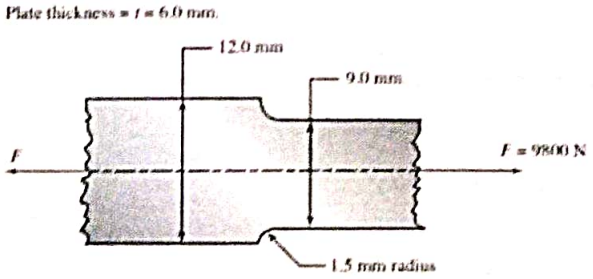
OR

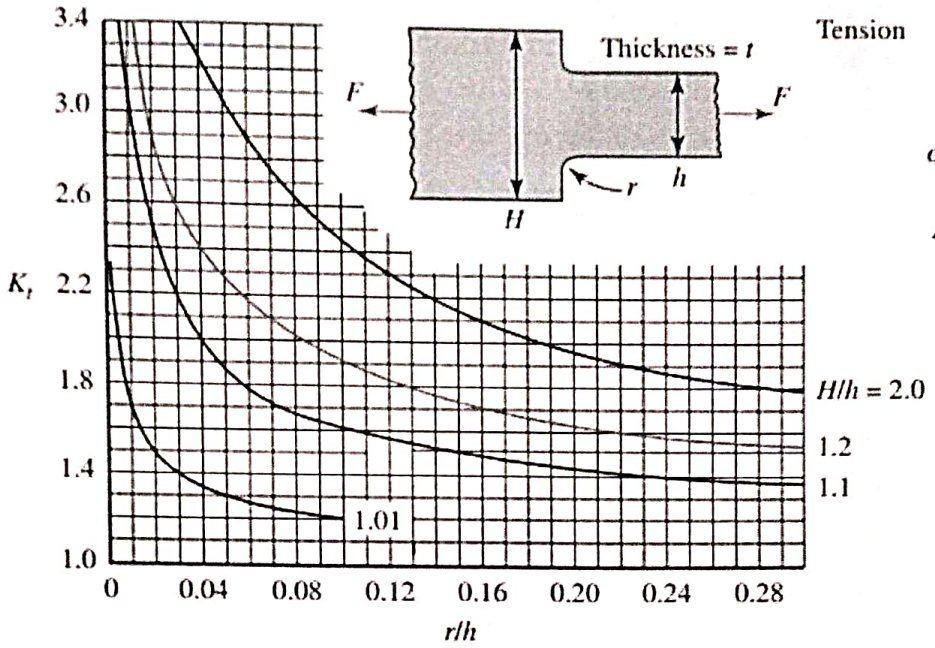
Compare the stress distribution in a solid shaft and a hollow shaft under identical torque. (3)

Group-C

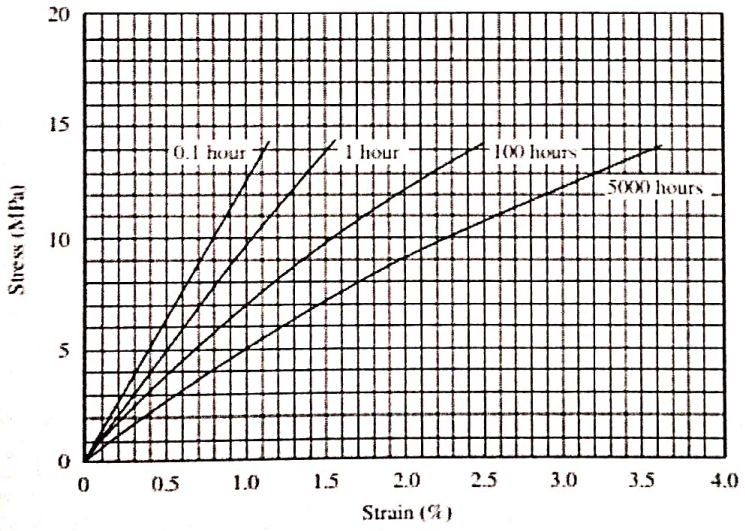
(Long Answer Type Questions) 5 x 6=30

7. A rotating bar made of steel 45C8 (Sut = 630 N/mm2) is subjected to a completely reserved bending stress. The corrected endurance limit of the bar is 315 N/mm2. Calculate the fatigue strength of the bar for a life of 90,000 cycles. (5)
8. Compute the maximum stress in a stepped flat plate subjected to an axial tensile force of 9800 N. (5)





9. A catalog lists the basic dynamic load rating for a ball bearing to be 8050 lb for a rated life of 1 million rev. Calculate the expected life of the bearing if it were subjected to a load of 3500 lb. (5)
10. Write a short note on multi-leaf spring. (5)
11. A helical compression spring, made of circular wire, subjected to an axial force, which varies from 3.5 kN to 4.5 kN. Over this range of force, the deflection of the spring should be approximately 5 mm. The spring index can be taken as 5. The spring has square and ground ends. Take ultimate tensile strength as 1000 MPa and modulus of rigidity of 80000 MPa. The permissible shear stress for the spring wire should be half of the ultimate tensile strength. Estimate the Solid length of the spring, Free length of the spring, Required spring rate and Actual spring rate. (5)
12. A solid circular bar has a diameter of 5.0 mm and a length of 250 mm. It is made from nylon 66 plastic (30% Glass, 50% R.H.) and subjected to a steady tensile load of 240 N. Estimate the elongation of the bar immediately after the load is applied and after 5000 hours (approximately seven months). Stress strain curve is given below for the reference. Take E= 5500 Mpa for nylon. (5)



OR

Calculate the design load for a bolted joint subjected to an eccentric load of 10 kN at 100 mm from the bolt center. Assume two bolts at 200 mm spacing. (5)

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