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BRAINWARE UNIVERSITY

Term End Examination 2025-2026

Programme – Dip.ME-2023

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) Name the type of stress that occurs when a material is subjected to a force tending to stretch it.
 - a) Compressive stress
 - b) Shear stress
 - c) Tensile stress
 - d) Bending stress
- (ii) Choose the material property that indicates a material's ability to undergo significant plastic deformation before rupture.
 - a) Brittleness
 - b) Hardness
 - c) Ductility
 - d) Elasticity
- (iii) In a rigid flange coupling, the flanges are connected by _____.
 - a) Welding
 - b) Bolts
 - c) Keys
 - d) Splines
- (iv) In a screw jack, name the material commonly used for the screw.
 - a) Cast iron
 - b) Low carbon steel
 - c) High carbon steel
 - d) Bronze
- (v) Name the type of bearing best suited for handling radial loads in high-speed applications.
 - a) Thrust bearing
 - b) Deep groove ball bearing
 - c) Needle roller bearing
 - d) Spherical roller bearing
- (vi) Identify the part of a knuckle joint where crushing stress occurs.
 - a) Eye
 - b) Fork
 - c) Pin
 - d) All of the above
- (vii) Name the factor that determines the thickness of a cotter.
 - a) Rod diameter
 - b) Cotter material
 - c) Applied torque
 - d) Fatigue life
- (viii) Name the failure mode of a knuckle joint fork due to excessive force.
 - a) Shear failure
 - b) Tensile failure
 - c) Crushing failure
 - d) Bending failure

(ix) Identify the component of ergonomics that focuses on the ease of machine use.

- a) Material strength
- c) Machine weight

- b) User interface design
- d) Production cost

(x) Select the primary aesthetic factor in machine design.

- a) Noise level
- c) Load-carrying capacity

- b) Color and shape
- d) Manufacturing process

(xi) Name the term representing the gear's ability to resist bending failure.

- a) Hertz stress
- c) Lewis form factor

- b) Dynamic factor
- d) Service factor

(xii) Identify the failure mode of a spur gear tooth due to excessive bending.

- a) Fatigue failure
- c) Cracking at the root

- b) Surface pitting
- d) Wear failure

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

- a) Decrease pressure angle
- c) Reduce gear ratio

- b) Increase face width
- d) None of the mentioned

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

- a) Reduces bending stress
- c) Increases friction

- b) Simplifies manufacturing
- d) Reduces contact ratio

(xv) Identify the main cause of bending failure in a spur gear.

- a) Overloading
- c) Excessive backlash

- b) Poor lubrication
- d) Misalignment

Group-B

(Short Answer Type Questions)

3 x 5 = 15

2. Calculate the maximum stress in a pulley arm subjected to a radial load of 8 kN and a bending moment of 150 Nm. Assume the arm has a section modulus of 200 mm³. (3)
3. State the applications of a Knuckle joint. (3)
4. Calculate the power transmitted by a V-belt pulley with a diameter of 250 mm, running at 1000 RPM, and transmitting a torque of 200 Nm. (3)
5. Explain the working and construction of a leaf spring with the help of a suitable diagram. (3)
6. Explain Maximum Distortion Energy Theory of failure. (3)

OR

- Explain the advantages of rolling contact bearings over sliding contact bearings. (3)

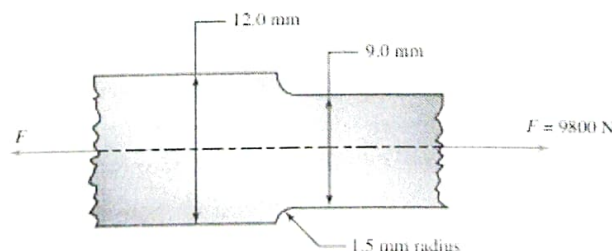
Group-C

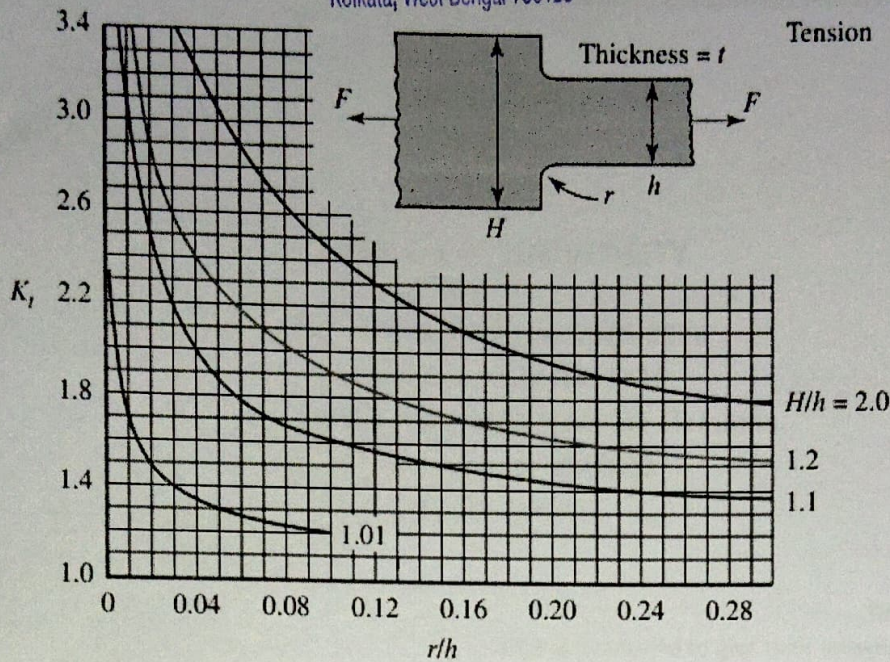
(Long Answer Type Questions)

5 x 6 = 30

7. Classify different types of mechanical springs and evaluate their applications in engineering. (5)
8. Explain the role of Wahl's factor in spring design and evaluate its influence on helical spring performance. (5)
9. Compute the maximum stress in a stepped flat plate subjected to an axial tensile force of 9800 N. (5)

Plate thickness = $t = 6.0$ mm.





10. 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)
11. A beam of uniform rectangular cross-section is fixed at one end and carries an electric motor weighing 400 N at a distance of 300 mm from the fixed end. The maximum bending stress in the beam is 40 MPa. Evaluate the width and depth of the beam, if depth is twice that of width. (5)
12. A helical compression spring, made of circular wire, subjected to an axial force, which varies from 2.5 kN to 3.5 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 1050 MPa and modulus of rigidity of 81370 MPa. The permissible shear stress for the spring wire should be half of the ultimate tensile strength. Calculate the following: (I) Wire diameter (II) Mean coil diameter (III) Number of active coils (IV) Total number of coils (5)

OR

- Two rods are connected by means of a cotter joint. The inside diameter of the socket and outside diameter of the socket collar are 50 and 100 mm respectively. The rods are subjected to a tensile force of 50 kN. The cotter is made of steel 40C8 ($S_{yt} = 380$ MPa) and the factor of safety is 4. The width of the cotter is five times of thickness. Calculate the width and thickness of the cotter on the basis of bending failure. (5)
