

Code No: 155AX

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD

B. Tech III Year I Semester Examinations, August - 2022

DESIGN OF MACHINE MEMBERS - I

(Mechanical Engineering)

Time: 3 Hours

Max. Marks: 75

Answer any five questions
All questions carry equal marks

Note: Assume suitable data, if necessary.

- 1.a) Considering fits and tolerances, give dimensions for the hole and shaft for the following
(i) a 12 mm electric motor sleeve bearing, (ii) a medium force fit on a 200 mm shaft,
(iii) a 50 mm sleeve bearing on the elevating mechanism of a road grader.
- b) Give examples of mechanical components that fail by (i) elastic deflection, (ii) general yielding, (iii) fracture. [7+8]
2. A solid circular shaft of 45 mm diameter is loaded by bending moment of 650 Nm, torque of 900 Nm, and an axial tensile force of 30 Nm. The shaft material is ductile with yield strength of 280 MPa. Determine the factor of safety according to Maximum principal stress and Tresca Von Mises theories of failure. [15]
3. A stepped shaft transmits a torque varying from 800 Nm to 1200 Nm. The ratio of diameters is 1.5 and the stress concentration factor is 1.2. Determine the diameter of the shaft for an infinite life for a design factor of safety 1.8. [15]
4. A bracket is attached to the ceiling with the help of two steel bolts, the bracket carries a load of 25 kN and the allowable stress for bolt material in tension is 90 MPa. The distance of first bolt from the leftmost edge is 100 mm, the distance between two bolts is 120 mm and the distance between leftmost edge and the line of application of load is 150 mm (Eccentricity). Find the size of the bolt to take this load. Take the load direction is parallel to the bolt axis. [15]
- 5.a) What is a knuckle joint? Where do you use it? Give practical examples.
- b) Two rods, made of plain carbon steel 30C8 ($\sigma_{yt} = 400 \text{ N/mm}^2$), are to be connected by means of a cotter joint. The diameter of each rod is 40 mm. Assuming yield strength in compression = $1.5 \sigma_{yt}$, yield strength in shear = $0.5 \sigma_{yt}$, and factor of safety = 5, calculate the: (i) Inside diameter of socket, (ii) Outside diameter of socket, and (iii) Diameter of socket collar. [7+8]
6. Design a clamp coupling to transmit 30 kW at 100 r.p.m. The allowable shear stress for the shaft and key is 40 MPa and the number of bolts connecting the two halves are six. The permissible tensile stress for the bolts is 70 MPa. The coefficient of friction between the muff and the shaft surface may be taken as 0.3. Sketch the coupling. [15]

- 7.a) Find the efficiency of a lap joint of 6 mm plates with 20 mm diameter rivets having a pitch of 55 mm. Assume the permissible tensile stress in the plate material is 120 MPa, permissible shear stress is 90 MPa, and the permissible crushing stress is 180 MPa.
- b) What are the methods of preventing loosening of threads between the nut and the screw? [7+8]
- 8.a) Compare the strength and stiffness of a hollow shaft of same outside diameter as that of a solid shaft.
- b) Explain the procedure to determine the endurance limit of a material. Also plot the S-N curve for steel and aluminum. [7+8]

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