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B. E. (Fifth Semester) Examination, April-May 2021

(Old Scheme)

(Mech., Mechatronics Engg. Branch)

MACHINE DESIGN-I

Time Allowed : Four hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Part (a) of each question a compulsory. Use of design data book is permitted.

Unit-I

1. (a) What is factor of safety? Why is the necessary to use factor of safety?   2

   (b) A rod of a linkage mechanism made of steel 40 Crl (S_{ut} = 550 N/mm²) is subjected to a completely reversed axial load of 100 kN. The rod is machined on a lathe and the expected reliability is 95%. There is no stress concentration. Determine the diameter

of the rod using a factor of safety of 2 for an infinite life condition. 14

Or

(c) It is required to design a chain drive to connect a 12 kW, 1400 rpm electric motor to a centrifugal pump running at 700 rpm. The service condition involve moderate shocks. 14

   (i) Select a proper roller chain and give a list of its dimensions.

   (ii) Determine the pitch circle diameters of driving and driven sprockets.

   (iii) Determine the number of chain links.

   (iv) Specify the correct centre distance between the axes of the sprouts.

Unit-II

2. (a) What is cotter joint. What are its advantages. 2

   (b) It is required to design a knuckle joint to connect two circular rods subjected to an axial kinetic force of 50 kN. The rods are co-axial and a small amount of angular movement between their axes is permissible.

   Design the joint and specify the dimensions of its components.

Select suitable material for the parts. 14

Or

(c) A standard splined connection $8 \times 52 \times 60$ mm is used for the gear and the shaft assembly of a gearbox. The splines transmit 20 kW power at 300 rpm. The dimensions of the splines are as follows: 14

Major diameter = 60 mm

Minor diameter = 52 mm

No. of splines = 8

Permissible normal pressure on splines is 6.5 N/mm^2. The coefficient of friction is 0.06.

Calculate :

   (i) The length of hub of the gear

   (ii) The force required for shifting the gear.

Unit-III

3. (a) How will you designate ISO metric coarse and fine threads. 2

   (b) A wall bracket is attached to the wall by means of four identical bolts, two at A and two at B, is shown. Assuming that the bracket is held against the wall and presented from tipping about the point C by all four bolts and why an allowable tensile stress in the

bolts as 35 N/mm². On the bar's of maximum
principal stress theory, determine the size of bolts. 14
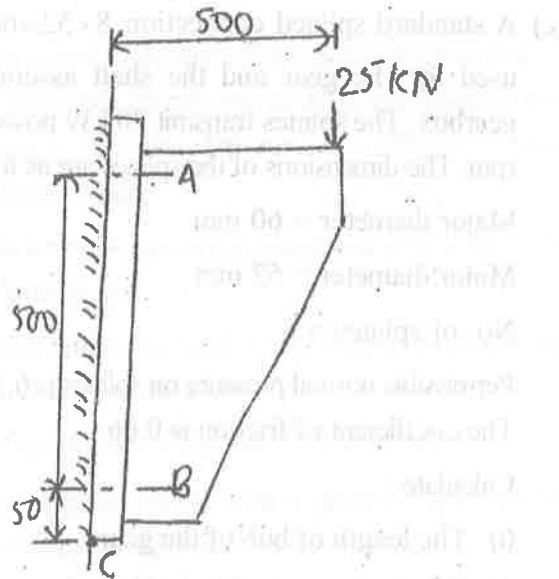
Or

(c) A double-threaded, power screw, with ISO metric
trapezoidal threads is used to raise a load of 300
kN. The nominal diameter is 100 mm and the pitch
is 12 mm. The coefficient of friction is 0.15 at the
screw threads. Neglecting collar friction, calculate: 14
(i) Torque required to raise the load.
(ii) Torque required to lower the load, and
(iii) Efficiency of the screw.

Unit-IV

4. (a) What are different types of rivet heads. 2

(b) A cylindrical pressure vessel with 1 m inner diameter
is subjected to internal steam pressure of 1·5 MPa.
The permissible stresses for the cylinder plate and
the rivets in tension, shear and compression are 80,
60 and 120 N/mm² respectively. The efficiency of
Longitudinal joint can be taken as 80% for the
purpose of calculating plate thickness. The efficiency
of circumferential lap joint should be at least 62%. 14
Design the circumferential lap joint and calculate :
(i) Thickness of the plate;
(ii) Diameter of the rivets;
(iii) Number of rivets;
(iv) Pitch of rivets;
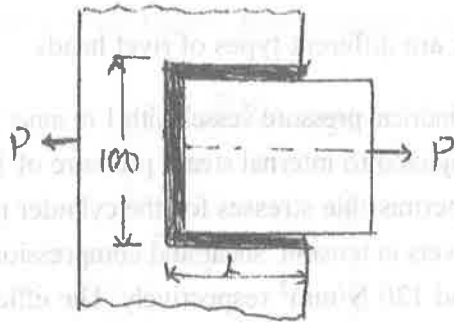(v) Number of rows of rivets; and
(vi) Overlap of the plates.

Or

(c) A steel plate, 100 mm wide and 10 mm thick, is
joined with another steel plate by means of single
transverse and double parallel fillet welds, as shown. 14

The strength of the welded joint should the equal to the strength of the plates to be joined. The permissible tensile and shear stresses for the weld material and the plates are 70 and 50 N/mm² respectively. Find the length of each parallel fillet weld.

Assume the tensile force acting on the plates as static.

Unit-V

5. (a) Why is transmission shaft stepped.   2

   (b) A solid shaft of diameter 'd' is used in power transmission. Due to modification of the existing transmission system, it is required to replace the solid shaft by a hollow shaft of same material and equally strong in torsion. Further, the weight of hollow shaft the metre length should be half of the

solid shaft. Determine the outer diameter of hollow shaft in terms of 'd'.   14

Or

(c) Design a muff coupling to connect two steel shafts transmitted 25 kW power at 360 rpm. The shaft and key are made of plain carbon steel 30 C 8 (S_{yt} = S_{yc} = 400 N/mm²). The sleeve is made up of gray cost iron FG 200 (S_{ut} = 200 N/mm²). The factor of safety for the shaft and lay is '4'. For the sleeve, the factor of safety is '6' based on ultimate strength.   14