(Following Paper ID and Roll No. to be filled in your Answer Books)

Paper ID : 2012304 Roll No. | | | | | | | | | |

B.TECH.

Regular Theory Examination (Odd Sem-V), 2016-17

MACHINE DESIGN - I

Time : 3 Hours *Max. Marks : 100*

Section - A

1. Attempt all parts of this questions. (10×2=20)

a) List the factor that influences selection of material during design.

b) State any one theory of failure.

c) What are soderberg & Goodman line?

d) List types of rivet heads.

e) Comment on factor of safety.

f) Define : Flat key, Woodruff key.

g) Why Wahl correction factor is used in design?

h) List the main terminology in Power Screw?

i) List different types of Springs.

j) What is notch Sensitivity?

Section - B

2. Attempt any Five parts (5×10=50)

a) A bolt is subjected to a tensile load of 25 KN and a shear load of 10KN. Determine the diameter of the bolt according to

i) Maximum principal stress theory.

ii) Maximum principal strain theory.

iii) Maximum stress theory. Assume factor of safety as 2.5, yield point stress in simple tension = 300 N/mm^2, poison ratio 0.25.

b) A railway wagon moving at a velocity of 1.5 m/s is brought to rest by a bumper consisting of two helical springs arranged in parallel. The mass of the wagon is 1500 kg. The springs are compressed by 150 mm in bringing the wagon to rest. The spring index can we taken a 6. The springs are made of oil-hardened and tampered steel wire with ultimate tensile strength of 1250 N/mm^2 and modulus of rigidity of 81 370 N/mm^2. The permissible shear stress for the spring wire can be taken as 50% of the ultimate tensile strength. The design the spring and calculate

i) Wire Diameter

ii) Mean coil diameter

iii) Number of active coils

iv) Total number of coils

v) Solid length

vi) Free length

vii) Pitch of the coil.

viii) Required spring rate

ix) Actual spring rate.

c) The layout of a transmission shaft carrying two pulleys B and C and supported on bearings A and D is shown in fig. 1. Power is supplied to the shaft by means of a vertical belt on the pulley B, which is then transmitted to the pulley C carrying a horizontal belt. The maximum tension in the belt on the pulley B is 2.5 kN. The angle of wrap for both the pulleys is 180^0 and the coefficient of friction is 0.24. The shaft is made of plain carbon steel 30C8 (Syt = 400 N/mm^2) and the factor of safety is 3. Determine the shaft diameter on strength basis.

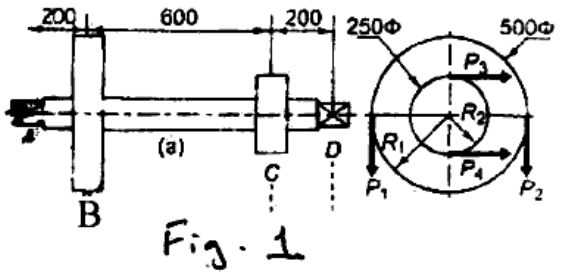


Fig. 1

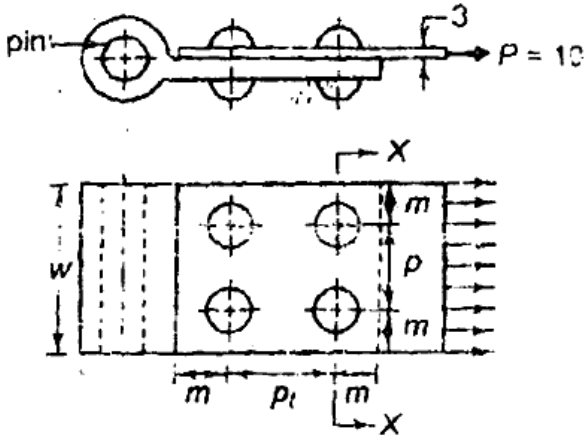
d) A rigid coupling is used to transmit 50 kW power at 300 rpm. There are six bolts. The outer diameter of the flanges is 200 mm. While the recess diameter is 150 mm. The coefficient of friction between the flanges is 0.15. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 3. Determine the diameter of the bolts. Assume that the bolts are fitted in large clearance holes.

e) Describe in detail with neat sketches the design procedure of a screw jack.

f) Describe the standard design procedure in detail. What are the different standards in design. Discuss in detail.

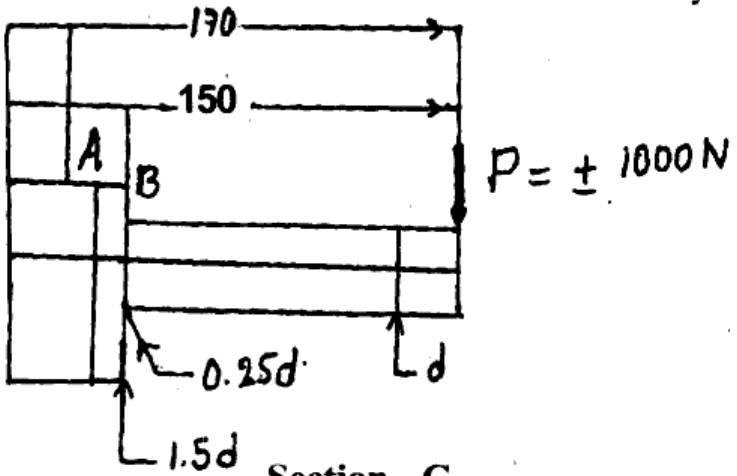
OR

g) A brake band attached to the hinge by means of a riveted joint is shown in fig. Determine the size of the rivets needed for the load of 10 kN. Also, determine the width of the band. This permissible stresses for the band and rivets in tension, shear and compression are 80, 60 and 120 N/mm^2 respectively. Assume, margin (m) = 1.5d, transverse pitch (p_t) = p, find the pitch of the rivets.



h) A cantilever beam made of cold drawn steel 20C8 (S_{ut} = 540 N/mm^2) is subjected to a completely reversed load of 1000N as shown in fig. The notch sensitivity factor q at the fillet can be taken as 0.85

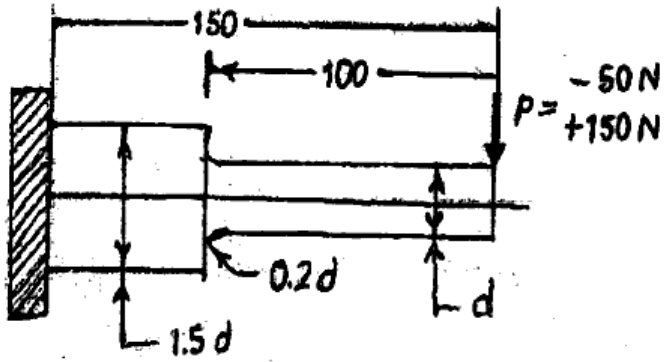
and the expected reliability is 90%. Determine the diameter d of the beam for a life of 10000 cycles.



Section - C

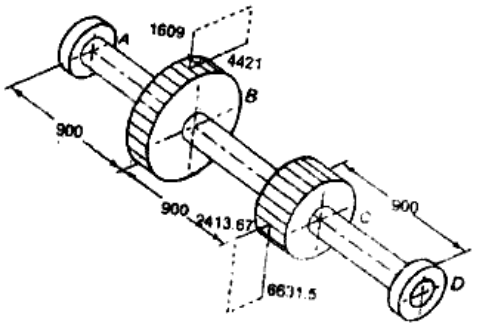
Attempt any two parts of this questions. (2×15=30)

a) A cantilever beam made of cold drawn steel 40C8 (S_{ut} = 600 N/mm² and S_{yt} = 380 N/mm²) is shown in fig. The force P acting at the free end varies from –50N to +150N. The expected reliability is 90% and the factor of safety is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter 'd' of the beam at the fillet cross-section.



b) The layout of an intermediate shaft of a gear box supporting two spur gears B and C is shown in fig. The shaft is mounted on two bearings A and D. The pitch circle diameters of gears B and C are 900 mm and 600 mm respectively. The material of the shaft is steel FeE 580 (S_{ut} = 770 and S_{yt} = 580 N/mm²). The factors k_b and k_t of ASME code are 1.5 and 2.0 respectively. Determine the shaft diameter using the ASME code.

Assume that the gears are connected to the shaft by means of keys.



4. a) A rigid coupling is used to transmit 50 kW power at 300 rpm. There are six bolts. The outer diameter of the flanges is 200 mm. While the recess diameter is 150 mm. The coefficient of friction between the flanges is 0.15. The bolts are made of steel 45C8 (S_{yt} = 380 N/mm²) and the factor of safety is 3. Determine the diameter of the bolts.

Assume that the bolts are fitted in large clearance holes.

b) It is required to design a bushed-pin type flexible coupling to connect the output shaft of an electric motor to the shaft of a centrifugal pump. The motor delivers 20 KW power at 720 rpm. The starting torque of the motor can be assumed to be 150% of the rated torque. Design the coupling and specified the dimensions of its components.

5. a) It is required to design a helical compression spring subjected to a maximum force of 7.5 KN. The mean coiled diameter should be 150 mm from space consideration. The spring radius 75 N/mm. The spring is made of oil-hardened and tempered steel wired with ultimate tensile strength of 1250 N/mm^2. The permissible shear stress for the spring wire is 30% of the ultimate tensile strength (G = 81 370 N/mm^2). Calculate

a) Wire diameter.

b) Number of active coils.

b) 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 friction at the screw threads is 0.15. Neglecting collar friction, calculate

a) Torque required to raise the load.

b) Torque required to lower the load.

c) Efficiency of the screw.

OR

The differential type screw jack is shown in fig. In this construction, the two screws do not rotate and the nut is rotated by the operator by applying a force of 100N at a mean radius of 500 mm. The coefficient of friction at the threads is 0.15. Calculate

i) The load that can be raised.

ii) The efficiency of the screw jack.