Printed Pages : 3

EME-501

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

PAPER ID : 2101

Roll No. | | | | | | | | | | |

B.Tech.

(SEMESTER-V) THEORY EXAMINATION, 2012-13

MACHINE DESIGN – I

Time : 2 Hours] *[Total Marks : 50*

SECTION – A

1. Attempt **all** questions. Missing data if any may suitable be assumed. Use of design data hand book is permitted. **5 × 2 = 10**

   (a) What are the various design requirements of machine elements ?

   (b) What are Soderberg and Goodman lines ?

   (c) What are the two stress theories used in design of shafts ?

   (d) What are the main terminology of a power screw ?

   (e) What are the major alloying elements and their effects in alloy steel ?

SECTION – B

2. Attempt any **three** parts : **5 × 3 = 15**

   (a) A circular cantilever rod of length 400 mm and 50 mm diameter is subjected to a torque of 300 N-m and a point load of 3 kN at its free end. Determine the stresses induced in the rod.

   (b) A steel rod having σ_u = 793.4 MPa, σ_y = 552.1 MPa and σ_{-1} = 448.2 MPa is subjected to an axial load fluctuating between 1 kN and 3 kN. Determine the diameter of the rod required based on a factor of safety of 2. Assume surface roughness factor = 1.266.

   (c) A Commercial Steel shaft in required to sustain a torque of 450 Nm and a bending moment of 300 Nm. Determine the diameter of the solid shaft required and the angular deflection. Assume steady load and light shock.

   (d) A power screw for a jack has square threads of proportion 50 × 42 × 8 mm. The coefficient of friction is 0.1 at the threads and 0.12 at the collar. Determine the weight that can be lifted by the Jack through a human effort of 400 N applied through a hand lever of span 400 mm.

SECTION – C

Attempt **all** questions. **5 × 5 = 25**

3. Attempt any **one** part : **(1 × 5 = 5)**

   (a) Distinguish between failure of brittle materials and ductile materials.

   (b) Compare the strength of a hollow shaft with that of a solid shaft of the same diameter and material of the diameter ratio is 0.75.

4. Attempt any **one** part : **(1 × 5 = 5)**

   (a) Design the longitudinal riveted joint for a boiler of diameter 2 m taking the permissible pressure as 25 MPa. Assume the tensile, shear and compressive stresses for the material of shell and rivets as 90 MPa, 60 MPa and 120 MPa respectively.

   (b) Figure 1 shows a bracket supported by four rivets of equal diameter to withstand an eccentric load of 50 kN. Determine the size of the rivet taking the permissible shear stress in the rivet equal to 80 MPa.

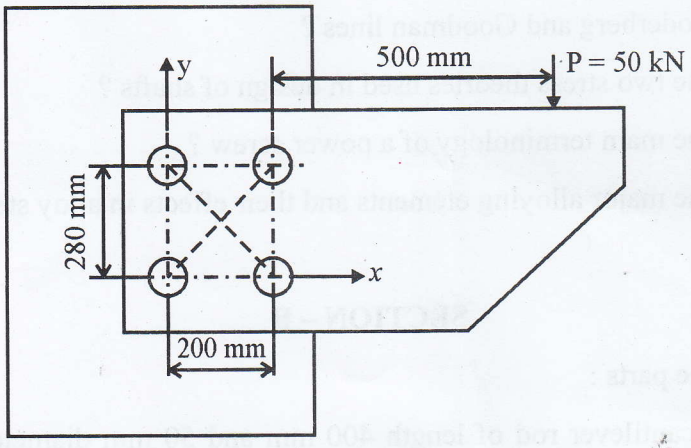

Fig. – 1

5. Figure 2 shows a stepped plate subjected to a load varying from 100 kN to 200 kN. Assume $\sigma_y = 300$ M/mm^2, $\sigma_{-1} = 250$ N/mm^2, $\sigma_u = 500$ M/mm^2. Determine the dimension of the plate based on factor of safety = 3. **5**

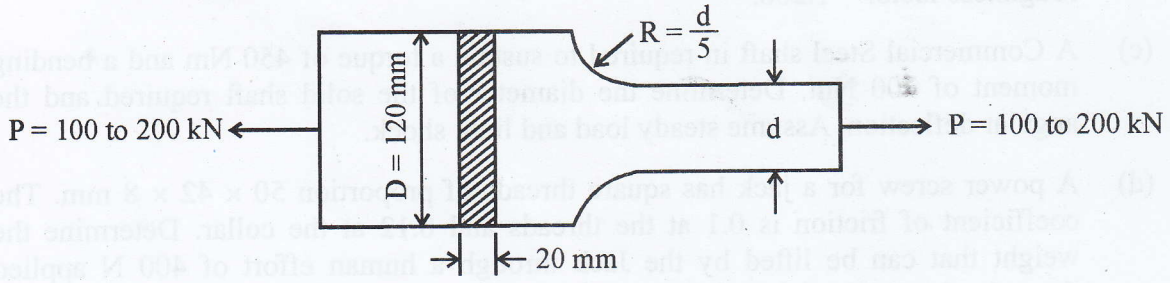

Fig. – 2

6. Attempt any **one** part : **1 × 5 = 5**

(a) A flange coupling is used to connect two commercial shafts of diameter 50 mm. Four bolts of same material as that of shafts are used in the coupling on a bolt circle of 240 mm diameter. The web thickness is 22 mm. Determine the size of the bolts required and the power transmitted at 200 rpm.

(b) A helical tension spring is to be designed to withstand a maximum load of 1500 N. The material of the spring has ultimate tensile strength σ_u = 1360 N/mm^2 and modulus of rigidity of 81370 N/mm^2. Assume permissible shear stress for the spring wire to be 50 percent of the ultimate tensile strength. The spring index can be taken as 6. Determine

(i) Wire diameter

(ii) Mean coil diameter

(iii) Number of active coils

(iv) Actual spring rate

7. Attempt any **one** part : **1 × 5 = 5**

(a) Discuss the different end styles of helical compression springs.

(b) Discuss the various forms of screw threads that are used in power screws.

(c) Give a comparison of various theories of failure of machine elements.