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UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

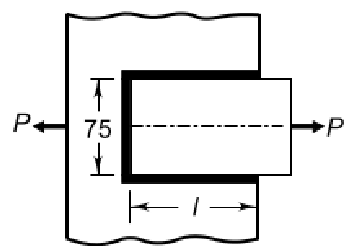
End Semester Examination, December 2017

Program: B.Tech - PIE | **Semester – V**
Subject (Course): Design of Machine Elements | **Max. Marks : 100**
Course Code : IPEG 325 | **Duration : 3 Hrs**
No. of page/s : 03

The paper contains three sections A, B and C. You have to attempt every section. Marks for each question is given on the right hand side of the question in brackets.

SECTION A

1. Explain hydrostatic and hydrodynamic bearings. (5)
2. The standard cross section for a flat key, which is fitted on a 50 mm diameter shaft, is 16 × 10 mm. The key is transmitting 475 N-m torque from the shaft to the hub. The key is made of commercial steel ($S_{yt} = S_{yc} = 230$ N/mm^2). Determine the length of the key, if the factor of safety is 3. (5)
3. Explain the terms endurance limit and notch sensitivity. (5)
4. A plate, 75 mm wide and 10 mm thick, is joined with another steel plate by means of single transverse and double parallel fillet weld, as shown in figure below. The joint is subjected to a maximum tensile force of 55 Kn. The permissible tensile and shear stresses in the weld material are 70 and 50 N/mm^2, respectively. Determine the required length of each parallel fillet weld. (5)

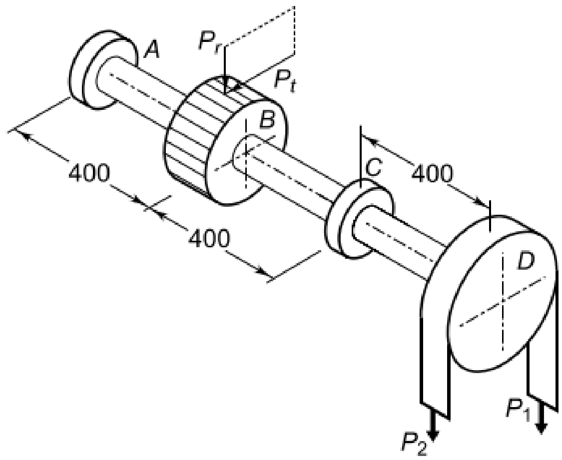


SECTION B

5. Select a suitable ball bearing to carry a radial load of 10000 N and an axial load of 4000 N. the shaft rotates at 100 rpm. Average life of bearing is 5000 hours. The inner race rotates. Draw the sectional view of the bearing with all important dimensions. (15)
6. A transmission shaft supporting a spur gear B and pulley D is shown in figure below. The shaft is mounted on two bearings A and C. The diameter of the pulley and the pitch circle diameter of gear are 450 and 300 mm respectively. The pulley transmits 20 kW power at 500 rpm to the gear. P_1 and P_2 are belt tensions in the tight and loose sides, while P_t and P_r are tangential and radial components of gear tooth force. Assume, (15)

$$P_1 = 3\,P_2 \quad \text{and} \quad P_r = P_t \tan(20^o)$$

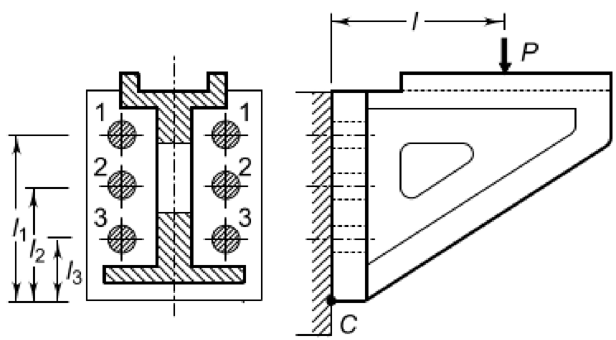
The gear and pulley are keyed to the shaft. The material of shaft is steel 50C4 (S_{ut} = 700 and S_{yt} = 460 N/mm^2). Design the shaft using ASME code on the basis of strength.



7. A bracket is fastened to the steel structure by means of six identical bolts as shown in figure below. Assume the following data, (10)

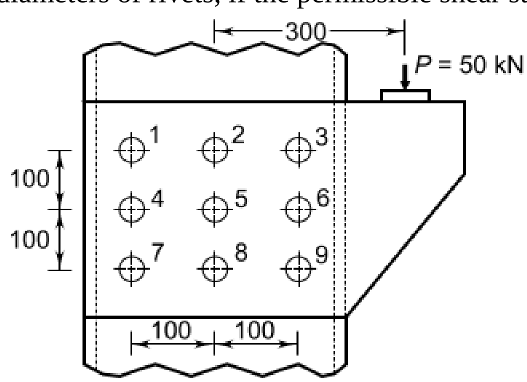
$$l_1 = 300 \text{ mm} \qquad l_2 = 200 \text{ mm} \qquad l_3 = 100 \text{ mm}$$
$$l = 250 \text{ mm} \qquad P = 50 \text{ kN}$$

Neglecting shear stress, determine the size of the bolts, if the maximum permissible tensile stress in any bolt is limited to 100 N/mm^2



OR

A bracket is attached to a steel channel by means of nine identical rivets as shown in figure below. Determine the diameters of rivets, if the permissible shear stress id 60 N/mm^2 (10)



SECTION C

8. A compressor running at 300 rpm is driven by a 15 kW, 1200 rpm motor through a 20º full depth gear. The centre distance is 0.375 m. Selecting a suitable material, design the gear for medium shock load conditions. Check the gear for wear. (20)

OR

Two helical gears are used in a speed reducer that is to be driven by an internal combustion engine. The rated power of the speed reducer is 75 kW at a pinion speed of 1200 rpm. The speed ratio is 3 to 1. Assuming medium shock conditions and 24 hour operation, design the gear by selecting a suitable material. (20)

9. It is required to design a coupling of flange type for connecting the motor and centrifugal pump shafts. The details of the duty required from the coupling are- (20)

Power to be transmitted = 18 kW

Speed = 1000 rpm

Taking a service factor of 1.2, design the coupling. The following data are given-

Allowable shear stress for shaft material is 50 N/mm^2

Allowable shear stress for bolt and key material is 30 N/mm^2

Allowable bearing stress for bolt and key material is 140 N/mm^2

Allowable shear stress for flange material is 20 N/mm^2