Printed Pages : 11

Roll No.

337551(37)

BE (5th Semester)
Examination, Nov.-Dec., 2017

(New Scheme)

Machine Design-I

Time Allowed : 4 hours *Maximum Marks :* 80
Minimum Pass Marks : 28

Note : (*i*) PSG data book and ISI sheets are allowed.
(*ii*) Part (*a*) of each question is compulsory and attempt any **two** parts from (*b*), (*c*) and (*d*).
(*iii*) The figures in the right-hand margin indicate marks.

Unit-I

1. (*a*) What is fluctuating stress? Draw a stress-time curve for fluctuating stress. [2]

(*b*) A round shaft made of a brittle material and subjected to a bending moment of 15 N-m is shown in Fig. 1(b). The stress concentration factor at the fillet is 1.5 and the ultimate tensile strength of the shaft material is

200 N/mm^2. Determine the diameter d, the magnitude of stress at the fillet and the factor of safety. [7]

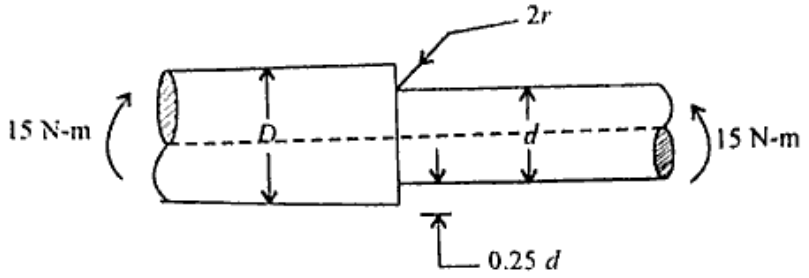

Fig. 1(b)

(*c*) A shaft carrying a load of 5 kN midway between two bearings is shown in Fig. 1(c). Determine the maximum bending stress at the fillet section. Assume the shaft material to be brittle. [7]

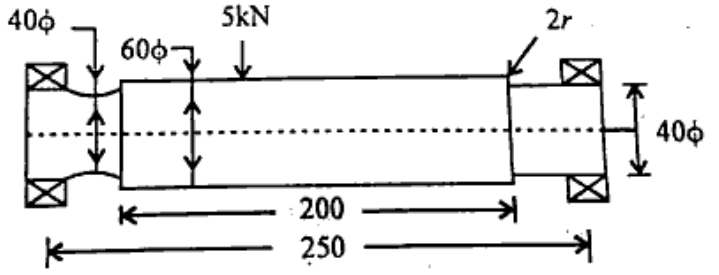

Fig. 1(c)

(*d*) A cantilever beam made of Steel Fe-540 (S_{ut} =540 N/mm^2 and S_{yt} = 320 N/mm^2) and subjected to a completely reversed load (P) of 5kN is shown in Fig. 1(d). The beam is machined and the reliability is 50%.

The factor of safety is 2 and the notch sensitivity factor is 0.9. Calculate : [7]

(*i*) Endurance limit at the fillet section, and

(*ii*) Diameter *d* of the beam for infinite life

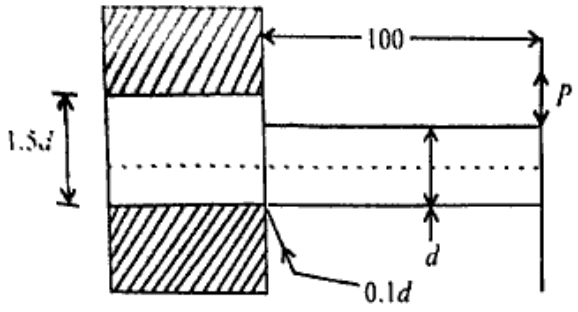

Fig. 1(d)

Unit-II

2. (*a*) What is stress concentration? [2]

(*b*) It is required to design a cotter joint to connect two steel rods of equal diameter. Each rod is subjected to an axial tensile force of 50 kN. Design the joint and specify its main dimensions. [7]

(*c*) It is required to design a rigid type of flange coupling in connect two shafts. The input shaft transmits 37.5 kW power at 180 rpm to the output shaft through the coupling. The service factor for the application is 1.5 i.e. the design torque is 1.5 times of the rated torque.

Select suitable materials for various parts of the coupling, design the coupling and specify the dimensions of its components. [7]

(*d*) A flexible coupling is used in transmit 15 kW power at 100 rpm. There are six pins and their pitch circle diameter is 200 mm. The effective length of the bush (l_b), the gap between two flanges and the length of the pin in contact with the right hand flange are 35, 5 and 23 mm respectively. The permissible shear and bending stresses for the pin are 35 and 152 N/mm^2 respectively. Calculate : [7]

(*i*) Pin diameter by shear consideration

(*ii*) Pin diameter by bending consideration.

Unit-III

3. (*a*) Which theories of failure are applicable for shafts? Why? [2]

(*b*) A transmission shaft supporting a spur gears *B* and the pulley *A* is shown in Fig. 3(b). The shaft is mounted on two bearings *A* and *C*. The diameter of the pulley and the pitch circle diameter of the gear are 450 mm and 300 mm respectively. The pulley transmits 20 kW power at 500 rpm to gear P_1 and P_2 are belt tensions in the tight and loose slides, while P_t and P_r tangential and radial components of gear tooth force. Assume.

$$P_1 = 3P_2 \text{ and } P_r = P_t \tan (20°)$$

The gear and pulley are keyed to the shaft. The material of the shaft is steel 50C4 (S_{ut} = 700 and S_{yt} = 460 N/mm^2) The factors K_f and K_t of the ASME code are 1.5 each. Determine the shaft diameter, using the ASME code. [7]

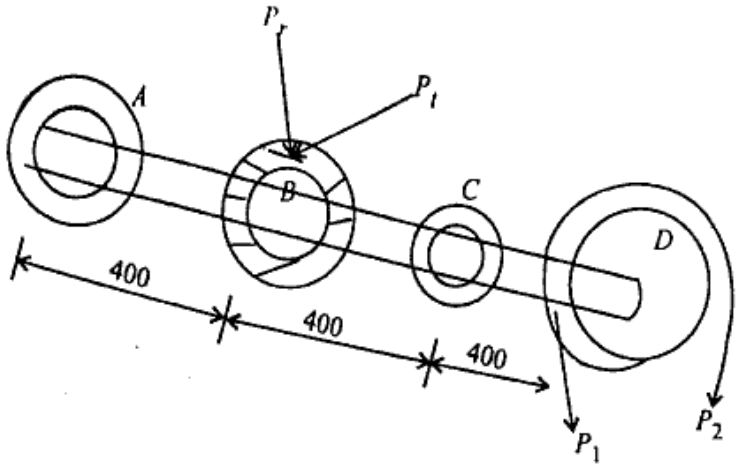

Fig. 3(b)

(*c*) A transmission shaft supporting a helical gear *B* and an overhung bevel gear *D* is shown in Fig. 3(c). The shaft is mounted on two bearings, *A* and *C*. The pitch circle diameter of the helical gear is 450 mm and the diameter of the bevel gear at the forces is 450 mm. Power is transmitted from the helical gear to the bevel gear. The gears are keyed to the shaft. The material of the shaft is steel 45C8 (S_{ut} = 600 and S_{yt} = 380N/mm^2). The factors K_b and K_t of ASME code

are 2.0 and 1.5 respectively. Determine the shaft diameter, using the ASME code. [7]

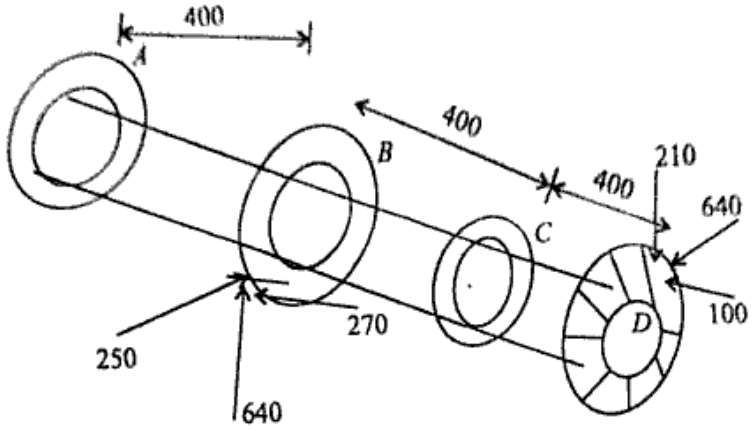

Fig. 3(c)

(*d*) An automotive plate clutch consists of two pairs of contacting surfaces with asbestos friction lining. The maximum engine torque is 250 N-m. The coefficient of friction is 0.35. The inner and outer diameters of friction lining are 175 and 250 mm respectively. The clamping force is provided by nine springs, each compressed by 5 mm to give a force of 800 N. When the clutch is new.

(*i*) What is the factor of safety with respect to slippage when the clutch is brand new?

(*ii*) What is the factor of safety with respect to slippage after initial wear has occurred?

(*iii*) How much wear of friction lining can take place before the clutch will slip? [7]

Unit-IV

4. (*a*) What are the advantages of threaded joints? [2]

(*b*) A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts is shown in Fig. 4(b). The bolts are made from plain carbon steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 3. Specify the size of bolts. [7]

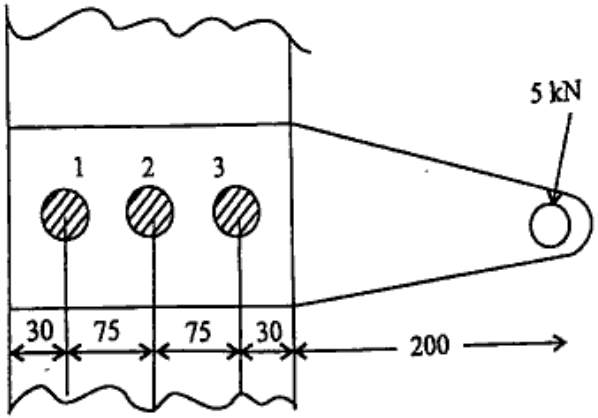

Fig. 4(b)

(*c*) The following data is given for the bracket illustrated in Fig. 4(c).

P = 25 kN e = 100 mm

l_1 = 150 mm l_2 = 25 mm

There is no pre-load in the bolts. The bolts are made of plain carbon steel 45C8 (S_{yt} = 380 N/mm^2) and the factor of safety is 2.5.

(Turn Over)

Using the maximum shear stress theory, specify the size of the bolts. [7]

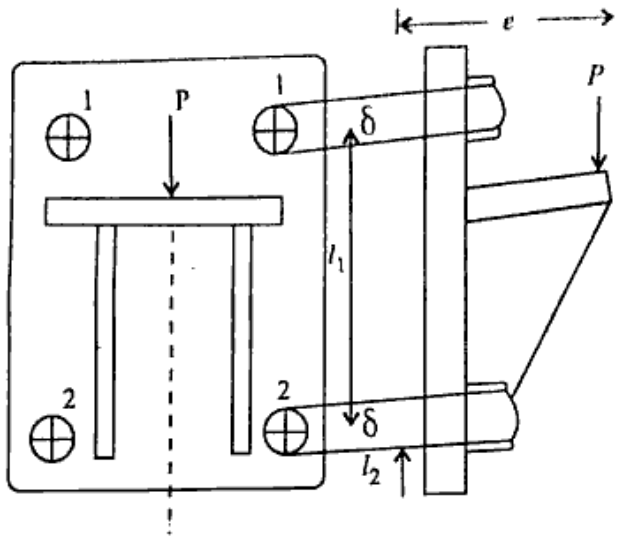

Fig. 4(c)

(*d*) The nominal diameter of a triple-threaded square screw is 50 mm, while the pitch is 8 mm. It is used with a collar having an outer diameter of 100 mm and inner diameter as 65 mm. The coefficient of friction at the thread surface as well as at the collar surface can be taken as 0.15. The screw is used to raise a load of 1.5 kN. Using the uniform wear theory for collar friction, calculate –

(*i*) torque required to raise the load ;

(*ii*) torque required to lower the load ;

(*iii*) the force required to raise the load, if applied at a radius of 500 mm. [7]

(Continued)

Unit-V

5. (*a*) What is the relationship between leg and throat of fillet weld. [2]

(*b*) A plate, 75 mm wide and 10 mm thick, is joined with another steel plate by means of single transverse and double parallel fillet welds, as shown in Fig. 5(b). 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. [7]

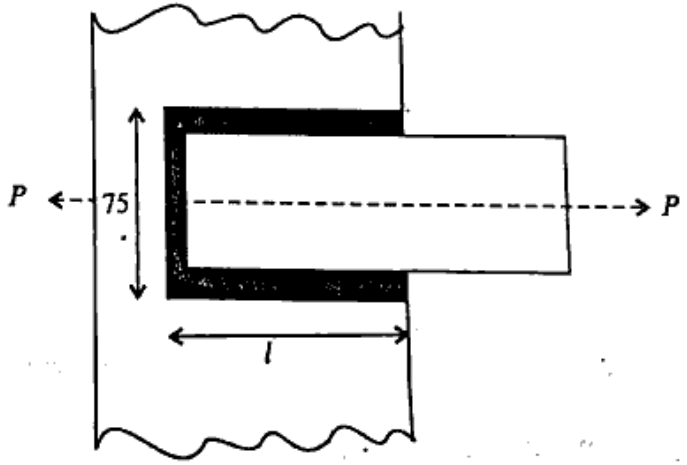

Fig. 5(b)

(*c*) A welded connection, as shown in Fig. 5(c) is subjected to an eccentric force of 7.5 kN. Determine the size of welds, if the permissible shear stress for the weld is 100 N/mm^2. Assume static conditions. [7]

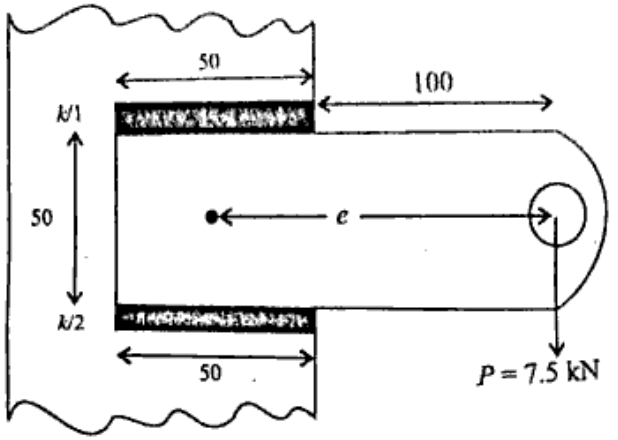

Fig. 5(c)

(*d*) A cylindrical pressure vessel with a 1.5 m inside diameter is subjected to internal steam pressure of 1.5 MPa. It is made from steel plate by triple-riveted double strap longitudinal butt joint with equal straps. The pitch of the rivets in the outer row is twice of the pitch of the rivets in the inner rows. The rivets are arranged in a zigzag pattern. The efficiency of the riveted joint should be at least 80%. The permissible stresses for the plate and rivets in tension, shear and compression are 80, 60 and 120 N/mm^2 respectively. Assume that the rivet in double shear is 1.875 times stronger than in single shear.

Design then joint and calculate —

(*i*) thickness of the plate;

(*ii*) diameter of rivets;

(*iii*) pitch of rivets;

(*iv*) distance between the rows of rivets;

(*v*) margin

(*vi*) thickness of the straps;

(*vii*) efficiency of the joint

Draw a neat sketch of the riveted joint showing calculated values of dimensions. [7]

———