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B. E. (Fifth Semester) Examination, April-May/ Nov.-Dec. 2020

(New Scheme)

(Mech. Engg. Branch)

MACHINE DESIGN-I

Time Allowed : Four hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Attempt all questions. Part (a) is compulsory from each question. Attempt all questions valuing for 16 marks. Use of Design Data book by PSG and Machine Design Data book by V. B. Bhandari is permitted in the exam.*

1. (a) Define factor of safety. 2

Solve any ***two*** *from part (b), (c) and (d) :*

(b) A flat plate subjected to a tensile force of 5 kN is shown in Fig. 1. The plate material is grey cast iron FG 200 and the factor of safety is 2·5. Determine the thickness of the plate. 7

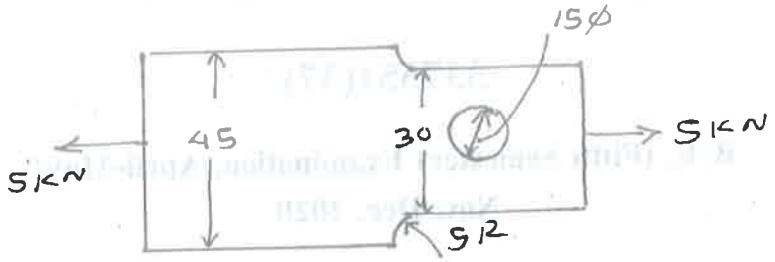

Fig. 1

(c) A forged steel bar, 50 mm in diameter is subjected to a reversed bending stress of 250 N/mm^2. The bar is made of steel 40C8 (S_{ut} = 600 N/mm^2) calculate the life of the bar for a reliability of 90%. 7

(d) A cantilever beam made of cold drawn steel 20C8 (S_{ut} = 540 N/mm^2) is subjected to a completely reversed load of 1000 N as shown in Fig 2. 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. 7

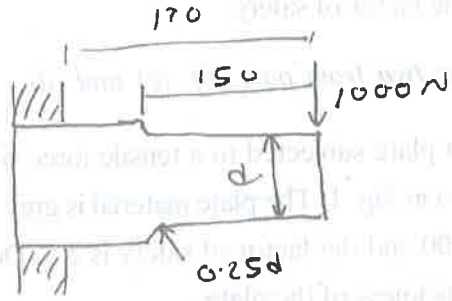

Fig. 2

2. (a) What are the types of keys? 2

*Solve any **one** from part (b) and (c) :*

(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. 14

(c) It is required to design a rigid type of flange coupling to 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. 14

3. (a) What is the difference between shaft and axle? 2

*Solve any **one** from part (b) and (c) :*

(b) A line shaft supporting two pulleys A and B is shown in fig. 3. Power is supplied to the shaft by means of a vertical belt on the pulley A, which is then transmitted to the pulley B carrying a horizontal belt. The ratio of belt tension on tight and loose sides is 3 : 1.

The limiting value of tension in the belts is 2·7 kN. The shaft is made of plain carbon steel 40C8 (S_{ut} = 650 N/mm^2 and S_{yt} = 380 N/mm^2). The pulleys are keyed to the shaft. Determine the diameter of the shaft according to the ASME code if, k_b = 1·5 and k_t = 1·0. 14

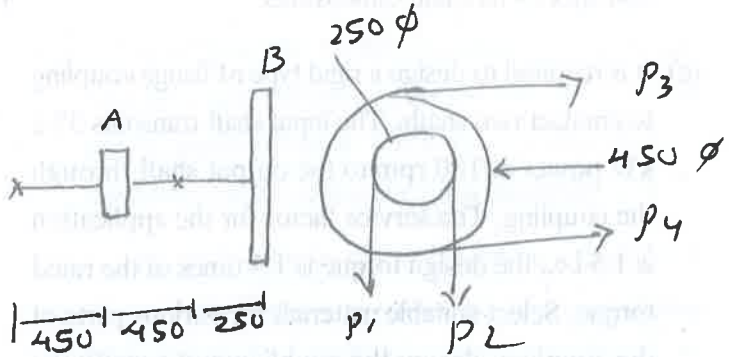

Fig. 3

(c) An automative 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 8000 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? 14

4. (a) What are the terminology of screw thread? 2

Solve any ***one*** *from part (b) and (c) :*

(b) A wall bracket is attached to the wall by means of four identical bolts. two at A and two at B, as shown in fig. 4. Assuming that the bracket is held against the wall and prevented from tipping about the point C by all four bolts and using an allowable tensile stress in the bolts as 35 N/mm^2, determine the size of the bolts on the basis of maximum principal stress theory. 14

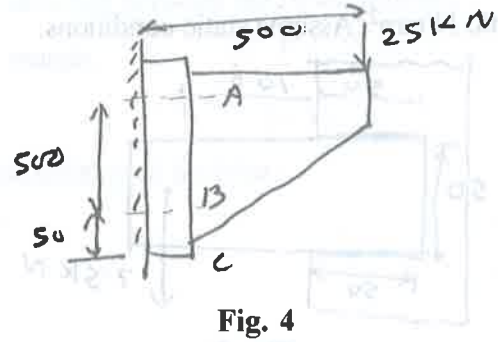

Fig. 4

(c) A screw jack is to lift a load of 80 kN through a height of 400 mm. The elastic strength of screw material in tension and compression is 200 MPa and in shear 120 MPa. The material for nut is phosphor-bronze for which the elastic limit may be taken as 100 MPa in tension, 90 MPa in compression and 80 MPa in shear. The bearing pressure between the nut and the screw is not to exceed 18 N/mm^2. Design and draw the screw jack. The design should include the design of (i) Screw, (ii) Nut, (iii) Handle and cup and (iv) Body. 14

5. (a) What are the different types of riveting joints? 2

*Solve any **one** from part (b) and (c) :*

(b) A welded connection, as shown in Fig. 5 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. 14

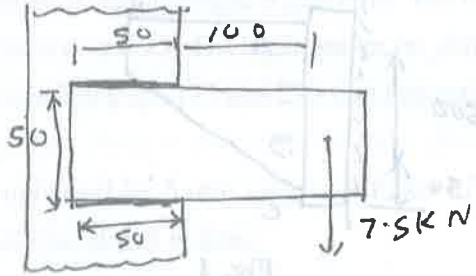

Fig. 5

(c) 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 zig-zag 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 the joint and calculate, 14

(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, and

(vii) efficiency of the joint.