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B. E. (Fifth Semester) Examination, Nov.-Dec. 2019

(New Scheme)

(Mech. Engg. Branch)

MACHINE DESIGN-I

Time Allowed : Four hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : *Attempt total of 16 marks from each question. Part (a) is compulsory. (2) Design data book by PSG is allowed in the examination. (3) Assume data if missing.*

1. (a) What do you mean by design stress? 2

(b) A cantilever beam made of cold drawn steel 40 C8

(S_{ut} = 600 N/mm^2 and S_{yt} = 380 N/mm^2) is shown in fig. 1. The force P acting at the free end varies from – 50 N to + 150 N. The expected reliability is 90% and the FOS is 2. The notch sensitivity factor at the fillet is 0.9. Determine the diameter of the beam at the fillet cross section. 7

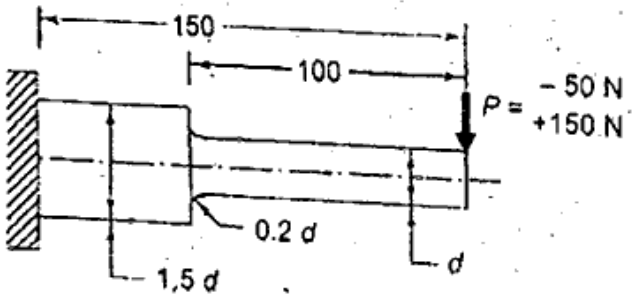

fig. (b)

(c) A rotating shaft subjected to a non-rotating force of 5 kN and simply supported between two bearings A and E as shown is fig. 2. The shaft is machined from plain carbon steel 30 C8 (S_{ut} = 500 N/mm^2) and the expected reliability is 90%. The equivalant notch radius at the fillet section can be taken as 3 mm. What is the life of the shaft? 7

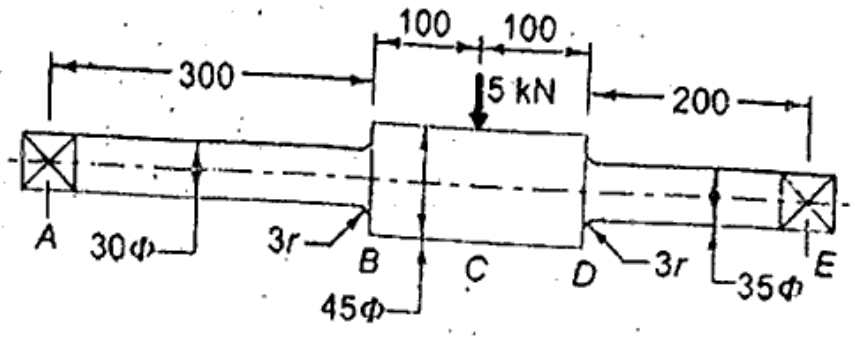

fig. (c)

(d) A transmission shaft carries a pulley midway between the two bearings. The bending moment at the pulley varies from 200 Nm to 600 Nm, as the torsional moment in the shaft varies from 70 Nm to 200 Nm. The frequencies of variation of bending and torsional moments are equal to the shaft speed. The shaft is made up of FeE 400 (S_{ut} = 540 N/mm^2 and S_{yt} = 400 N/mm^2). The connected endurance limit of the shaft is 200 N/mm^2. Determine the diameter of the shaft using FOS as 2. 7

2. (a) What is coupling? Write different types of couplings? 2

(b) Design and draw a cotter joint to support a load of

30 kN vaying from in compression to tension. The material used in carbon steel for which the following allowable stresses may be used. The load is applied statically. Tension stress is equal to compression stress and is 50 MPa, Shear stress = 35 MPa and crushing stress is 90 MPa. 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 of the application is 1.5 i.e. design torque is 1.5 times the rated torque Select suitable materials for various parts of the coupling. Design the coupling and specify the dimensions of its components in line diagram of the coupling. 14

3. (a) What is the permissible shear stress for design of shaft as per ASME code? 2

(b) A transmission shaft supporting two pulleys A and B and is mounted between two bearings C_1 and C_2 as shown in fig. 3. power is transmitted from pulley A to B. The shaft is made of plain carbon steel 45 C8

(S_{ut} = 600 and S_{yt} = 380 N/mm²). The pulleys are keys to the shaft. Determine the diameter of shaft using ASME code if K_b=1·5 & K_t = 1·0. Also determine diameter of shaft if the permissible angle of twist between the two pulleys is 0·5° and the modulus of rigidity is 79300 N/mm². 14

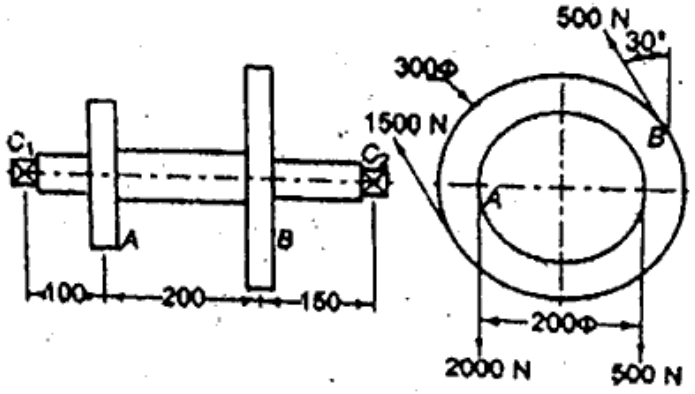

fig. (b)

(c) What are the different theories applied to friction plate clutch? Which theory is usually applied for design of friction clutch? A multidisk cluth consists of two steel disks with one bronze disk. The inner and outer diameter of the contacting surface are 200 and 250 mm respectively. The coefficient of friction is 01 and the maximum pressure between the contacting surfaces is limited to 0.4 N/mm². Assuming uniform wear theory, calculate the force

required to change the clutch and the power transmission capacity at 720 rpm. 14

4. (a) What is self locking of power screws? 2

(b) A steel plate subjected to a force of 5 kN and fixed to a channel by means of three identical bolts as shown in fig. 4. The botts are made from plain carbon steel 45 C8 (S_{yt} = 380 N/mm²) and the factor of safety is 3. specify the size of bolts.

Dervie equation of primary and secondary shear forces of eccentrically loaded bolted joints. 14

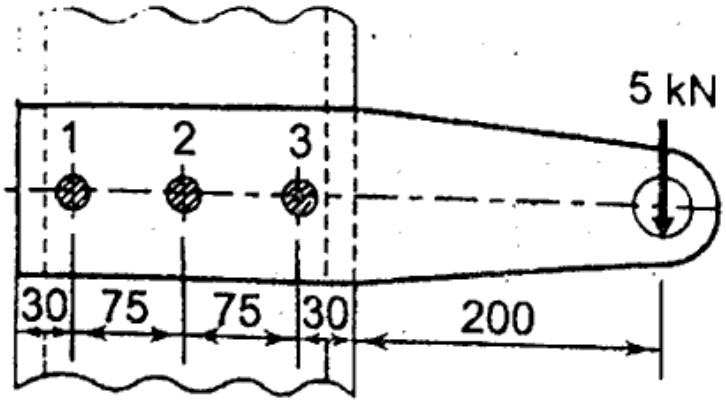

fig. (b)

(c) A single start square threaded screw is used in a

screw press to exert a force of 50 kN. The screw is made of plain carbon steel 10 C4 (S_{ut} = 340 N/mm^2) and the factor of safety is 4. The permissible tensile and compressive stresses are equal and permissible shear stress is 50 % of the permissible tensile stress. The nut is made up of gray cast iron FG. 200 and the permissible bearing pressure between the contacting surfaces of screw and nut is 17 MPa. A low friction thrust ball bearing is used in the mechanism and collar friction can be neglected. The coefficient of friction is 0·15. Determine the size of screw and length of nut. Check the transverse shear stresses in screw and nut. The axial length of threads in the nut should be between 1 to 1·5 times the nominal diameter of the screw. 14

5. (a) Why are riveted joints replaced by welded joints. 2

(b) Two flat plates subjected to a tensile force P are connected together by means of double strap butt joint as shown in fig. The force P is 250 kN and the width is 200 mm. The rivets and plates are made of the same steel & the permissble stresses is tension, compression and shear are 70, 100 and 60 N/mm^2.

Calculate : 7

(i) The diameter of the rivets

(ii) The thickness of the plates

(iii) The dimensions of the seam p. p_1 and m_1

(iv) The efficiency of the joint

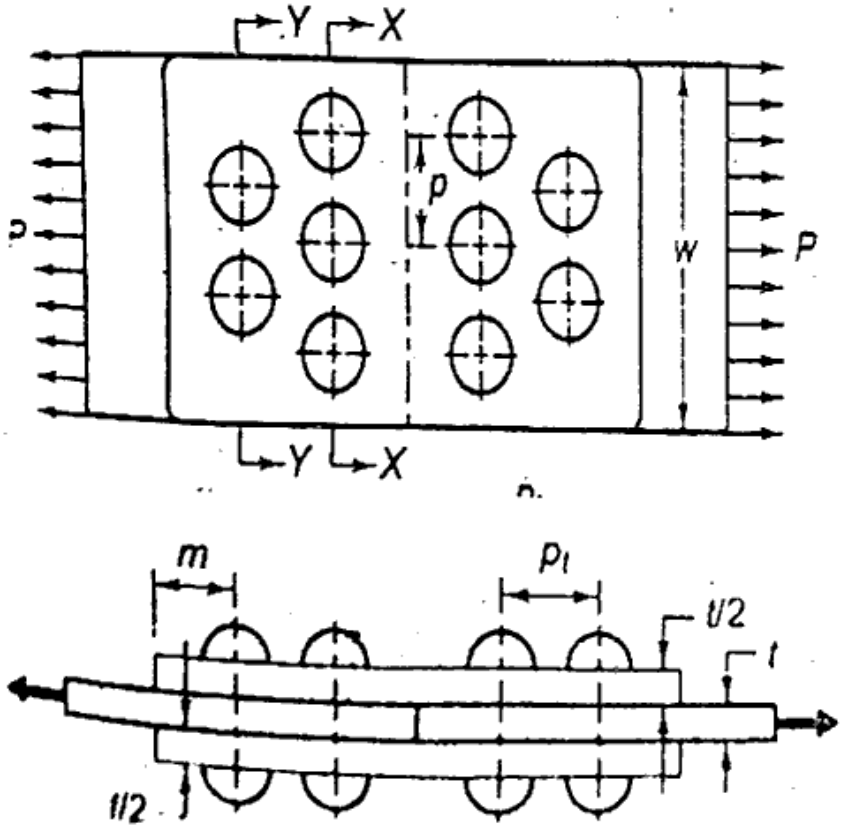

fig. (b)

(c) A cylindrical pressure vessel with 1 m inner diameter is subjected to internal steam pressure of 1.5 MPa. The permissible stresses of the cylinder plate and the rivets in tension, shear and compression are 80, 60 and 120 N/mm^2 resptty. The efficiency of the longitudinal joint can be taken as 80% for the purpose of plate thickness calculations. The efficiency of the circumferential lap joint should be at least 62%. Design the circumferential lap joint and 7

Calculate :

(i) Thickness of the plate

(ii) Diameter of the rivet

(iii) No of joints

(iv) Pitch of rivets

(v) Number of rows of rivets

(vi) Overlap of the plates

(d) Why the reinforcement is required in the welded joint? A plate 100 mm wide and 12·5 mm thick is to be welded to another plate by means of single

transverse and double parallel fillet welds. Determine the length of the weld run in each case if the joint is subjected to varying loads. The recommended design stress in tension is not to exceed 70 N/mm^2 and in shear 56 N/mm^2 for static loading. 7