

337551(37)

B. E. (Fifth Semester) Examination,

Nov.-Dec. 2016

(New Scheme)

(Mech. Engg. Branch)

MACHINE DESIGN-I

Time Allowed : Four hours

Maximum Marks : 80

Minimum Pass Marks : 28

Note : Attempt all questions. Use of PSG data is permitted. Assume suitable data if required. Attempt 16 marks from each unit.

http://www.csvtuonline.com

http://www.csvtuonline.com

337551(37)

PTO

1. (a) What is factor of safety? 2

(b) Write short note on : 7

(i) S-N curve

[2]

(ii) Maximum principal stress theory

(iii) Modified Goodman diagram

(c) A round shaft made of a brittle material and subjected to a bending moment of 15 N-m as shown in Fig.-1. The stress concentration factor at the fillet is 1.5 and the ultimate tensile strength of the shaft material is 200 N/mm². Determine the shaft diameter d , the magnitude of stress at the fillet and factor of safety. 7

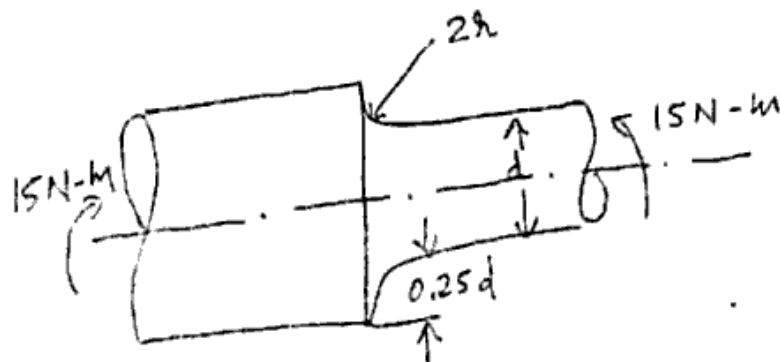


Fig-1

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

http://www.csvtuonline.com

http://www.csvtuonline.com

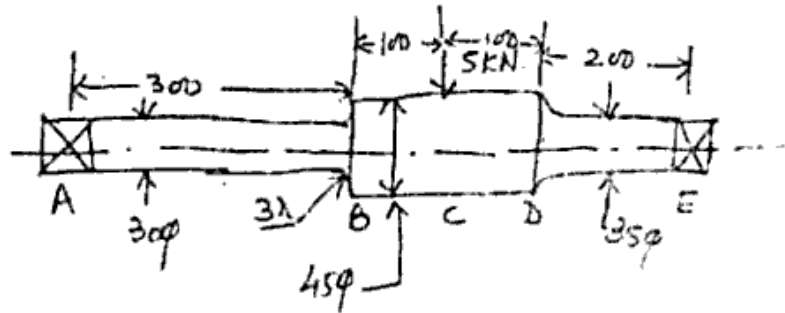


Fig.-2

2. (a) What is coupling? Where do you use it?
- (b) Two rods made of plain-carbon steel 40 C8 ($S_{yt} = 380 \text{ N/mm}^2$) are to be connected by means of cotter joint. The diameter of each rod is 50 mm and cotter is made from a steel plate of 15 mm thickness. Calculate the dimensions of the spigot & socket joint making the following assumptions.
 - (i) Yield strength in compression is twice of the tensile yield strength.
 - (ii) Yield strength in shear is 50% of the tensile yield strength.

http://www.csvtuonline.com

The factor of safety 6. Also draw cotter joint. 14

- (c) Design a muff coupling to connect two steel shafts transmitting 25 kW power at 360 rpm. The shaft and key are made up of plain carbon steel 30 C8 ($S_{yt} = S_{yc} = 400 \text{ N/mm}^2$). The sleeve is made of grey cast iron FG200 $S_{ut} = 200 \text{ N/mm}^2$. The factor of safety for the shafts and key is 4. For sleeve, the factor of safety is 6 based on ultimate strength.

3. (a) What types of stresses induced in a shaft?
- (b) The layout of an intermediate shaft of a gear box supporting two spur gears B and C is shown in fig. 3. The shaft is mounted on two bearing A and D. The pitch circle diameter of gears B and C are 900 and 600 mm. The material of the shaft is FeE580 ($S_{ut} = 770$ & $S_{yt} = 580 \text{ N/mm}^2$). The factors K_b and K_t of ASME code are 1.5 and 2.0 respectively. Determine the shaft diameter using ASME code. Assume that gears are connected to the shaft by means of keys.

http://www.csvtuonline.com

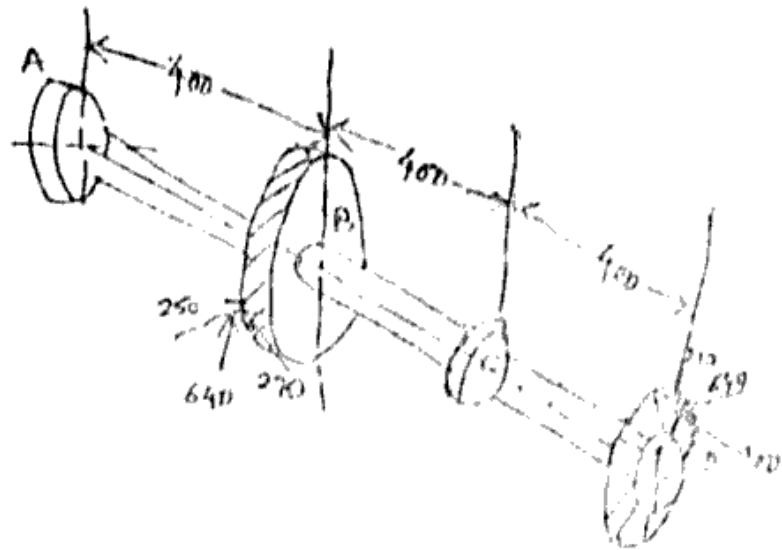


Fig-3

(c) A single dry plate clutch is tube designed to transmit 7.5 kW at 900 rpm find diameter of shaft, mean radius and face width if $r/b = 4$, Outer and inner radii of clutch plate.

7

(d) A centrifugal clutch is to be designed to transmit 15 kW at 900 rpm. The shoes are four in number. The speed at which the engagement begins is $3/4$ th of the running speed. The inside radius of the pulley rim is 150 mm. The shoes are lined with ferrodo for which the coefficient of friction is 0.25. Determine the mass and size of shoes.

7

337551(37)

4. (a) Define following terms :

2

Major Diameter, Minor diameter Lead, Pitch.

(b) Write the method of determining the size of bolt when the bracket carries an eccentric load perpendicular to the axis of the bolt?

4

(c) A bracket is fastened to the steel structure by means of six identical bolts as shown in fig-4. Assume following data : $l_1 = 300$ mm , $l_2 = 200$ mm , $l_3 = 100$ mm , $l = 250$ mm , $p = 50$ kN .

Neglecting shear stress determine the size of the bolts if the maximum principal tensile stress in any bolt is limited to 100 N/mm².

10

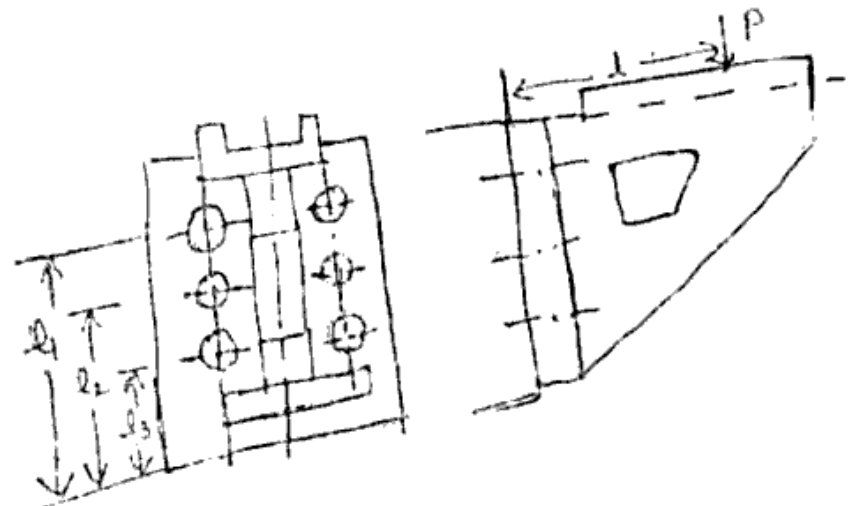


Fig-4

(d) What do you mean by thread efficiency? A double threaded power screw with ISO metric trapezoidal threads is used to raise a load of 300 kN. The nominal diameter is 100 mm and pitch 12 mm. $\mu = 0.15$. Calculate : Torque required to raise the load, torque required to lower the load and efficiency of thread.

10

(a) What are the different types of rivet heads?

2

(b) What are the advantages of welded joint compared to riveted joint?

4

(c) A cylindrical steam pressure vessel of 1 m inside diameter is subjected to an internal pressure of 2.5 MPa. Design a double riveted double strap longitudinal butt joint for the vessel. The straps are of equal width. The pitch of the rivets in outer row is twice the pitch of inner rows. A zig-zag pattern is used. The efficiency of rivet joint is 70%. For steel plate $\sigma_L = 80 \text{ N/mm}^2$ for rivet materials $\tau = 60 \text{ N/mm}^2$.

Make a neat sketch of joint.

10

(d) A bracket is welded to the vertical column by means

of two fillet welds as shown in fig.-5. Determine the size of welds if $\tau = 70 \text{ N/mm}^2$.

10

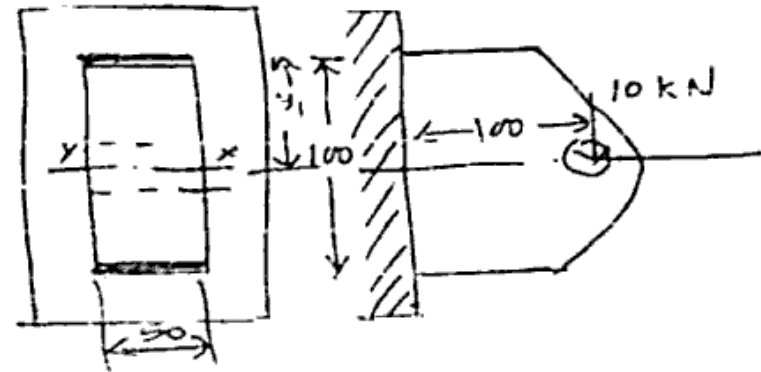


Fig.-5