Reg. No. : | | | | | | | | | | |

# V 4598

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2008.

Fifth Semester

(Regulation 2004)

Mechanical Engineering

ME 1302 — DESIGN OF MACHINE ELEMENTS

(Common to B.E. (Part-Time) Fourth Semester – Regulation 2005)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

Use of approved design data book is permitted.

Assumptions and assumed data have to be stated clearly.

PART A — ($10 \times 2 = 20$ marks)

1. Differentiate the stress distribution in a bar subjected to axial force and beam subjected to bending.

2. For Ductile material, which of the strength is considered for designing a
   (a) component subjected to static loading
   (b) component subjected to fatigue loading.

3. Why a hallow shaft has greater strength and stiffness than solid shaft of equal weight?

4. What type of stresses are developed in the key?

5. State any two advantages of welded joints over riveted joints.

6. What is the meaning of bolt M24 $\times$ 2?

7. State any two important applications of leaf spring.

8. State the following :

(a) Leverage

(b) Load on the lever.

9. What is the advantage of Teflon which is used for bearings?

10. What is the purpose of flywheel that is used in an IC engine?

PART B — ($5 \times 16 = 80$ marks)

11. (a) (i) Explain the following with mathematical expressions.

Maximum principal stress theory; Von-mises stress theory. (8)

(ii) A cost iron pulley transmits 12 kW at 330 rpm. The diameter of the pulley is 1.3 m and it has four straight arms of elliptical cross section in which the major axis is twice the minor axis. Determine the dimensions of the arm if the allowable bending stress is 18 MPa. (8)

Or

(b) A shaft of 760 mm length is simply supported at its ends. It is subjected to a central concentrated cyclic load that varies from 12 to 36 kN. Determine the diameter of the shaft assuming a factor of safety of 2, size correction factor of 0.8, and surface correction factor of 0.85. The material properties are ultimate strength = 500 MPa; yield strength = 280 MPa; and endurance limit = 250 MPa. Fatigue stress concentration factor = 1.5. (16)

12. (a) Design a knuckle joint to with stand a tensile load of 70 KN using steel with the following permissible stresses

$\sigma$ (in tension) = 60 MPa

$\sigma$ (in crushing) = 72 MPa

$T$ (in shear) = 48 MPa. (16)

Or

(b) Design a bushed-pin type of flexible coupling to connect a pump shaft to a motor shaft transmitting 30 kW at 900 rpm. The overall torque is 15% more than mean torque. The material allowable properties are as follows :

$\sigma$ (in crushing for shaft and key material) = 80 MPa

$T$ (in shear for shaft and key material) = 40 MPa

$T$ (in shear for cast iron) = 15 MPa.

Bearing pressure for rubber bush = 0.8 MPa

Material of the pin as same as that of shaft and key. Draw the sketch of the coupling. (16)

13. (a) A steam engine of effective diameter 300 mm is subjected to a steam pressure of 1.5 MPa. The cylinder head is connected by 8 bolts having yield point 330 MPa and endurance limit at 240 MPa. The bolts are tightened with an initial preload of 1.5 times the steam load. A soft copper gasket is used to make the joint leak-proof. Assuming a factor of safety equal to 2, find the size of bolt required. The stiffness factor for copper gasket may be taken as 0.5.

Or

(b) (i) A plate 75 mm wide and 12.5 mm thick is joined with another plate by a single transverse weld and a double parallel fillet weld as shown in Fig. 1. The maximum tensile and shear stresses are 70 MPa and 56 MPa respectively.

Find the length of each parallel fillet weld, if the joint is subjected to both static and fatigue loading.

Stress concentration factor for transverse weld is 1.5 and for parallel fillet weld is 2.7. (10)

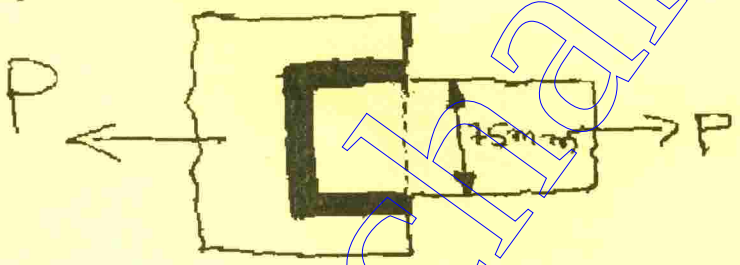


Fig. 1. Problem 13 (b)(i)

(ii) A welded joint as shown in Fig. 2 is subjected to an eccentric load of 2 kN. Find the size of weld, if the maximum shear stress in the weld is 25 MPa. (6)

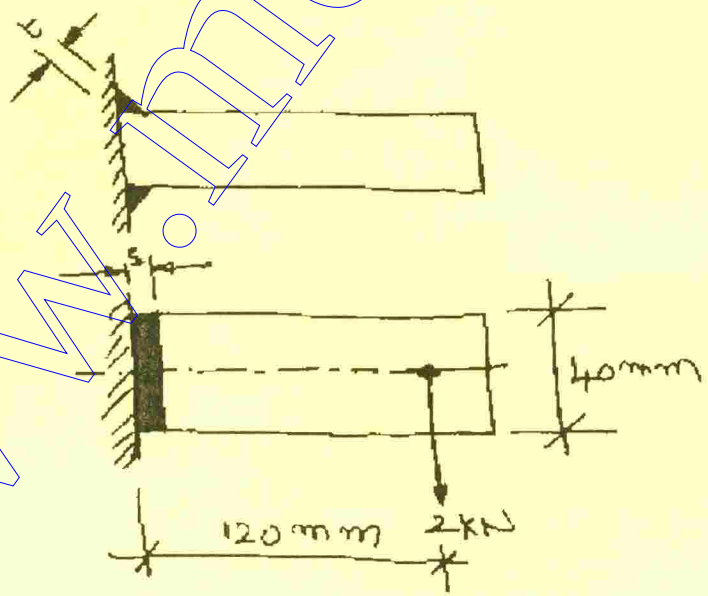


Fig. 2. Problem 13 (b)(ii)

14. (a) Design a spring for spring loaded safety valve for the following condition :

Operating pressure = 1 MPa

Diameter of the valve seat = 110 mm

Design shear stress for the spring = 360 MPa

$G$ = shear modulus = 82 GPa

The spring is to be kept in the casing of 130 mm inner diameter and 400 mm long. The spring should be at maximum lift of 6 mm when the pressure is 1.08 MPa. (16)

Or

(b) A lever loaded safety valve is 75 mm in diameter and is to be designed for a boiler to blow-off at pressure of 1.1 MPa. Design a suitable mild steel lever of rectangular cross-section using the following permissible stresses :

Tensile stress = 72 MPa;

Shear stress = 48 MPa;

Bearing pressure intensity = 24 MPa.

The pin is also made of mild steel. The distance from the fulcrum to the weight of the lever is 900 mm and the distance between the fulcrum and pin connecting the valve spindle links to the lever is 100 mm. (16)

15. (a) A bearing for an axial flow compressor is to carry a radial load of 2500 N and thrust of 1500 N. The service imposes light shock and the bearing will be in use for 40 hours/week for 5 years. The speed of the shaft is 1000 rpm. Select suitable ball bearing for the purpose and give the required tolerances on the shaft and the housing. Diameter of the shaft is 50 mm. (16)

Or

(b) A punching press pierces 30 holes per minute in a plate using 12 kN-m of energy per hole during each revolution. Each piercing takes 35% of the time needed to make one revolution. The punch receives power through a gear reduction unit, which in turn is fed by a motor driven belt pulley 750 mm diameter and turning at 240 rpm. Find the power of the electric motor if overall efficiency of the transmission unit is 80%. Design a cast iron flywheel to be used with the punching machine for a coefficient of fluctuation of speed is 0.05, if the space considerations limits the maximum diameter to 1.3 m.

Allowable shear stress in the shaft mateial = 48 MPa

Allowable tensile stress for cast iron = 5 MPa

Density of cast iron = 7200 Kg/m$^3$. (16)

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