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BAS-010

00554

B.TECH. (AEROSPACE ENGINEERING) PROGRAMME (BTAE)

Term-End Examination

June, 2011

BAS-010 : MACHINE DESIGN

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt **any seven** questions. Assume missing data if any. Use of calculator is permitted. Use of machine Design Data Book is permitted.*

1. (a) What are fits and tolerances ? How are they designated ? 5+5

   (b) Specify approximate carbon limits for cast iron, steel and wrought iron. What are the usual impurities present with them ?

2. (a) The shaft and flange of a marine engine are to be designed for a flange coupling in which flange is forged on the end of the shaft. Following particulars are to be considered 5+5

   Power of engine = 3 MW

   Speed of engine = 100 rpm

Shear stress for bolt and shaft = 60 MPa.
No of bolts used = 8
P.C.D of bolts = 1.6 (dia of shaft)

Find (i) Diameter of shaft.

(ii) Diameter of bolts.

(iii) Thickness of flange.

(iv) Diameter of flange.

(b) Distinguish between Cotter joint and Knuckle ioint.

3. A shaft is supported on two bearing placed 1 m apart. A 600 mm diameter pulley is mounted at a distance of 300 mm to the right of the left hand bearing and this drives a pulley directly below it with the help of a belt having maximum tension of 2.25 kN. Another pulley of 400 mm diameter is placed 200 mm to the left of right hand bearing and is driven with the help of electric motor and belt which is placed horizontally to the right. Angle of contact for both the pulleys is 180° and $\mu = 0.24$. **10**

Determine suitable diameter of solid shaft having $\sigma_{per} = 63$ MPa, and $\tau_{per} = 42$ MPa.

Assume Torque on both the pulley is same.

4. Two flat plates, 300 mm wide, are connected together by means of a double - strap butt joint as shown in figure - 1. The plates are subjected to a tensile force P of 200 kN. The rivets and the plates are made of same steel and the permissible stresses in tension, compression, and shear are 70 N/mm^2, 140 N/mm^2 and 60 N/mm^2 respectively. Calculate ; **10**

(i) The diameter of the rivets.

(ii) The thickness of the plates.

(iii) The pitch of the rivets and.

(iv) The efficiency of the joint.

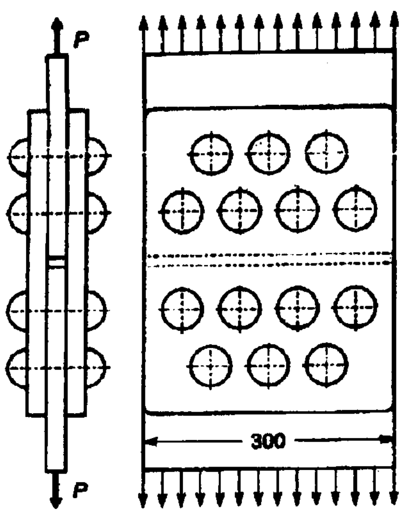

Figure - 1

5. Determine the required diameter of a steel shaft carrying two equal pulleys of 200 kg each. The shaft is 75 cm long, simply supported at its ends and the two pulleys are so located that they divide the shaft in three equal parts. Belt pull on left pulley is 10 kN (horizontal) while the pull on right pulley is 10 kN (vertical) downwards. The shaft transmits a torque of 3000 N-m between two pulleys. Assume a combined shock and fatigue factor of 1.5. Allowable stresses in tension are 150 N/mm^2, and allowable stresses in shear are 70 N/mm^2. Use maximum normal stress theory and maximum shear stress theory. **10**

Further calculate angular twist in the shaft.

$E = 2 \times 10^5\ N/mm^2$, $G = 0.86 \times 10^5\ N/mm^2$.

6. (a) Why hollow shafts are stronger than solid shafts for the same cross-sectional area ? **5+5**

   (b) Why cast iron is used for machine beds and guide ways ?

7. A transmission shaft is supported on two bearings which are 1 m apart. Power is supplied to the shaft by means of a flexible coupling, which is located to the left of left hand bearing. Power is transmitted from the shaft by means of a belt pulley, 250 mm diameter, which is located at a distance of 300 mm from the left hand bearing. The mass of the pulley is 20 kg and the ratio of belt tension on tight and slack sides is 2 : 1. The belt tensions act vertically downward. The shaft is made of steel FeE 300 ($S_{yt} = 300\ N/mm^2$) and factor of safety is 3. Determine the shaft diameter, if it transmits 10 kW power at 360 rpm from the coupling to the pulley. **10**

8. A double - threaded power screw, with I.S.O. metric trapezoidal threads is used to raise a load of 300 kN. The nominal diameter is 100 mm and the pitch is 12 mm. The co-efficient of friction at screw threads is 0.15. Neglecting collar friction, **10**

Calculate :

(i) Torque required to raise the load

(ii) Torque required to lower the load, and

(iii) Efficiency of the screw.

9. 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 figure - 2. The joint is subjected to a maximum tensile force of 55 kN. The permissible tensile and shear stresses in the weld material are 70 N/mm^2 and 50 N/mm^2 respectively. Determine the required length of each parallel fillet weld. **10**

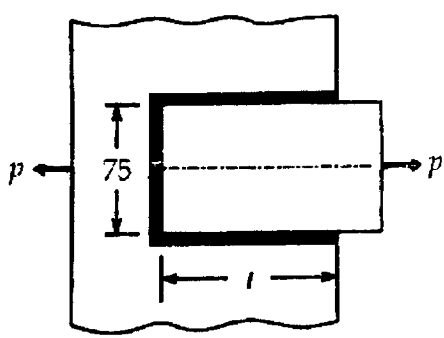

Figure - 2

10. Write short notes on *any five* of the following : **5x2=10**

(a) Design for production.

(b) Fatigue failure.

(c) Design for Rigidity.

(d) Failure theories.

(e) Stress concentration - cause and mitigation.

(f) Factor of safety.

(g) Reliability.

(h) Ductility and Brittleness.