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

Term-End Examination

June, 2012

BAS-010 : MACHINE DESIGN

Time : 3 Hours   *Maximum Marks : 70*

Note :   (i)   Attempt *any seven* questions.

(ii)   *Q 1 is compulsory.*

(iii)   *Use of scientific calculators is permitted.*

(iv)   *Assume any missing data and clearly specify the assumptions.*

1.   (a)   The process which improves machine ability of steel, but lower the hardness and tensile strength is   **10x1=10**

(i)   Normalising

(ii)   Full annealing

(iii)   Process annealing

(iv)   Spheroidising

(b)   Factor of safety for steel under steady load is :

(i)   2   (ii)   4   (iii)   6   (iv)   8

(c) Failure of material is called Fatigue when it fails

    (i) at elastic limit

    (ii) below elastic limit

    (iii) below yield point

    (iv) None of these

(d) The objective of caulking in a rivet joint is to make the joint.

    (i) free from corrosion

    (ii) free from stresses

    (iii) leakproof

    (iv) stronger in tension.

(e) A feather key is generally

    (i) loose in the shaft and Tight in hub

    (ii) Tight in shaft and loose in hub

    (iii) Tight in both shaft and hub

    (iv) loose in both shaft and hub.

(f) An stresses produced in a belt drive are

    (i) compressive stresses

    (ii) tensile stresses

    (iii) both tensile and compressive stresses

    (iv) shear stresses.

(g) In a leaf spring, The longest leaf is known as :

   (i)   Lower leaf

   (ii) Master leaf

   (iii) Upper leaf

   (iv) None of these.

(h) The product of diametral pitch and circular pitch is equal to

   (i)   1

   (ii) $\dfrac{1}{\pi}$

   (iii) π

   (iv) $\pi \times$ number of teeth

(i) The cold working on metals is carried out _____ the recrystallisation temp

   (i) above   (ii) below   (iii) at

(j) The energy stored in a body when strained within elastic limit is known as

   (i)   resilience

   (ii) proof resilience

   (iii) impact energy

   (iv) strain energy.

2. (a) Explain various steps involved in design process. **2+8=10**

   (b) A foundation bolt with circular end is secured by means of a cotter. The cotter and the bolt are made of plain carbon steel 40 C 8 ($Syt = 380$ N/mm^2) and the factor of safety is 5. The yield strength in compression can be assumed to be twice of the tensile yield strength. The bolt is subjected to a maximum pull of 50 kN calculate :

   (i) The diameter of the bolt

   (ii) The diameter of the enlarged end of the bolt

   (iii) The Thickness and the width of the cotter ; and

   (iv) The compressive stress between the cotter and the bolt.

3. A line shaft transmits 25 kW power at 200rpm by means of a vertical belt drive. The diameter of the belt pulley is 1000 mm and the pulley overhangs 150 mm beyond the centre line of the end bearing. The belt tensions act vertically downward. The Tension on the tight side of the belt is 2.5 times that on slack side. The shaft is made of plain carbon steel 40C8 ($Syt = 380$ N/mm^2) and the factor of safety is 5. The mass of the pulley is 25 Kg. Determine the diameter of the shaft. **10**

4. (a) Name the types of welding. **2+8=10**

(b) A 50 mm diameter solid shaft is welded to a flat plate as shown in figure. If the size of the weld is 15 mm, find the maximum normal and shear stress in the weld.
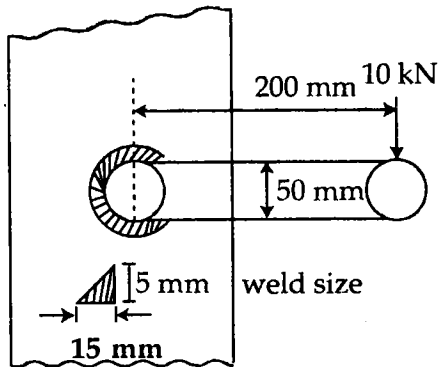
5. (a) Explain types of Gears and their applications. **3+7=10**

(b) A bronze spur pinion rotating at 600 rpm drives a castiron spur gear at a transmission ratio 4 : 1. The allowable state stresses for the bronze pinion and castiron gear are 84 MPa and 105 Mpa respectively. The pinion has 16 standard 20 full depth involute teeth of module 8 mm. The face width of both the gears is 90 mm. Find the power that can be transmitted from the stand point of strength.

6. A plate clutch having a single driving plate with **10** contact surfaces on each side is required to transmit 110 kW at 1250 rpm. The outer diameter of the contact surfaces is to be 300 mm. The coefficient of friction is 0.4 .

   (a) Assuming a uniform pressure of $0.17 \, N/mm^2$, determine the inner diameter of the friction surfaces.

   (b) Assuming the same dimensions and the same total axial thrust, determine the maximum torque that can be transmitted and the maximum intensity of pressure when uniform wear conditions have been reached.

7. (a) Name the types of screw threads used for power screws. **2+8=10**

   (b) A vertical screw with single start square threads of 50 mm mean diameter and 12 -5mm pitch is raised against a load of 10 kN by means of a hand wheel the boss of which is threaded to act as a nut. The axial load is taken up by a thrust collar which supports the wheel boss and has a mean diameter of 60 mm. The coefficient of friction is 0.15 for the screw and 0.18 for the collar. If the tangential force applied by each hand to the wheel is 100 N, find the diameter of the hand wheel.

8. (a) Name the types of springs and spring materials. **3+7=10**

    (b) Design a helical compression spring for a maximum load of 1000 N for a deflection of 25 mm using the value of spring index as 5. The maximum permissible shear stress for the spring wire is 420 MPa and modulus of rigidity is 84 kN / mm^2.

9. (a) What are the types of Keys ? **3+7=10**

    (b) A 45 mm diameter shaft is made of steel with a yield strength of 400 MPa. A parallel key of 14 mm wide and 9 mm thick made of steel with a yield strength of 340 MPa is to be used. Find the required length of key, if the shaft is loaded to transmit the maximum permissible torque - use maximum shear stress theory and assume a factor of safety of 2.

10. Write short notes on *any four*. **2.5x4=10**

    (a) Factor of safety

    (b) Wahl's Factor

    (c) Maximum Principal Strain Theory (Saint Venant's Theory)

    (d) Stress concentration factor

    (e) Self locking of screw

    (f) Surge in Springs.