

NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL & MANUFACTURING ENGINEERING

Engineering Design Principles - TIE 2107

1ST SEMESTER EXAMINATION - FEBRUARY 2010

Time : 3 Hours
Instructions : Answer Five Questions

QUESTION 1

From 1st principles derive the equation for torque T required to advance a screw against a load W [20]

QUESTION 2

- a) For belt drives derive the following $\frac{T_1 - mv^2}{T_2 - mv^2} = e^{\alpha f}$ where T_1 and T_2 are tension in the belt and m is the mass density, v is velocity and f is friction. [10]
- b) A smaller pulley of a crossed belt drive transmits 7.5 kW at 1000 rpm. The smaller pulley has a diameter of 250 mm, velocity ratio 2 and center distant is 1.25 m. It is desired to use a flat belt 6mm thick with expected coefficient of friction 0.3. If the maximum allowable stress in the belt is 1.7 MPa determine the leather belt width b. Leather has a density of 970 kg/m³ [10]

QUESTION 3

- a) Assuming uniform wear, derive the torque capacity for one pair of surfaces pressed together with an axial force F. [10]
- b) A multiple disc clutch is composed of 5 steel and four bronze disks. The clutch is required to transmit 16 Nm torque. If the inner diameter is restricted to 50 mm, determine:
- i) The necessary outer diameter of the disks and [5]
 - ii) The necessary axial force.
- The coefficient of friction may be taken as 0.1 and the average pressure not to exceed 350kN/m². Assume uniform wear [5]

QUESTION 4

A gear set consists of a 16-tooth pinion driving a 40 tooth gear, the module is 12 mm and the addendum and dedendum are 12 mm and 15 mm respectively.

Compute:

- a) The circular pitch, [8]
- b) Center distance and [4]
- c) Radii of base circles. [8]

QUESTION 5

A cone clutch has a cone angle of 11.5° , a mean friction diameter of 320mm, and a face width of 60mm. The clutch is to transmit a torque of 200 Nm. The coefficient of friction is 0.26. Find the actuating force and pressure. Use the assumption of uniform pressure. [20]

QUESTION 6

Pinion 2 in the Fig Q6 below runs at 1800 revs/min and transmits 3 Kw to the idler gear 3. the teeth are cut on the 20° full depth system and have a module of 3 mm.

- a) Draw a free body diagram of gear 3 and show all the forces which act upon it. [10]
- b) Calculate also the resultant shaft reactions. [10]

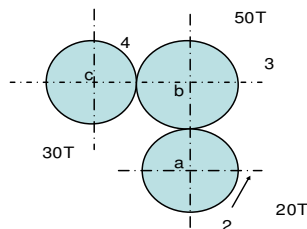


Fig Q6

QUESTION 7

A 360 mm radius brake drum contacts a single shoe as shown in the figure Q6 and sustains 225 Nm torque at 500 rpm. For a coefficient of friction of 0.3, determine,

- i) The normal force N on the shoe [4]
- ii) The normal force F to apply the brake for clockwise rotation. [4]
- iii) The normal force F to apply the brake for counterclockwise direction [4]
- iv) The dimensions required for self locking assuming other dimensions remain as shown [4]
- v) The rate of heat generated. [4]

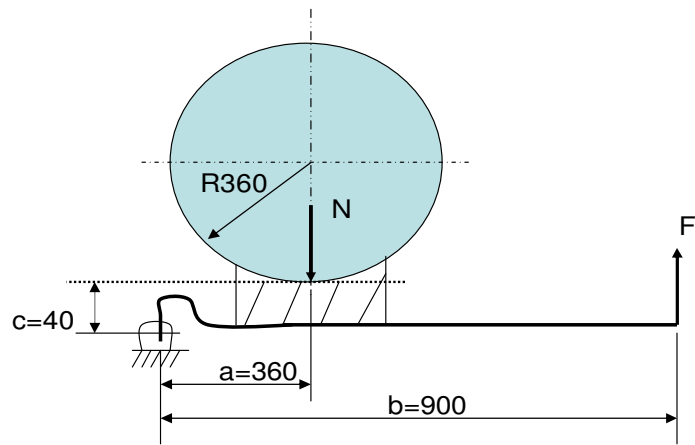


Fig.6

End of Exam