NATIONAL UNIVERSITY OF SCIENCE AND TECHNOLOGY

FACULTY OF INDUSTRIAL TECHNOLOGY

DEPARTMENT OF INDUSTRIAL & MANUFACTURING ENGINEERING

ENGINEERING DESIGN APPLICATIONS 1 – TIE 2107

1st SEMESTER EXAMINATIONS FEB 2011

Time: 3hours

Instructions:

Answer Five Questions

Question1

Explain the design phases

[20]

Question 2

A pair of straight bevel gears has a velocity ratio of 4/3. The pitch diameter of the pinion is 150 mm. Face width is 50mm. the pinion rotates at 240rpm. The teeth are 5mm module, 14 1/2° involute. If 6kW is transmitted, determine:

i) The tangential force *Ft* at the mean radius [8]
ii) The pinion thrust *Fp* [6]
iii) The gear thrust force *Fg* [6]

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 16Nm 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/m^2. Assume uniform wear [5]

Question 4

A soft surface cone clutch must handle 200Nm of torque at 1250rpm. The large diameter of the clutch is 350mm, cone pitch angle is 6.258, face width is 65mm. and the coefficient of friction is 0.20

Determine: [5]

i) The axial force F required to transmit the torque.

ii) The axial force required to engage the clutch Fe engagement takes place when the Clutch is not rotating [5]

iii) The average nominal force *p* on the conduct surfaces when the maximum torque is being transmitted. [5]

vi) The maximum normal pressure assuming uniform wear.

Question 5

a) Derive $$\frac{T_1 - mv^2}{T_2 - mv^2} = e^{\alpha f}$$ [10]

b) A smaller pulley of a crossed belt drive transmits 7.5kW at 1000rpm. The smaller pulley has a diameter of 250mm, velocity ratio 2 and center distant is 1.25m. 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 1.7MPa determine the leather belt width *b*. Leather has a density of 970kg/m^3 [10]

Question 6

Referring to Fig Q5, spur gear A receives 3kW at 600rev/min through its shaft and rotates clockwise. Gear B is an idler and gear C is the driven gear. The teeth are 20 degrees full depth. (The pitch circles are shown in the sketch.)

Determine:

a) The torque each shaft must transmit, [8]

b) The tooth load for which each gear must be designed, [7]

c) The force applied to the idler shaft as a result of the gear tooth loads. [5]

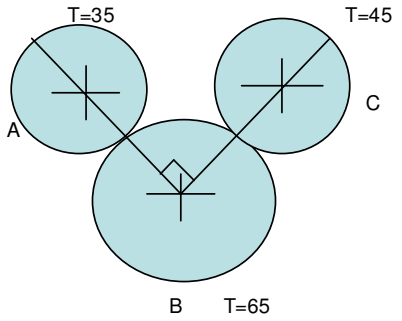


fig.Q5 spur gear drive

Question 7

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

Determine:

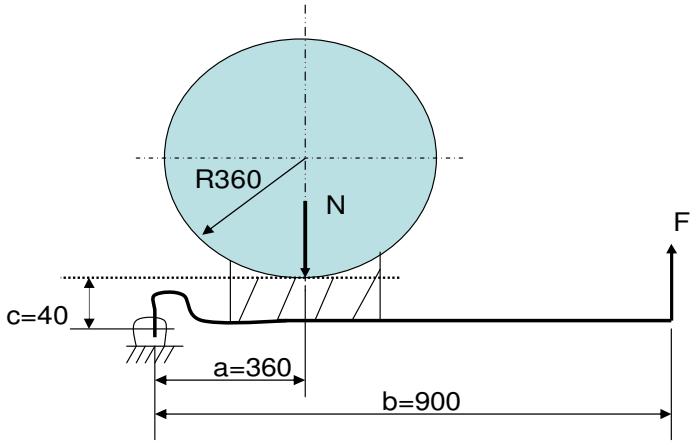
i) The normal force N on the shoe [4]

ii) The normal force F to apply the brake for clockwise rotation. [4]

iii) The normal force F to apply the brake for counter clockwise direction [4]

iv) The dimensions required for self locking assuming other dimensions remain as shown [4]

v) The rate of heat generated [4]



Question 8

A worm transmitting 6kW at 1200rpm drives a worm gear rotating at 60rpm. The pitch diameter of the worm is 71.26mm and the worm is triple threaded. The module of the worm gear is 20 mm which is the same as the axial module of the worm. The worm gear has 60 teeth with a 208 stub. The coefficient of friction f is 0.10. The worm is right handed.

Calculate:

i) The tangential force F_t on the worm [8]

ii) The tangential force F_t on the gear [6]

iii) The separating force F_r [6]