Tutorial # 1 - Solution

1- A 15-tooth spur pinion has a module of 3 mm and runs at a speed of 1600 rpm. The driven gear has 60 teeth. Find the speed of the driven gear, the circular pitch, and the theoretical center-to-center distance.

Solution:

$$n_G = 1600(15/60) = 400 \text{ rev/min} \quad Ans.$$

$$p = \pi m = 3\pi \text{ mm} \quad Ans.$$

$$C = [3(15 + 60)]/2 = 112.5 \text{ mm} \quad Ans.$$

2- A spur gear-set has a module of 4 mm and a velocity ratio of 2.8. The pinion has 20 teeth. Find the number of teeth on the driven gear, the pitch diameters, and the theoretical center-to-center distance.

Solution:

$$N_G = 20(2.80) = 56 \text{ teeth} \quad Ans.$$

$$d_G = N_G m = 56(4) = 224 \text{ mm} \quad Ans.$$

$$d_P = N_P m = 20(4) = 80 \text{ mm} \quad Ans.$$

$$C = (224 + 80)/2 = 152 \text{ mm} \quad Ans.$$

3- Shaft **a** shown in figure 1-1 has a power input of 75 kW at a speed of 1800 rev/min in the counterclockwise direction. The gears have a module of 5 mm and a 20° pressure angle. Gear **3** is an idler one. Gears **2**, **3** and **4** has 17 T, 34 T and 51 T respectively.
a) Find the force that gear **3** exerts against shaft **b** (F3b).
b) Find the torque that gear **4** exerts on shaft **c** (T4c).

Solution:

$$H = T\omega = 2\pi T n/60 \quad (T \text{ in N} \cdot \text{m}, H \text{ in W})$$

So

$$T = \frac{60H(10^3)}{2\pi n}$$

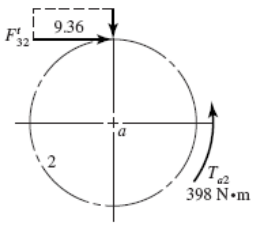
$$= 9550H/n \quad (H \text{ in kW}, n \text{ in rev/min})$$

$$T_a = \frac{9550(75)}{1800} = 398 \text{ N} \cdot \text{m}$$

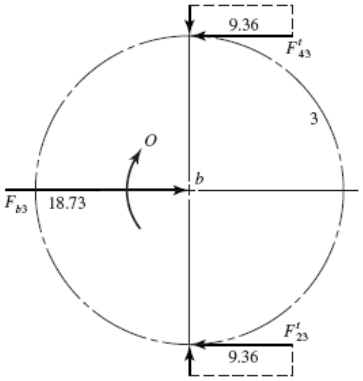
$$r_2 = \frac{mN_2}{2} = \frac{5(17)}{2} = 42.5 \text{ mm}$$

So

$$F_{32}^t = \frac{T_a}{r_2} = \frac{398}{42.5} = 9.36 \text{ kN}$$



$F_{3b} = -F_{b3} = 2(9.36) = 18.73$ kN in the positive x-direction.

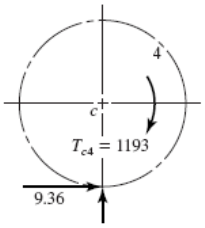


(b)

$$r_4 = \frac{mN_4}{2} = \frac{5(51)}{2} = 127.5 \text{ mm}$$

$$T_{c4} = 9.36(127.5) = 1193 \text{ N} \cdot \text{m} \quad \text{cw}$$

$$\therefore T_{4c} = 1193 \text{ N} \cdot \text{m} \quad \text{ccw} \quad \textit{Ans.}$$



Note: The solution is independent of the pressure angle.