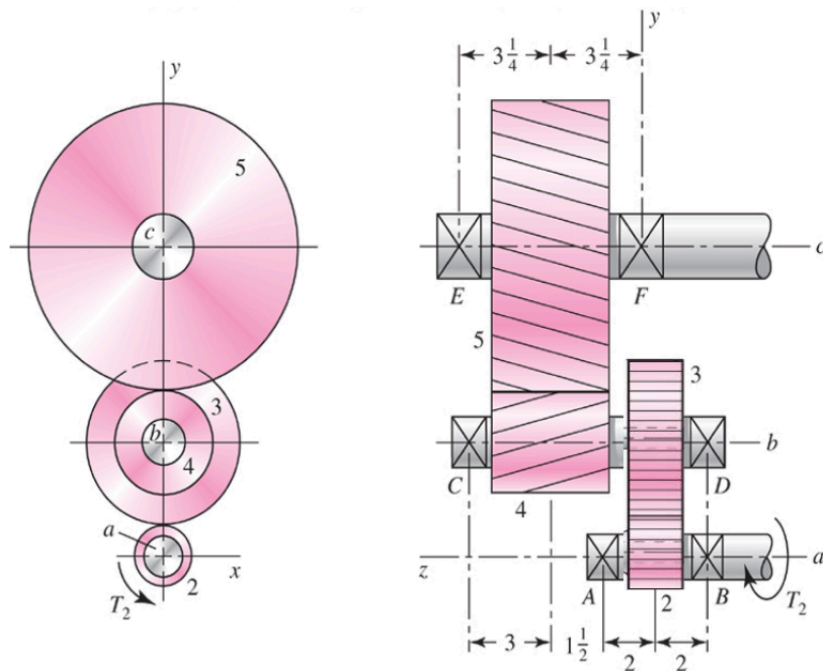


Tutorial 4

Question 1



COORDINATE SYSTEM

x out of the page

y goes up

z to the left

Shaft a is spinning in the $+z$ axis

Shaft b is spinning in the $-z$ axis

Shaft c is spinning in the $+z$ axis

Equation 13-1: $P = \frac{N}{d}$

$P \sim$ diametral pitch [teeth/in]

$N \sim$ # of gear teeth

$d \sim$ pitch diameter

$N_2 = 14$ teeth

$N_3 = 54$ teeth

$P_{2,3} = 10$ teeth/min

$$d = \frac{N}{p}$$

$$d_2 = \frac{N_2}{p_2} = 1.4 \text{ in}$$

$$d_3 = \frac{N_3}{p_3} = 5.3 \text{ in}$$

center distance

$$y_{2,3} = \frac{d_2 + d_3}{2} = 3.4 \text{ in}$$

speed

Equation 13-29

$$n_2 = \frac{N_1}{N_2} n_1 = \frac{d_1}{d_2 n_1} = e_{1,2} n_1$$

$$n_b = n_3 = e_{2,3} n_2 = \frac{N_2}{N_3} n_2 = 233 \text{ rpm about } -z \text{ axis}$$

$$n_c = n_5 = \frac{N_4}{N_5} n_4 = \frac{N_4}{N_5} n_3 = 104 \text{ rpm about } +z \text{ axis}$$

center distance

$$y_{4,5} = \frac{d_4 + d_5}{2}$$

$$d_4 = \frac{N_4}{P_4}$$

$$d_5 = \frac{N_5}{P_5}$$

$$P_4 = P_5 = P_t$$

From figure 13-18

$\psi \sim$ helix angle

$$P_n = \frac{P_t}{\cos \psi}$$

$$P_t = 5.44 \text{ teeth/in}$$

$$d_4 = 2.94 \text{ in}$$

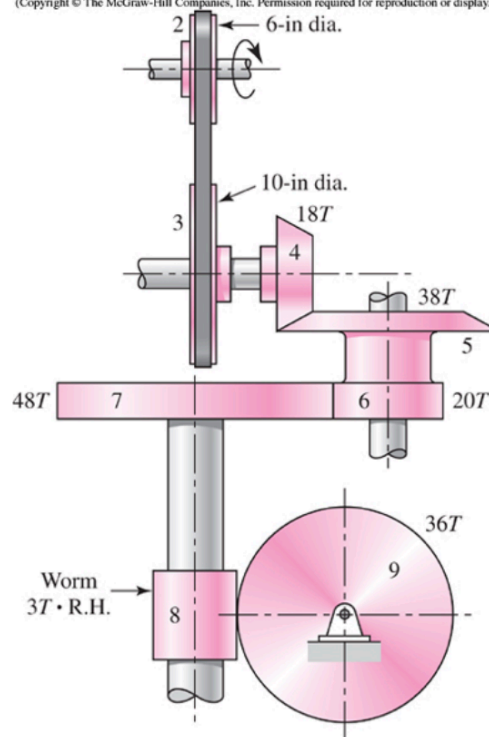
$$d_5 = 6.62$$

$$y_{4,5} = 4.78 \text{ in}$$

force on shaft b = $+z$

force on shaft c = $-z$

Question 2



COORDINATES

x to the right

y goes up

z goes out of the page

Pulley 2 rotates at 1200 rev/min determine the speed and direction of rotation of gear 9

$$n_9 = 1200 \cdot \frac{6}{10} \cdot \frac{18}{38} \cdot \frac{20}{48} \cdot \frac{3}{36} = 11.84 \text{ rpm}$$

2. $-x$

3. $-x$

4. $-x$

5. $+y$

6. $+y$

7. $-y$

8. $-y$

9. $-z$