Given:

Pinion	Gear
6 teeth/in	60 teeth
22 teeth	
20° pressure angle	
1200 rpm	
15 hp	
face = 2 in.	

Find: Estimate for bending stress.

Solution: The AGMA bending stress equation is

$$\sigma = \frac{W_t P_d}{F J} * K_a * K_s * K_m * K_v$$

The torque may be found from

$$T = 63{,}000 \frac{P}{n}$$

$$= 63{,}000 \left(\frac{15\ hp}{1200\ rpm} \right) = 787.5\ in\text{-}lb$$

The pitch diameter can be found from

$$P_d = \frac{N}{d} = 6 = \frac{22}{d} \Rightarrow d = \frac{22}{6} = 3.66\ in$$

The transmission force W_t can be found from $W_t = \frac{T}{(d/2)} = \frac{787.5\ in\text{-}lb}{(3.66\ in/2)} = \underline{\underline{430.3\ lb}}$

The form factor, J, can be found from the chart in the lecture notes, or Shigley Fig 14-4

$$J \simeq 0.35$$

$1/K_v$ can be found from figure 14-7 in Shigley.

The pitch line velocity is given by

$$V = r\omega$$

$$V = \left(200 \frac{rev}{min}\right)\left(2\pi \frac{rad}{rev}\right)\left(\frac{3.66 in}{2}\right)\left(\frac{ft}{12 in}\right)$$

$$= 1{,}150 \text{ ft/min}$$

The quality factor is chosen to be 8,

$$\Rightarrow \frac{1}{K_v} = 0.8$$

K_m is found from Table 14-6. For a medium rigidity mounting, $K_m = 1.6$

K_a and K_s are taken to be 1.

$$\Rightarrow \sigma \simeq \frac{(430.316)(6)}{(2)(0.35)}\left(\frac{1}{0.8}\right)(1.6)(1.0)(1.0)$$

$$\boxed{\sigma = \underline{\underline{7{,}400 \text{ psi.}}}}$$

Given: Pinion

module = 1.25 mm = $\frac{d}{N}$

$N = 18$

$\phi = 20°$

$F = 12\,mm.$

$n = 1800\ rev/min$

$P = 0.5\,kW$

Find: Bending stress

Solution:

The power is given by

$$P = T\omega$$

$$\Rightarrow T = \frac{P}{\omega} = \frac{(0.5\,kW)\left(10^3\,\frac{W}{kW}\right)\left(\frac{N.m}{S.W}\right)}{(1800\,rev/min)\left(\frac{min}{60\,sec}\right)\left(\frac{2\pi\,rad}{rev}\right)}$$

$$= 2.65\,N.m$$

The pitch diameter can be found from the module and number of teeth

$$\Rightarrow d = N * m = 18(1.25\,mm) = 22.5\,mm$$

The tooth load force $W_t = \frac{T}{(d/2)} = \frac{2.65\,N.m}{(0.0225/2\,m)}$

$$W_t = 236.\,N$$

The AGMA equation is

$$\sigma = \frac{W_t P_d}{F J} * K_a * K_s * K_m * K_v$$

The geometry factor is estimated to be $J = 0.3$ from Figure 14-4.

The pitch line velocity is obtained from

$$V = r\omega$$

$$= \left(\frac{0.0225}{2} m\right)\left(1800 \frac{rev}{min}\right)\left(\frac{min}{60 sec}\right)\left(\frac{2\pi rad}{rev}\right)$$

$$= 2.12 \, m/s$$

From Figure 14-7, $1/K_v \simeq 0.9$

$$\Rightarrow K_v = \frac{1}{0.9} = 1.111$$

From Figure 14-6, $K_m \simeq 1.6$

$$\Rightarrow \sigma = \frac{\left(236 \times \frac{1}{0.00125}\right)(1.111)(1.6)}{(0.012)(0.3)}$$

$$= 93.2 MPa$$