Ex 10) Spur Gear Strength: Bending

- **Estimate maximum power (kW) the following spur gear (pinion) can transmit at 1200 rpm with safety factor $n_s = 3$ against yielding due to bending. Assume moderate applications and gear teeth are manufactured by cutting. Use the following parameters as needed.**

(AISI 1020 steel with $S_y = 207$ MPa),
$m = 3$ (module), $F = 38$ mm (face width), $N = 16$ teeth, $\phi = 20^o$,

$m = 3$, $F = 38\,mm$, $N = 16$, $\phi = 20°$, $S_y = 207\ MPa$

Allowable stress : $\sigma_{all} = \frac{S_y}{n_s} = \frac{207\ MPa}{3} = 69\ MPa$

We want : $\sigma = K_v \frac{W_t P}{FY} \le \sigma_{all}$

Computing K_v :

d (pitch diameter) $= mN = 3 \times 16 = 48\ mm$

$V = \frac{\pi dn}{1000} = \frac{\pi \times 48 \times 1200}{1000 \times 60} = 3.02\ m/s$

$K_v = \frac{6.1 + V}{6.1} = \frac{6.1 + 3.02}{6.1} = 1.5$

V: pitch line (linear) velocity [ft/min] or [m/s]

Manufacturing Type	a		b	c
	US	SI		
cast iron, cast profile	600	3.05	1	1
cut or milled profile	1200	6.1	1	1
hobbed or shaped profile	50	3.56	½	1
shaved or ground profile	78	5.56	½	½

For $N = 16$, we have $Y = 0.296$

Number of Teeth	Y
12	0.245
13	0.261
14	0.277
15	0.290
16	0.296

Diametral pitch $P = \frac{1}{m} = \frac{1}{3}$ tooth/mm

$W_t = \frac{FY\sigma_{all}}{K_v P} = \frac{(38 \times 10^{-3}) \times 0.296 \times 10^6}{1.5 \times \frac{1}{3} \times 100} = 1552\ N$

Transmittable power :

$P_{tr} = W_t \times V = 1552 \times 3.02 = 4687\ W$

$= 4.687\ kW$