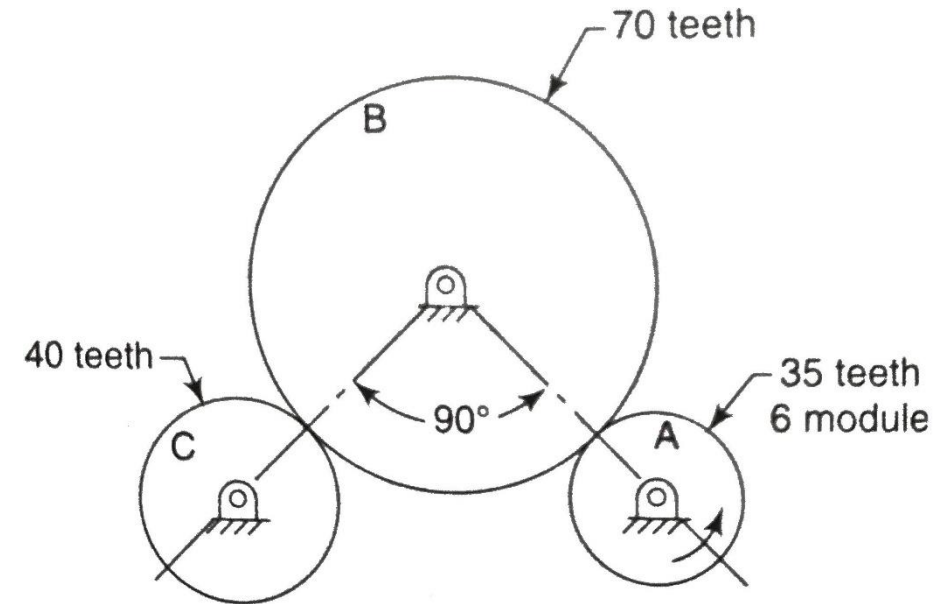


## Example

Gear A receives 5 kW at 500 rpm through its shaft and rotates counter clockwise. Gear B is an idler and gear C is the driven gear.

- (i) What is the torque on the shaft of each gear
- (ii) What is the tangential force for which each gear must be designed?
- (iii) What force is applied to the idler shaft as a result of the gear tooth loads?



Given  $P = 5 \text{ kW}$   $N = 500 \text{ rpm}$

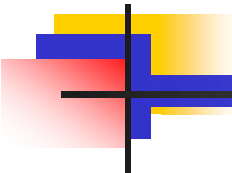
module  $m = 6 \text{ mm}$  (same for all gears)

Teeth,  $T_A = 35$   $T_B = 70$   $T_C = 40$

Pitch circle diameters of gears

$$D_A = mT_A = 6 \times 35 = 210 \text{ mm}, D_B = 6 \times 70 = 420 \text{ mm}$$

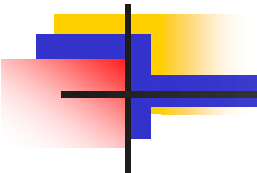
$$D_C = 6 \times 40 = 240 \text{ mm}$$



(i) Torque on shaft A,  $(\text{Torque})_A = \frac{60P}{2\pi N} = \frac{60 \times 5 \times 10^3}{2\pi \times 500} = 95.5 \text{ Nm}$

Torque on shaft B = 0, for idler gear. [If you take the moment about centre of shaft B with tangential forces acting from A and C, total moment will be zero. Tangential component of force on each gear is same in this system.]

Torque on shaft C,  $(\text{Torque})_C = (\text{Torque})_A \times \frac{D_C}{D_A} = 95.5 \times \frac{240}{210} = 109.1 \text{ Nm}$



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Tangential force on gear A,  $F_t = \frac{(\text{Torque})_A}{D_A/2} = \frac{95.5 \times 2}{210 \times 10^{-3}} = 909.5 \text{ N}$

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Tangential force will be the same on teeth of gear B and C.

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Assume pressure angle,  $\phi = 20^\circ$

Radial component of force,  $F_r = F_t \tan \phi = 331 \text{ N}$

Resultant force on the idler shaft

$$= \sqrt{(909.5 - 331)^2 + (909.5 - 331)^2}$$
$$= 818.1 \text{ N}$$

