1- The spur gears shown figure 2-1 have a module of 12 mm and a pressure angle of 20°. The pinion **2** rotates at 1800 rev/min cw and transmits 150kW through the idler part to gear **5** on shaft **c**. The number of teeth for gears **2**, **3**, **4** and **5** are 18T, 32T, 18T and 48T respectively. What forces and torques do gear **3** and **4** transmit to the idler shaft?

Solution:

$d_2 = N_2 m = 216$ mm $\qquad\qquad d_3 = N_3 m = 384$ mm

$d_4 = N_4 m = 216$ mm $\qquad\qquad d_5 = N_5 m = 576$ mm

Gear 2:

$\omega = 2 . \pi . 1800/60 = 188.5$ rad/s

$T = H/\omega = 795.76$ Nm

$F^t_{23} = T/r_2 = 7366$ N

$F^r_{23} = F^t_{23} \tan 20° = 2681$ N

$F^t_{32} = F^t_{23}$ (in opposite direction)

$F^r_{32} = F^r_{23}$ (in opposite direction)
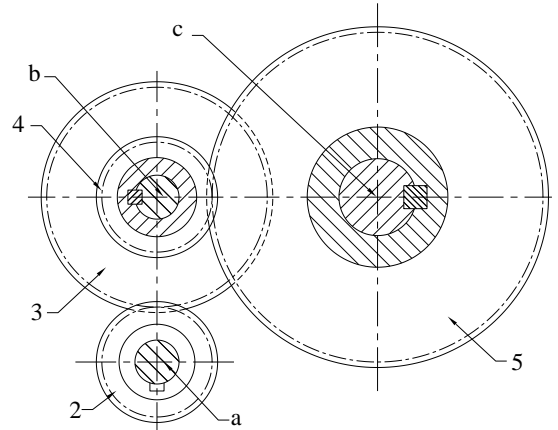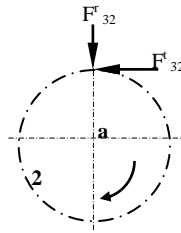
Gears 3 & 4:

$T_{3b} = F^t_{23} r_3 = 7366 * 0.192 = 1414$ N.m

Gear **3** transmits the forces F^t_{23} & F^r_{23} and torque T_{3b} to the idler shaft **b**
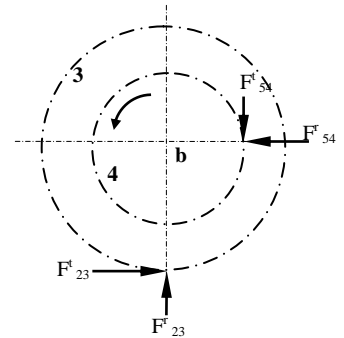
From equilibrium of torques on shaft b:

$T_{4b} = T_{3b}$ *(opposite directions)*

$F^t_{54} r_4 = F^t_{23} r_3$

$F^t_{54} = 13092.6$ N

$F^r_{54} = F^t_{54} \tan 20° = 4765$ N

Gear **4** transmits the forces F^t_{54} & F^r_{54} and torque T_{4b} to the idler shaft **b**

2- A 20° spur pinion with 20 teeth and a module of 2.5 mm transmits 120 W to a 36 tooth gear. The pinion speed is 100 rev/min, and the gears are grade 1, 18 mm face width, through-hardened steel at 200 Brinell, uncrowned, manufactured to a No.6 quality standard, and considered to be of open gearing quality installation. Find the contact ratio for this gear set analytically and graphically.

Solution:

d_p= 50 mm $\qquad\qquad$ *d_g= 90 mm* $\qquad\qquad$ *C= 70 mm* $\qquad\qquad$ *p_c=2.5π mm*

$$Z = \sqrt{(r_p + a_p)^2 - (r_p \cos\varphi)^2} + \sqrt{(r_g + a_g)^2 - (r_g \cos\varphi)^2} - C \sin\varphi$$

$\quad = 12$ mm

m_c=Z /p_c cos φ = 1.626