Exercice 3 :

Pour une turbine radiale, on a les données suivantes :

$$\frac{P_0}{P_{2,is}} = 3.5, \qquad P_{2,is} = 1\ bar, \qquad T_0 = 923\ K, \qquad \frac{U_1}{C_1} = 0.66$$

$$\frac{D_2}{D_1} = 0.45, \qquad N = 16000\frac{tr}{min}, \qquad \alpha_1 = 20°,$$

1. **Les diamètres du rotor :**

$$D_1 = \frac{U_1 * 60}{\pi N}$$

U_1= ?

$$U_1 = 0.66 * C_1$$

$$C_p T_0 = C_p T_{2,is} + \frac{1}{2}{C_1}^2$$

$$C_1 = \sqrt{2 * C_p * (T_0 - T_{2,is})}$$

$$\frac{P_0}{P_{2,is}} = \left(\frac{T_0}{T_{2,is}}\right)^{\frac{\gamma}{\gamma-1}} \leftrightarrow T_{2,is} = T_0\left(\frac{P_{2,is}}{P_0}\right)^{\frac{\gamma-1}{\gamma}}$$

$$T_{2,is} = 923\left(\frac{1}{3.5}\right)^{\frac{1.4-1}{1.4}}$$

$$T_{2,is} = 645.28\ K$$

$$C_1 = \sqrt{2 * 1005 * (923 - 645.28)}$$

$$C_1 = 747.14\frac{m}{s}$$

Donc :

$$U_1 = 0.66 * C_1 = 0.66 * 747.14$$

$$U_1 = 493.11\frac{m}{s}$$

$$D_1 = \frac{U_1 * 60}{\pi N} = \frac{493.11 * 60}{\pi 16000}$$

$$D_1 = 0.59\ m$$

On a : $\frac{D_2}{D_1} = 0.45$

$$D_2 = 0.45 * D_1$$

$$D_2 = 0.2655\ m$$

2. L'angle de sortie des aubes de rotor

$$tg\beta_2 = \frac{C_{m2}}{U_2}$$

$$U_2 = \frac{\pi D_2 N}{60} = \frac{0.2655 * \pi * 16000}{60}$$

$$U_2 = 222.42 \frac{m}{s}$$

$$C_{m2} = C_{m1} = U_1 tg\alpha_1 = 493.11 * tg20$$

$$C_{m2} = 179.47 \frac{m}{s}$$

$$tg\beta_2 = \frac{C_{m2}}{U_2} = \frac{179.47}{222.42} = 0.808$$

$$\beta_2 = 38.85°$$