PART 2

For the High-Pressure Compressor, the following assumptions will be taken:

- Constant mean radius.
- Repeating stages, repeating rows and constant axial velocity throughout the whole compressor.
- Inlet angle: $\alpha_1 = 30°$.
- Inlet Mach number: $M_{in} = 0.4$.
- For the rotor of the first stage: $r_h = 0.32$ m and $r_t = 0.48$ m.
- Maximum temperature rise (per stage): $(\Delta T_t)_s = 45\text{K}$.
- Same polytropic efficiency for all stages, η_p.
- Rotor polytropic efficiency: $\eta_p^{(r)} = \frac{1+\eta_p}{2}$.

The following is requested:

1. Determine the polytropic efficiencies η_p and $\eta_p^{(r)}$.
2. Minimum number of stages of the compressor, and its turn speed (in m/s).
3. The blade inlet angles at the hub and tip of the rotor blade of the 5th stage.

Assume the compressor is driven by a turbine (with the same angular velocity), consisting of N_{HPT} repeating stages, with axial inlet flow at each stage, degree of reaction 0.5, and constant mean blade radius. It is also assumed that the HPT is designed according to maximum power per unit mass flow.

The following is requested:

4. The mean blade radius of the turbine.
5. The values of M_1, α_2, M_2 and $\dot{W}/A_1$ for the first stage, using an assumed value X (with $1 < X < 1.5$).