

**Aero Engine Technology – Assignment 3, Turbomachinery**

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# **Introduction**

The aim of this document is to develop the conceptual design of the high pressure compressor for the Energy Efficient Engine by NASA. The task was pursued through multiple steps. Firstly, the initial parameters were set, as well as the number of stages of the axial compressor. Successively, the specific work and the isentropic efficiency of each stage were calculated in order to obtain from the Smith Chart. Thanks to these values, the design of the first stage was completed, obtaining the values of the radii and the velocity triangles. In conclusion the procedure was repeated for all the stages.

# **Assumptions**

* Perfect gas: specific heats are constant.
* Adiabatic compressions and expansions in the stages.
* Mass conservation throughout the compressor.
* Kinetic energy is negligible. ????
* Non-isentropic thermodynamic transformations.
* Total pressure ratio equally distributed among the stages.

# **Procedure**

The procedure which the calculations are based on is shortly explained in this paragraph. The results and plots are obtained with the MATLAB code attached at the end of this document, in which the reader can also find the input data considered.

* Real mass flow:
* Number of stages:
* Single stage pressure ratio:
* Stage specific work: ;
* Isentropic efficiency: ;
* Fixing values for degree of reaction and load coefficient and considering the isentropic efficiency before calculated, the flow coefficient is determined by the Smith Chart: ; How did we choose these values?
* Velocity triangles:
* Meridional rotational speed:
* Velocities:
* Temperature at the stage outlet can be found from the total enthalpy relation.
* Density was instead calculated through the isentropic relation.
* Maximum rotational velocity at the blades tip was imposed in order to avoid sonic conditions:
* Then, the following system of three equations in the three unknowns was implemented:
* Initial condition (0.5 1 356) How did we choose these values?
* In conclusion a cycle was implemented to repeat the calculations for each stage.