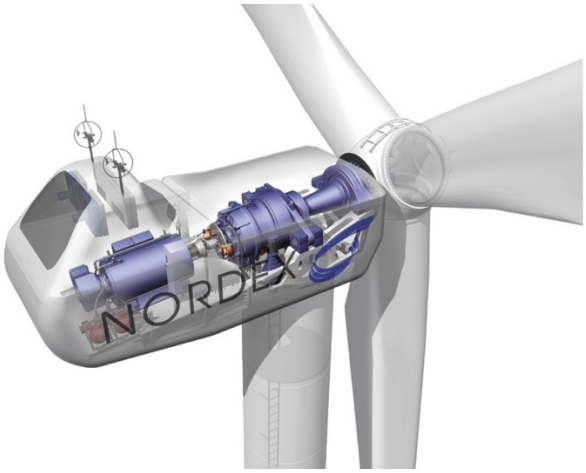
T6 – THE SYNCHRONOUS MACHINE

We onsider a three-phase alternator of a wind turbine, whose excitation is assumed to be constant, with the following characteristics:

- S = 35 kVA
- Voltage = 230/400 V
- f = 50 Hz
- rotation speed = 1500 t/min
- No-load voltage = 250 V



This alternator is driven by a gear train connected to the shaft of the wind turbine and supplies P = 30 kW at a voltage V = 210V to a unit power factor load (= 1).

The armature resistance is measured and equal to R = 0.05 Ω, the mechanical loss torque is estimated at 10 N.m and, under the above conditions, the wind turbine develops a motor torque C_{motor} = 210 N.m.

1) **Determine** the number of pole pairs p.
2) **Calculate** the line current.
3) **Calculate** the real rotation speed
4) **Calculate** the power supplied by the wind turbine
5) **Calculate** the efficiency of the alternator
6) **Draw** the equivalent diagram of the unsaturated synchronous machine and **calculate** the no-load emectromotive force and the synchronous reactance.