Assignment #2:
This assignment is about using the unsteady BEM code to simulate a PI collective pitch controller.

Q#1 Assuming the operational condition yielding the highest C_p of the DTU 10 MW reference wind turbine is λ=8 and θ_p=0^o determine the optimum generator characteristic, $M_G(\omega)$that would ensure this. Neglect any constraint of the rotational speed and assume a constant torque after rated power P=10.64MW is reached.

Now implement a PI controller in the unsteady BEM code and compute dynamically the rotational speed as

$$I\frac{d\omega}{dt} = M_{aero}(V_o, \theta_{p,}\omega) - M_G(\omega)$$

The inertia moment of the drivetrain is I=1.6·10^{8}kgm^2. The gains for this operation are KI=0.64 rad/rad, KP=1.5 rad/(rad/s) and KK=14 deg.

Remember that the rotational speed is no longer constant so the relative wind becomes

$$\begin{pmatrix} V_{rel,y} \\ V_{rel,z} \end{pmatrix} = \begin{pmatrix} V_{o,y} \\ V_{o,z} \end{pmatrix} + \begin{pmatrix} W_y \\ W_z \end{pmatrix} + \begin{pmatrix} -\omega(t)\cdot r \\ 0 \end{pmatrix}$$

Q#2 Show that the steady result for a constant wind of 7 m/s (below rated) ends in λ=8 and θ_p=0^o corresponding to maximum C_p. Then use this code to determine the necessary pitch angle $\theta_p(V_o)$ to obtain the rated power of 10.64 MW for a constant wind speed of 15 m/s (above rated).

Q#3 Finally, try and simulate the output using a turbulent wind speed for 7m/s and 15m/s.