→ STATE VARIABLES OF THE SYSTEM

ω_r rotational speed of the rotor

ω_g rotational speed of the generator

$\theta = \theta_r - \frac{\theta_g}{N_g}$ torsional angle

1) $\dot{\omega}_r = \frac{d}{dt}(\omega_r) = \frac{1}{J_r}\left(\tau_a - \tau_{es}\right)$

$= \frac{1}{J_r}\left(\frac{1}{2}\rho A R C_P(\lambda, \beta)\frac{v^2}{\dot{\lambda}} - K_d\theta - B_d\dot{\theta} - \tau_{sd}\left(\omega_r - \frac{1}{N_g}\omega_g\right)\right)$

CONTROL INPUTS

DISTURBANCE

2)

$$\dot{\omega}_g = \frac{1}{J_g}\left(\tau_{hs} - \tau_g\right)$$

$$= \frac{1}{J_g}\left[\left[\frac{1}{\nu_g}\left(\kappa_d\theta + B_d\left(\omega_n - \frac{\omega_g}{\nu_g}\right)\right) - \tau_g\right]\right]$$

$$\tau_{hs} = \frac{\tau_{es}}{\nu_g}$$

$$= \frac{1}{\nu_g}\left(\kappa_d\theta + B_d\left(\omega_n - \frac{\omega_g}{\nu_g}\right)\right)$$

3)

$$\dot{\theta} = \dot{\theta}_r - \frac{1}{\nu_g}\dot{\theta}_g$$

$$= \boxed{\omega_r - \frac{1}{\nu_g}\omega_g}$$

$$\frac{d}{dt}\theta_r = \omega_r$$

$$\frac{d}{dt}\theta_g = \omega_g$$

$P_e = 5\ MW$

$\omega_{r_0} = 1.2671\ rad/s$

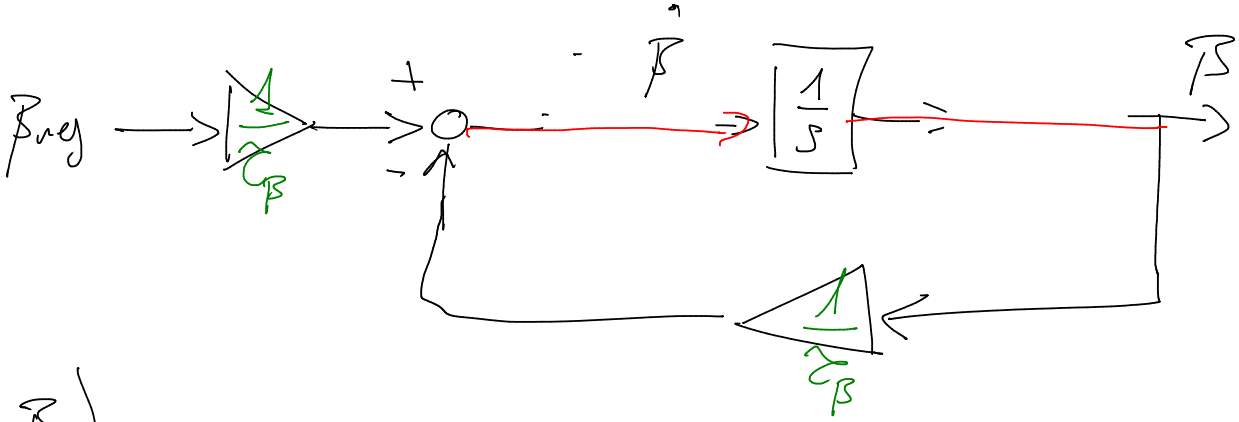
} available

$\dot{\theta} = \omega_r - \frac{\omega_g}{N_g} \Rightarrow \boxed{\omega_g = N_g\, \omega_{r_0}}$

$\dot{\theta} = 0$ STATIONARY CONDITION

ACTUATORS

BLADE PITCH ACT.



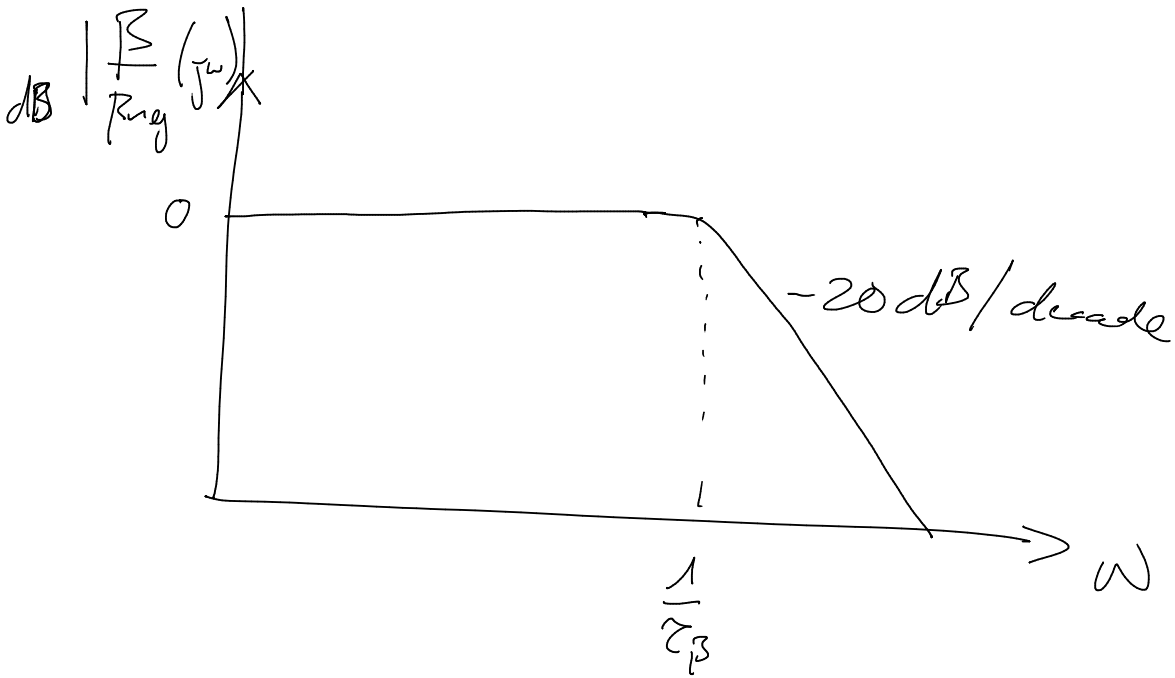
$$\dot{\beta} = \frac{1}{\tau_\beta}\left(\beta_{req} - \beta\right)$$

$$s\beta = \frac{1}{\tau_\beta}\left(\beta_{req} - \beta\right) \Rightarrow \beta\left(s + \frac{1}{\tau_\beta}\right) = \frac{1}{\tau_\beta}\beta_{req}$$

$$\frac{\beta}{\beta_{req}} = \frac{\frac{1}{\tau_\beta}}{s + \frac{1}{\tau_\beta}}$$

DC GAIN = 1

BW = $\frac{1}{\tau_\beta}$


dB
$\left|\frac{E}{R_{eq}}(j\omega)\right|$
0
-20 dB / decade
1
$\frac{1}{\tau_3}$
ω

$$x = [\omega_r \quad \omega_g \quad \theta]^T \qquad u = [\beta, \tau_g]^T$$

$$\dot{x} = A_{ol}\, x + B_{ol}\, u + B_v\, v$$

$$y = C_{ol}\, x + D_{ol}\, u$$

$$y = [\omega_r \quad P_e]^T$$