

Name: _____ UIN: _____ Section: _____ Score: _____

A 60 Hz generator is supplying 100 MW and 0 Mvar to an infinite bus (with 1.0 per-unit) through two parallel transmission lines. Each transmission line has a per-unit impedance (with 100 MVA base) of $j0.06$. The per-unit transient reactance for the machine is $j0.02$, and its inertia constant is 8 seconds. A fault occurs at time = 0 halfway down one of the lines. There is no damping.

$$\begin{aligned} \dot{\delta} &= \omega \\ \frac{2H}{\omega_s} \dot{\omega} &= T_M - \frac{E'V_s}{X'_d + X_{ep}} \sin(\delta - \theta_{vs}) - D \cdot \omega \end{aligned}$$

Using the classical generator model with equations given above, determine the pre-fault internal voltage magnitude and angle of the generator $E' \angle \delta$, and find the pre-fault initial values of ω and the mechanical torque T_M . You do not need to write the equations after the fault or solve.

Before the event

The generator connects to a Thev. equiv. with $V_s \angle \theta_{vs} = 1.0 \angle 0$ and $X_{ep} = j0.06 || j0.06 = j0.03$. Solve the circuit for the generator internal voltage, which will give you E' and initial value of δ :

$$I = \left(\frac{S}{V}\right)^* = \left(\frac{1.0}{1.0}\right)^* = 1.0$$

$$E' \angle \delta = 1.0 + (1.0)(j0.02 + j0.03) = 1.00125 \angle 0.04996 \text{ (rad)}$$

Now consider steady-state, to get $\omega = 0$

$$\text{And } T_M = \frac{E'V_s}{X'_d + X_{ep}} \sin(\delta - \theta_{vs}) = \frac{1.00125 \cdot 1}{0.02 + 0.03} \sin(0.0499) = 1.0$$