

Indian Institute of Technology Patna
Department of Electrical Engineering
EE549 - Power System Dynamics and Control
Spring - 2021
Mid Semester Exam- Online
23 February 2021

There are 2 questions. They carry equal marks.

$$(2 \times 10 = 20)$$

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1. A 5 kVA, 415 V, 1500 rpm, 3-phase synchronous machine has $X_d = X_q = 1.5$ and $X_{md} = 1.4$.

- (a) Find E_{fd} and I_{fd} when it supplies no load.
(b) Find E_{fd} and I_{fd} when it supplies the rated load at unity power factor.

Neglect armature resistance and magnetic saturation.

2. The turbine/governor model is as follows:

$$T_{CH} \frac{dP_{CH}}{dt} = -T_M + P_{SV}$$
$$T_{SV} \frac{dP_{SV}}{dt} = -\frac{1}{R_D} \left(\frac{\omega}{\omega_{base}} - 1 \right) + P_{ref} - P_{SV},$$

Since there is no reheat system, $P_{CH} = T_M$.

$$T_{SV} = 0.2 \text{ sec}, P_{ref} = 0.7 \text{ pu}, R_D = 0.05 \text{ pu}$$

$$T_{CH} = 0.4 \text{ sec}, \omega_{base} = 2\pi 60 \text{ rad/sec}$$

- (a) Find the steady-state values of P_{SV} and T_M if $\omega = 376.9 \text{ rad/s}$.
(b) Find the dynamic response of P_{SV} and T_M if ω changes at time zero to be 376.8 rad/s. (The change is small.)