ECE 330 HW 10

IMPORTANT: Please treat HW10 as a homework assignment and please upload your solution by 10 A.M. on April 22$^{\text{th}}$ to Gradescope. We expect and trust that you will continue to show academic integrity. It is okay to discuss with fellow students, but you must submit your own solutions. Please continue to use Piazza to ask questions, but do not post solutions/answers on Piazza. Stay Safe!

Problem 1
A three-phase, 60 Hz, 550 V (line-line), six-pole, wye-connected synchronous generator is delivering 50 kW at rated voltage. The excitation voltage E_{ar} is 460 V per phase, and the synchronous reactance $x_s = 2\ \Omega$.

(a) Calculate torque angle δ and torque in N-m.
(b) Find generator current, power factor, and reactive generation Q.

Problem 2
A 1000 kVA, 11 kV, 60 Hz, four-pole, three-phase, wye-connected synchronous generator has synchronous reactance $x_s = 1\ \Omega$. The generator is delivering power to a load at a power factor of 0.8 lagging at rated voltage and at rated current. Find the speed, E_{ar}, δ, and the torque of electric origin.

Problem 3
A three-phase, six-pole, 60 Hz, wye-connected synchronous *motor* with $x_s = 2\ \Omega$ is drawing a complex power of $P + jQ$, where $P = 1500$ kW and $Q = 3000$ kVAR. The machine is operating at rated voltage 2300 V (line-line). Find the $\overline{E}_{ar}$ of the motor and the torque angle δ.

Problem 4
A three-phase, four-pole, 60 Hz, round rotor, wye-connected synchronous machine is delivering 5.7 kW (three-phase) to a load at 480 V (line-line). When the rotor (field) current is 5 A, the machine is **underexcited** (absorbing VAR's). In this condition, the generator line current is 8 A, and the torque angle is 30° (electrical).

(a) Taking the load voltage as a reference phasor with an angle of zero degrees, compute the complex phasor associated with the load current.
(b) What is the maximum amount of real power this machine can deliver of the network voltage remains at 480 V and the rotor (field) current remains at 5 A?
(c) What is the synchronous reactance of this machine?