ECE470 POWER SYSTEMS I

Homework Set 2

1. From 2 poles to 10 poles, calculate the prime mover speeds in rpm required to generate ac at frequencies of 60 Hz and 50 Hz.

2. Calculate the frequency produced by a prime mover turning an 8 pole synchronous generator at 825 rpm.

3. A three-phase, 50 hp, 2300 V, 50 Hz synchronous motor is operating at 600 rpm. Determine the number of poles in the rotor.

4. Determine the shaft speed of a four-pole synchronous motor operating from a three-phase, 50 Hz, 4160 V system.

5. A three-phase, 100 kVA, 240 V, 60-Hz, six-pole, wye-connected synchronous generator is supplying a load of 80 kVA at 230 V and 0.866 power factor lagging. The armature has a synchronous impedance of $0.1 + j0.5\ \Omega$ per phase. Determine the following:

a) Armature current
b) Excitation voltage
c) Power angle
d) Input shaft torque (neglecting losses)

6. A cylindrical-rotor synchronous generator has a per-unit synchronous reactance of 1.0 and a negligible armature resistance. The generator supplies rated kVA to a load at a terminal voltage of 1.0 per unit and a leading power factor of 0.8. Determine the excitation voltage.

7. In the system shown below, the **generator** bus is to be held at 25 kV. Its current is metered at 2 kA, 0.9 lagging. Working on bases of 100 MVA and 345 kV in the line circuit:

a) draw the pu reactance diagram,
b) determine the resulting load terminal voltage (kV), and
c) determine the resulting load MVA and power factor.