



The Ohio State University
Department of Electrical Engineering

EE 341

Energy Conversion
Homework Set # 7

Print Your Name

Reading Assignments:

1. Chapter 6: AC Synchronous Motors

Page 324~341

Solve the following problems:

1. 6-1, 6-2 (page 352), and 6-7 (page 354).

- 6-1.** A 480-V, 60 Hz, six-pole synchronous motor draws 80 A from the line at unity power factor and full load. Assuming that the motor is lossless, answer the following questions:
- (a) What is the output torque of this motor? Express the answer both in newton-meters and in pound-feet.
 - (b) What must be done to change the power factor to 0.8 leading? Explain your answer, using phasor diagrams.
 - (c) What will the magnitude of the line current be if the power factor is adjusted to 0.8 leading?
- 6-2.** A 480-V, 60 Hz, 400-hp 0.8-PF-leading eight-pole Δ -connected synchronous motor has a synchronous reactance of 1.0Ω and negligible armature resistance. Ignore its friction, windage, and core losses for the purposes of this problem.
- (a) If this motor is initially supplying 400 hp at 0.8 PF lagging, what are the magnitudes and angles of \mathbf{E}_A and \mathbf{I}_A ?
 - (b) How much torque is this motor producing? What is the torque angle δ ? How near is this value to the maximum possible induced torque of the motor for this field current setting?
 - (c) If $|\mathbf{E}_A|$ is increased by 15 percent, what is the new magnitude of the armature current? What is the motor's new power factor?
 - (d) Calculate and plot the motor's V-curve for this load condition.
- 6-7.** A 208-V Y-connected synchronous motor is drawing 50 A at unity power factor from a 208-V power system. The field current flowing under these conditions is 2.7 A. Its synchronous reactance is 0.8Ω . Assume a linear open-circuit characteristic.
- (a) Find the torque angle δ .
 - (b) How much field current would be required to make the motor operate at 0.78 PF leading?
 - (c) What is the new torque angle in part (b)?

2. Use Matlab to solve 6-2 (d). Please submit the Matlab code, comments and results.