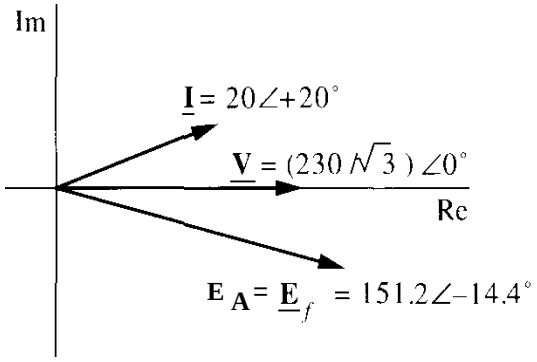
Name_____ Synchronous Motors Due: Wed, 2/26/25

ECE 3600 Homework SG3 a

1. 4.39 Refer to the per-phase phasor diagram at right.
   It is for a 12-pole, three-phase synchronous machine.
   a) Is the machine operating as a motor or a generator?

   b) What is the voltage and apparent power into/out of the machine?



   c) Determine the synchronous reactance of the machine.

   d) For the same real power, what magnitude of excitation voltage yields unity power factor?

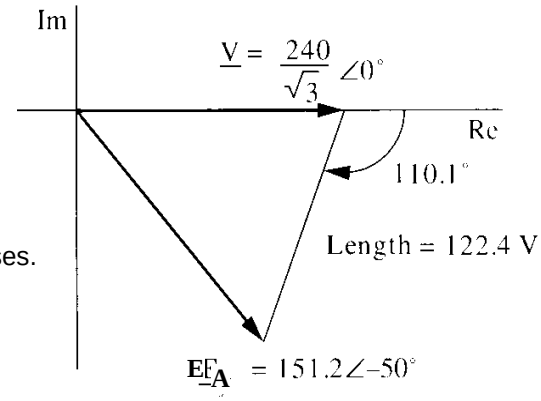
2. 4.41. A cylindrical-rotor, 60-Hz, Y-connected, three-phase, 12-pole synchronous motor operates from 2300 V and produces 500 hp. The motor operates with unity power factor with an excitation voltage of $E_A = 1620$ V per phase. Neglect losses. Determine the following:
   a) The current.

   b) The synchronous reactance.

c) The torque.

d) The rotor power angle.

3. 4.43. The per-phase phasor diagram for a three-phase, 60-Hz, 8-pole synchronous motor is shown. Note that all sides and two angles of the triangle are shown. The current/phase is 21 A



a) Is the motor overexcited or underexcited?

e) Determine the output power and torque, neglecting mechanical losses.

b) What is the rotor power angle?

c) What is the power factor and is it leading or lagging?

d) Determine the synchronous reactance per phase.

Answers

1. a) motor b) 132.8·V 7.97·kVA c) 2·Ω d) $E_A = 138 \cdot V$
2. a) 93·6·A b) 9.92·Ω c) 5934·N·m d) 34.95·deg
3. a) underexcited b) - 50·deg c) 0.939 lagging
   d) 5.83·Ω e) 11·hp 87·N·m