

Name \_\_\_\_\_

## Synchronous Motors

Due: Fri , 3/1/24

### ECE 3600 Homework SG3

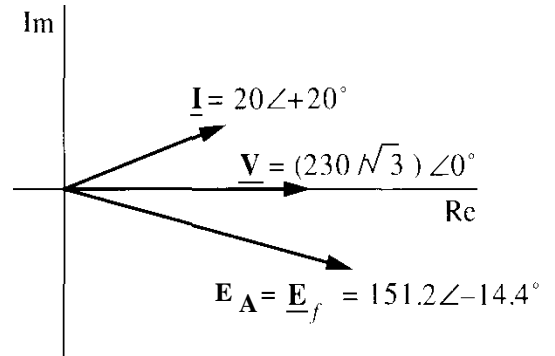
a

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.

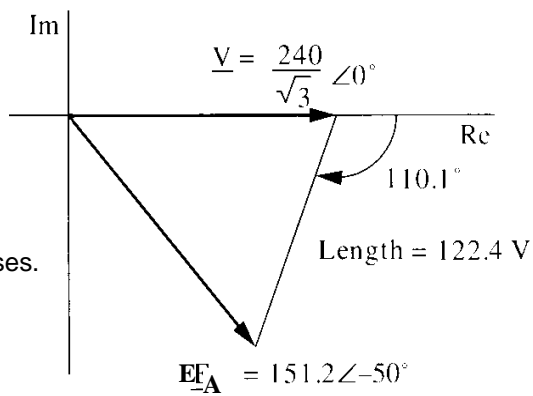
b) The synchronous reactance.

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) $E_A = 138·V$ |
| 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           |              |                  |