

# KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

## ELECTRICAL ENGINEERING DEPARTMENT

### EE 306 – Term 191

#### HW # 5: Synchronous Machines

**Due Date: (Nov. 25<sup>th</sup>, 2019)**

##### **Problem # 1:**

A 3-phase, 120 MVA, 13.8 kV, 0.8 PF lagging, 60 Hz and Y-connected synchronous generator has synchronous reactance of  $1.2 \Omega$  per phase, and its armature resistance is  $0.1 \Omega$  per phase.

- Determine the voltage regulation at rated conditions,
- Determine the voltage and apparant power rating if this generator is operated at 50 Hz with the same armature and field losses at it had at 60 Hz,

##### **Problem # 2:**

A 3-phase, 40 MVA, 13.8 kV, 60 Hz,  $\Delta$ -connected alternator requires field current of 250 A to produce an open circuit rated voltage while a field current of 150 A is required to produce short circuit rated armature current. Neglect armature resistance.

Determine the Synchronous Reactance ( $X_s$ ).

##### **Problem # 3:**

A 380 V, 40 hp, 4 pole, 60 Hz, Y-connected synchronous motor has a synchronous reactance of  $2.5 \Omega$  per phase and negligible armature resistance. The total rotational losses of the machine are 1.5 kW. If the shaft load is 10-hp, find the **Armature Current, Excitation Voltage and Torque Angle**. The power factor of the motor at this load is 0.8 leading.

##### **Problem # 4:**

A 230 V, 50 Hz, two-pole, synchronous motor draws 40 A from the line at unity power factor and full load. Determine the following assuming that the motor is lossless:

- Output torque of the motor,
- What should be done to change the power factor to 0.85 leading? explain using phaser diagram.
- Magnitude of the line current if the power factor is adjusted to 0.85 leading.