KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

ELECTRICAL ENGINEERING DEPARTMENT

EE 306 – Term 192

HW # 5: Synchronous Machines

Due Date: (April 8th, 2020)

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 Ω per phase, and its armature resistance is 0.1 Ω per phase.

(a) Determine the voltage regulation at rated conditions,

(b) 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, Δ-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 Ω 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:

(a) Output torque of the motor,

(b) What should be done to change the power factor to 0.85 leading? explain using phaser diagram.

(c) Magnitude of the line current if the power factor is adjusted to 0.85 leading.