University of Saskatchewan
EE 341.3 Electric Machines I
Mid-Term Examination

Dated: March 3, 2008 **Time: 6:00pm-8:00pm**
Instructor: Dr. Rama Gokaraju **Total Marks: 30**

Problem 1

The parameters of a 12 kVA, 120/360 V, 60 Hz, two-winding, step-up transformer are R_H=0.6 Ω, X_H= 1.2 Ω, R_L=0.1 Ω, X_L= 0.3Ω, $R_{c,H}$=3.2 kΩ (found from high-voltage side) and $X_{m,H}$=25 kΩ (found from high-voltage side).

The two-winding transformer is connected as a 120/480 V, step-up autotransformer. It delivers its rated load at 0.8 pf lagging. Determine its efficiency.

10 Marks

Problem 2

A three-phase generator is connected to a three-phase load via a 220/2200 V, Δ-Y connected, three-phase, step-up transformer, a short transmission line, and a 2200/220 V, Y- Δ connected step-down transformer. The per-phase winding resistance and the leakage reactance as referred to the high-voltage side for each transformer are 1.2 Ω and 4.8 Ω, respectively. Neglect the core-loss resistance and the magnetizing reactance of the transformers. The impedance of the transmission line is 2.5 + j2.1 Ω. The per-phase reactance of the generator is j1.2 Ω (neglect the per-phase winding resistance of the generator). If the load is 50 kVA at 220 V and a lagging pf of 0.8, determine the generator voltage. Use the pu system for calculations.

10 Marks

Problem 3

The following readings are taken from the results of open-circuit and short-circuit tests on a 10 MVA, three-phase, Y-connected, 13.8 kV, 2-pole, 60 Hz synchronous generator driven at synchronous speed:

Field current, A:	170	200
Armature current, short-circuit test, A:	418	460
Line-to-line voltage, open-circuit test, V:	13,000	13,800
Line-to-line voltage, air-gap line, V	15,500	17,500

Neglect the armature resistance.

a) Determine the unsaturated value of the synchronous reactance in ohms per phase.
b) Compute the saturated value of the synchronous reactance in ohms per phase.
c) Find the short-circuit ratio.

5 Marks

Problem 4

A three-phase, Y-connected, 2300 V, 60 Hz round-rotor synchronous generator has a synchronous reactance of 2 Ω per phase and negligible armature resistance.

a) If the generator supplies a line current of 350 A operating at 0.8 pf leading, calculate the excitation voltage and the power angle.
b) If the generator is operating on load with a power angle of 20°, and the excitation is adjusted so that the excitation voltage is equal in magnitude to the terminal voltage, determine the armature current and the power factor of the generator.

5 Marks

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