Take Home Problem Set 2

Instructions:

1. Please complete the take home problem set, save it as MatricNo.pdf and upload it to the **Assignment: Take Home Problem Set 2** in the Teams Channel for EE2029 - AY2021/22-S2
2. The folder will close at **23:59** 17/04/2022. Late submissions will incur a penalty of **5%** for every day of delay.
3. For the purpose of this problem set, please take note of the digits ***a***, ***b***, ***c*** and ***d*** in your student number A0xx***abcd***X. These digits will be used in the questions in this quiz.

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1. A three-phase induction motor runs at 988 rpm at no load, and 902 rpm at full load when supplied from a three-phase, 50 Hz source. The equivalent-circuit parameters per-phase referred to the stator are R_1 = 0.22 Ω; R_2 = 0.207 Ω; X_1 = 1.95 Ω; X_2 = 2.42 Ω; X_m = 45.7 Ω. It has an input power of '**X'** kW, and a terminal current of 20 A.

   - What is the slip in percent at full load?
   - What is the frequency of the rotor currents at full load?
   - Draw the equivalent circuit of the induction motor referred to the stator.
   - Find the heat dissipated in the rotor.

   Parameter Calculations: $\boldsymbol{X = a + b + 10}$

2. A 345 kV, 50 Hz, three-phase transmission line is 200 km long. The resistance per phase is 0.036 Ω/km and the inductance per phase is 0.8 mH/km. The shunt capacitance is 0.0112 μF/km where shunt conductance is negligible. The receiving end load is '**Y'** MVA with 0.8 lagging power factor at 325 kV. Use nominal Π model, determine the voltage regulation and transmission line efficiency. If the power factor is corrected to 0.9 leading, keeping the receiving end MVA constant, what will be the new voltage regulation and transmission line efficiency?

   Parameter Calculations: $\mathbf{Y} = \boldsymbol{d * 10 + 200}$

3. A three phase, 50 HZ system is shown in the Figure Q3 below.

Parameter Calculations: $\boldsymbol{R = a + b + c + d + 180}$, $\boldsymbol{D = c + d + 100}$

- **Transmission Line**: 1000 km three-wire overhead line has solid cylindrical conductors arranged in the form of an equilateral triangle with '**D**' cm conductor spacing. Conductor diameter is 1 cm. Calculate the line inductance in H/m, and the total inductive reactance (X_L)in Ω.
- Draw the per unit impedance diagram (including the generator parameters) using per unit analysis. Use a power base of 10MVA.
- Find the transmission line losses.
- **Generator**: The generator G1 is a 3-phase, 50Hz and wye connected. Calculate the power angle of the generator.

Transmission Line Impedance: Z_{line}: $R + jX_L$ Ω

T_1: 14 MVA, 11kV/220kV, Leakage Reactance: 7%, Y-Δ

T_2: 7 MVA, 240kV/120kV, Leakage Reactance: 14%, Δ- Y

Generator G1: Synchronous Reactance X_s= 12 Ω, V_S = 7kV

Load Impedance Z_{load} : 800 Ω Y connected load

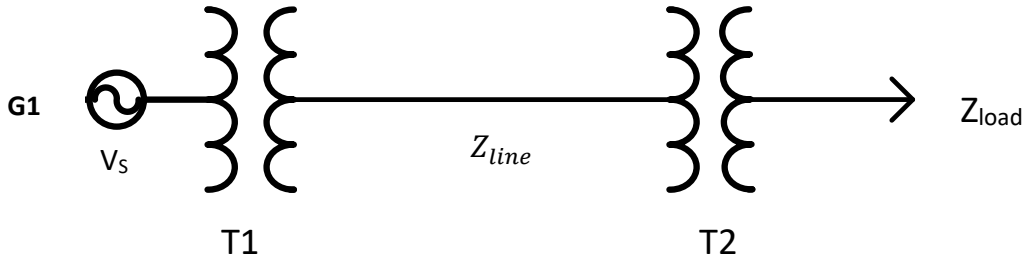

Figure Q3

4. A 66 kVA, 960/120 V, single phase transformer was tested and the following test data were obtained. Draw the simplified equivalent circuit of this transformer.

Parameter Calculations: $\boldsymbol{P1 = d * 15 + 150}$, $\boldsymbol{P2 = c + d * 15 + 150}$

	Voltage (V)	**Current (A)**	**Power (W)**
Short Circuit Test	85	Rated Current	P1
Open Circuit Test	Rated Voltage	12	P2