Power Systems Analysis,
Mock-up Exam, Part I

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Questions:
2 points for this part
For every question there is only one correct answer. If you choose:

- The only correct answer; ⟶ +0.2 points
- One of the three incorrect answers ⟶ −0.06 points;
- None or multiple answers ⟶ 0 points.

⟵ Insert your SCIPER number on the left and write your full name below. ↓

Surname and Name:

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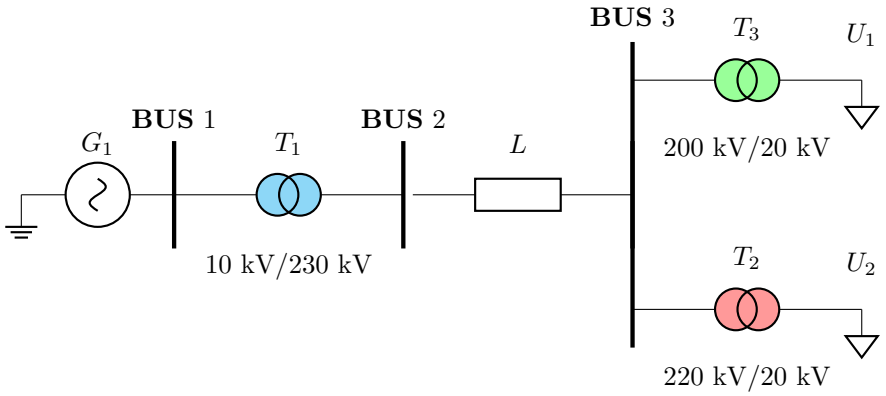


Figure 1: Equivalent single phase circuit

Questions

Consider the grid of Fig. 1 and reply to the following multiple-choice questions:

1. Consider the circuit of Fig. 1, with U_1 and U_2 disconnected (line L in no load condition). Which one of the three auxiliary constants of the line L defines the ratio of the voltage at its input (**BUS 2**) to the voltage at its output (**BUS 3**)?

   ☐ A.
   ☐ B.
   ☐ C.
   ☐ None of the above.

2. Consider the circuit of Fig. 1, with U_1 and U_2 disconnected (line L in no load condition). Which one of the following statements is **TRUE**.

   ☐ If line L is very long, then G_1 is under-excited.
   ☐ If line L is very long, the voltage magnitude of **BUS 3** is lower than the voltage magnitude of **BUS 2**.
   ☐ Generator G_1 is providing zero active power because no load is connected.
   ☐ If the line length is 50 km $\leq L \leq$ 100 km, the shunt capacitance of the line can be neglected.

3. Consider the circuit of Fig. 1 with Loads U_1 and U_2 supplied. What are the key parameters that determine the reactive power transfer over Line L if its longitudinal inductance is predominant over the longitudinal resistance and shunt capacitance?

   ☐ Voltage magnitudes of line terminations.
   ☐ Phase difference between voltage phasors.
   ☐ Both voltage magnitudes and phase difference between voltage phasors.
   ☐ Neither voltage magnitudes nor phase difference between voltage phasors.

4. Consider the circuit of Fig. 1 with Loads U_1 and U_2 supplied. Consider the magnitude of the current of on the primary side I_A and secondary side I_B of Transformer T_1. Which of the following statement is true:

   ☐ $I_A << I_B$ because $V_A << V_B$.
   ☐ $I_A \approx I_B$ because of the Kirchhoff Current Law (KCL) applied on the transformer.
   ☐ $I_A \approx 23 \cdot I_B$
   ☐ $I_A \approx 23^2 \cdot I_B$

5. Consider the following bases for the system represented in Fig. 1:

   $$V_{b1} = 10.0 \text{ kV}, \quad V_{b2} = 230 \text{ kV}, \quad V_{bU1} = 23 \text{ kV}, \quad V_{bU2} = 20.9 \text{ kV}, \quad P_b = 1000 \text{ MW}$$

   If the per-unit impedance of T_1 computed on the secondary side **BUS 2** is 0.1, then the per-unit impedance of T_1 computed on the primary side **BUS 1** is:

   ☐ equal to 0.1
   ☐ equal to $0.1 \cdot 23^2$
   ☐ equal to $\frac{0.1}{23^2}$
   ☐ None of the above.

6. Which of the following statements about G_1 is **TRUE**?

   ☐ The rotor speed is independent of the prime mover speed.

   ☐ The field winding on the rotor is supplied with AC current.

   ☐ The electromagnetic torque developed in the generator opposes the torque of the prime mover.

   ☐ The stator carries the field current supplied by a DC source.

7. Consider Transformer T_3 in Fig. 1. A Power Systems Analysis student has been asked to go and count the number of turns of both primary and secondary windings. After counting, the student states: "There are 1000 turns on the HV side and 100 turns on the LV side". Which of the following statements is **TRUE**?

   ☐ The student must have made a mistake while counting, it is not possible.

   ☐ The transformer has Y-Y connection or Δ-Δ connection.

   ☐ The transformer has Y-Δ connection.

   ☐ No information about the connection can be obtained.

8. A Power Systems Analysis student has been asked to go and measure the speed of a the synchronous machine G_1. The measure indicates a speed of 3006 rpm. Which of the following statements is **FALSE**?

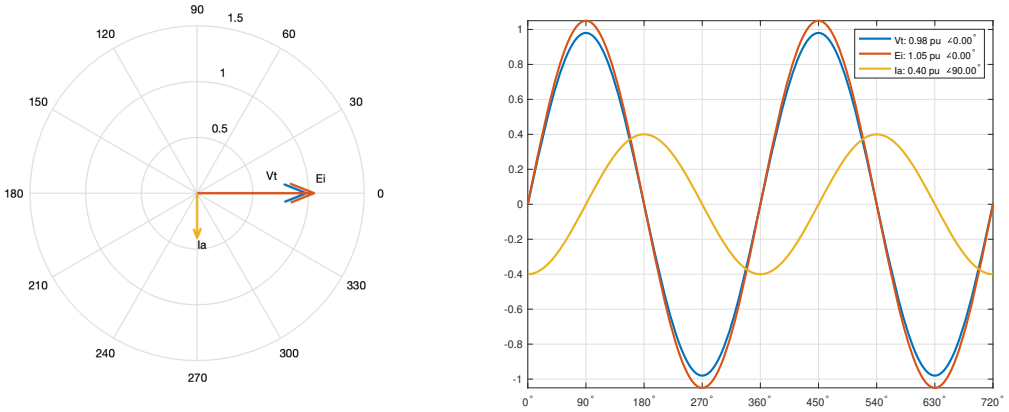
   ☐ The student must have made a mistake while measuring, it is not possible.

   ☐ The synchronous machine is not connected in the United States, or a country with fundamental frequency equal to 60 Hz.

   ☐ The synchronous machine has one pair poles.

   ☐ The frequency of the system is probably above its nominal value.

9. Figure 2 displays the terminal voltage V_a, the internal voltage E_i and the current output I_a of a synchronous machine. What can you say on the operating conditions of the machine?



(a) Figure 1 (b) Figure 2

Figure 2: Two figures side by side

- ☐ The excitation current is zero.
- ☐ The synchronous machine is operating as a motor.
- ☐ The synchronous machine is operating as a synchronous condenser (i.e. providing only reactive power control).
- ☐ The machine is providing around 40% of its nominal active power and 5% of its nominal reactive power.

10. Which of these statements regarding a real transformer is NOT CORRECT:

- ☐ Hysteresis core losses can be mitigated by a proper choice of core material.
- ☐ Core eddy current losses are due to induced currents in the iron and can be mitigated by building up the core with a single block of steel.
- ☐ If a sinusoidal voltage is applied to the primary winding of a transformer with the secondary winding open, only magnetizing and losses currents flow.
- ☐ With the hypothesis of small voltage drop across the primary impedance z_1, the equivalent circuit parameters of a single-phase transformer can be determined through short circuit and open circuit tests.