Q1)

Would you expect a 400-Hz generator to be larger or smaller than a 60-Hz generator for the same power and voltage rating? Why?

Q2)

A 13.8-kV, 50-MVA, 0.9-power-factor-lagging, 60-Hz, four-pole Y-connected synchronous generator has a synchronous reactance of 2.5 Ω and an armature resistance of 0.2 Ω. At 60 Hz, its friction and windage losses are 1 MW, and its core losses are 1.5 MW. The field circuit has a dc voltage of 120 V, and the maximum I_F is 10 A. The current of the field circuit is adjustable over the range from 0 to 10 A. The OCC of this generator is shown in Figure P4-1.

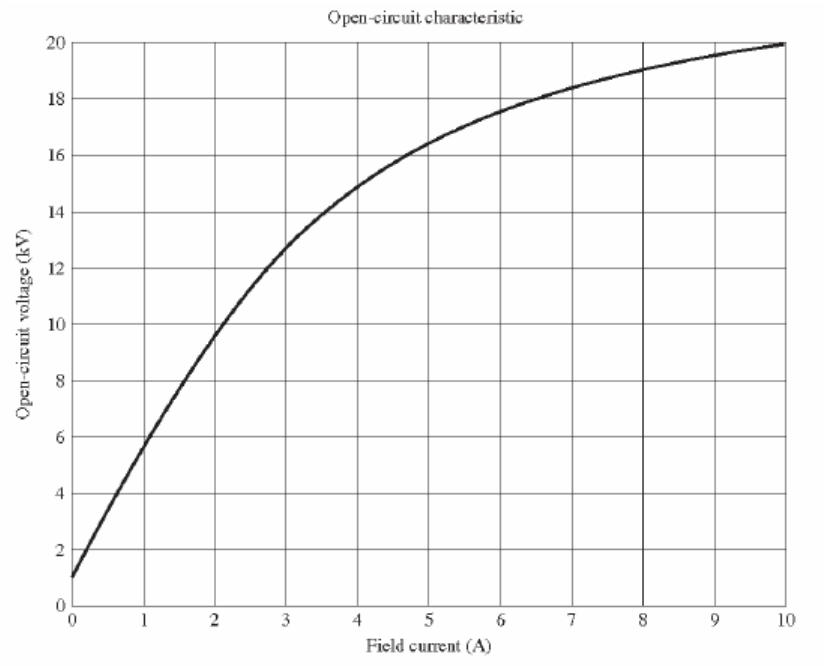


FIGURE P4–1
Open-circuit characteristic curve for the generator

(a) How much field current is required to make the terminal voltage V_T (or line voltage V_L) equal to 13.8 kV when the generator is running at no load?

(b) What is the internal generated voltage E_A of this machine at rated conditions?

(c) What is the phase voltage V_ϕ of this generator at rated conditions?

(d) How much field current is required to make the terminal voltage V_T equal to 13.8 kV when the generator is running at rated conditions?

(e) Suppose that this generator is running at rated conditions, and then the load is removed without changing the field current. What would the terminal voltage of the generator be?

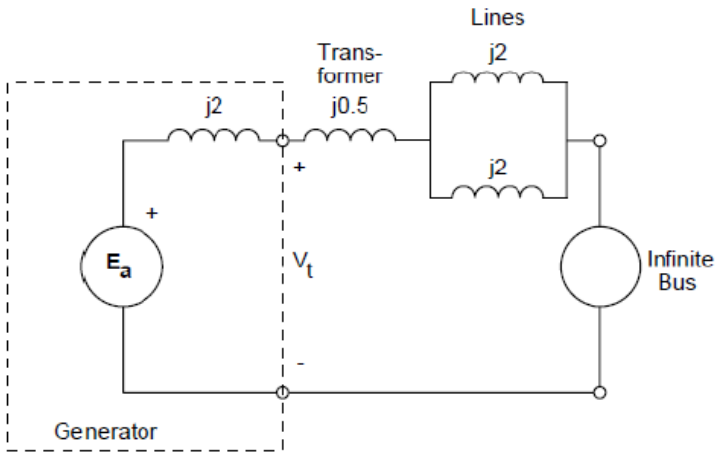
(f) How much steady-state power and torque must the generator's prime mover be capable of supplying to handle the rated conditions?

Q3) Textbook Problem 6.9

Q4) Textbook Problem 6.11

Q5)

A small power system is composed of a synchronous generator, a transformer bank, and two transmission lines in parallel feeding a large metropolitan area that may be approximated by an infinite bus with (line to line) voltage 25 kV. The torque and field current of the generator are set to deliver 100 MVA at 0.8 power factor, current lagging, to the infinite bus (that is, downstream of the transmission lines). The per phase equivalent circuit, with impedances in ohms, is given in the diagram.



Suppose a lightning strike opens one of the transmission lines. Find the complex power **S** delivered to the infinite bus after this happens, assuming machine torque T and field current i_f do not change. (Hint: You may pretend that the generator X_s includes the transformer and transmission line impedances.