Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Science and Technology
300 level 2nd Semester Examination – Dec. 201/ Jan. 2017
SCT 369-2 Electric Power and Machines

Uva Wellassa University

Instructions to candidates

Duration: Two (02) hours
Number of questions: Four (04)
Mark allocation: 100 marks
Answer all questions

1. A single phase power system consists of a $480\ V\ 60\ Hz$ generator, supplying a load which is given by $Z_{load} = 4\Omega + 3\ \Omega\ j$ through a transmission line which is given by $Z_{line} = 0.18\Omega + 0.24\ \Omega\ j$. Answer the following questions about the system.
   i. Suppose the power system is exactly described in figure 1. What will be the voltage at the load ? What will be the transmission line losses ?
   ii. Suppose a 1:10 step-up transformer is placed at the generator end of the transmission line and a 10:1 step down transformer is placed at the load end of the line as shown in figure 2. What will be the load voltage in this new circuit ? What will be the transmission line losses in this new circuit ? **(25 Marks)**

2. A 50 kW, 460 V, 50 Hz, two-pole induction motor has a slip of 5 % when operating at full-load conditions. At full-load conditions, the friction and windage losses are 700 W, and the core losses are 600 W. Find the following values for full-load conditions:
   i. The shaft speed n_m
   ii. The output power in Watts
   iii. The load torque τ_{load} in Newton-meters
   iv. The induced torque τ_{induce} in Newton-meters
   v. The rotor frequency in hertz **(25 Marks)**

3.
   a. With the usal notation, obtain an expression for the rms values of induced emf in a transformer. The final expression should be

$$E = 4.44 f \emptyset_m N$$

   Note that N_P is the number of turns in the primary winding , N_S is the number of turns in the secondary winding ϕ_m is the maximum value of the flux and f is the frequency of the supply.

15

b. Including the effect of armature resistance, draw the phasor diagram of a salient polesynchronous generator which supplies a lagging load. Define all the terms you have used. **(25 Marks)**

4. A 13.8 kV, 50 MVA , 60-Hz, four-pole Y-connected synchronous generator which has a 0.9 power-factor-lagging 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 current 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 3.

   i. What is the rotational speed of the magnetic field in rpm?

   ii. What is the field current that must be supplied to the generator to make the terminal voltage 13.8 kV at no load?

   iii. What is the internal generated voltage E_A and phase voltage V_ϕ of this machine at rated conditions

   iv. How much field current is required to make the terminal voltage equal to 13.8 kV when the generator is running at rated conditions?

   v. How much steady-state power and torque must the generator's prime mover be capable of supplying to handle the rated conditions? **(25 Marks)**

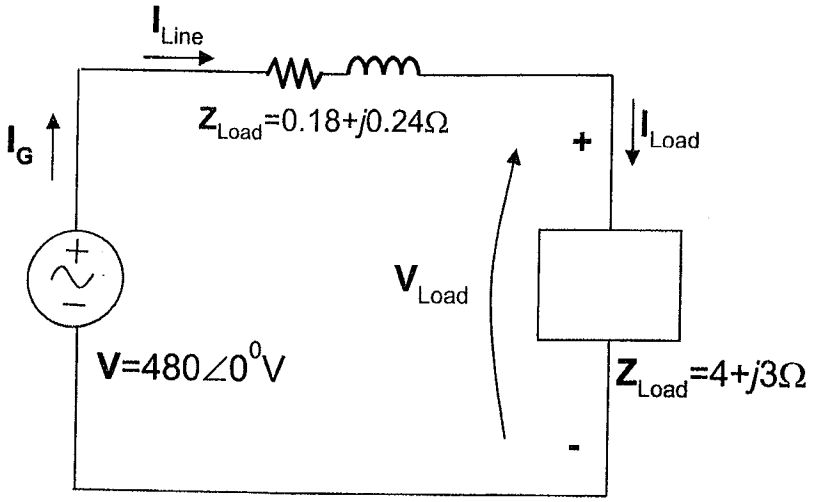

Figure 1

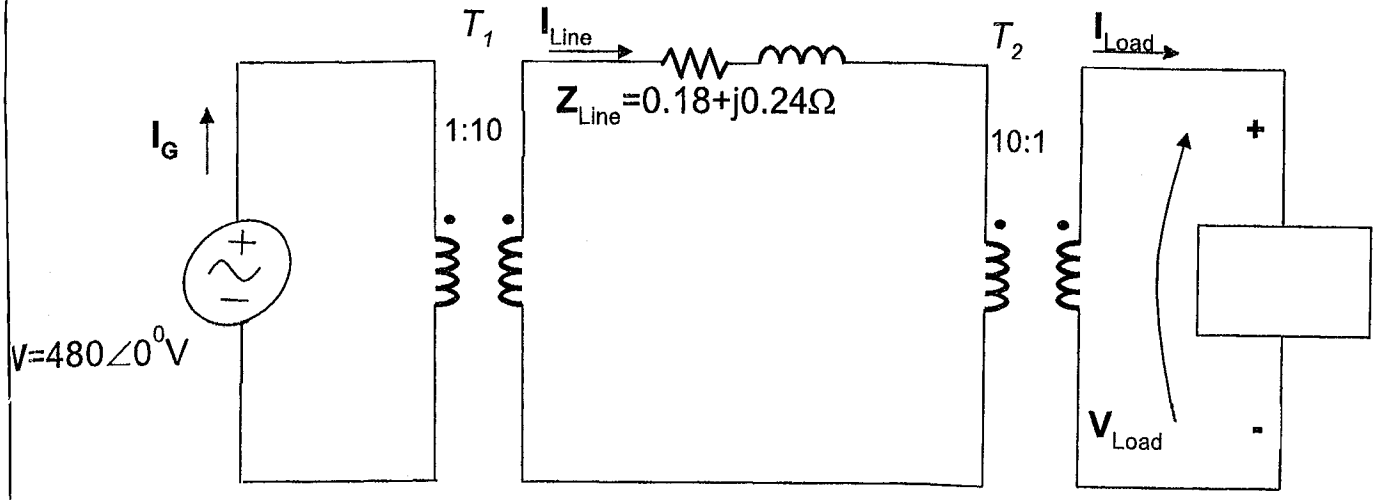

Figure 2

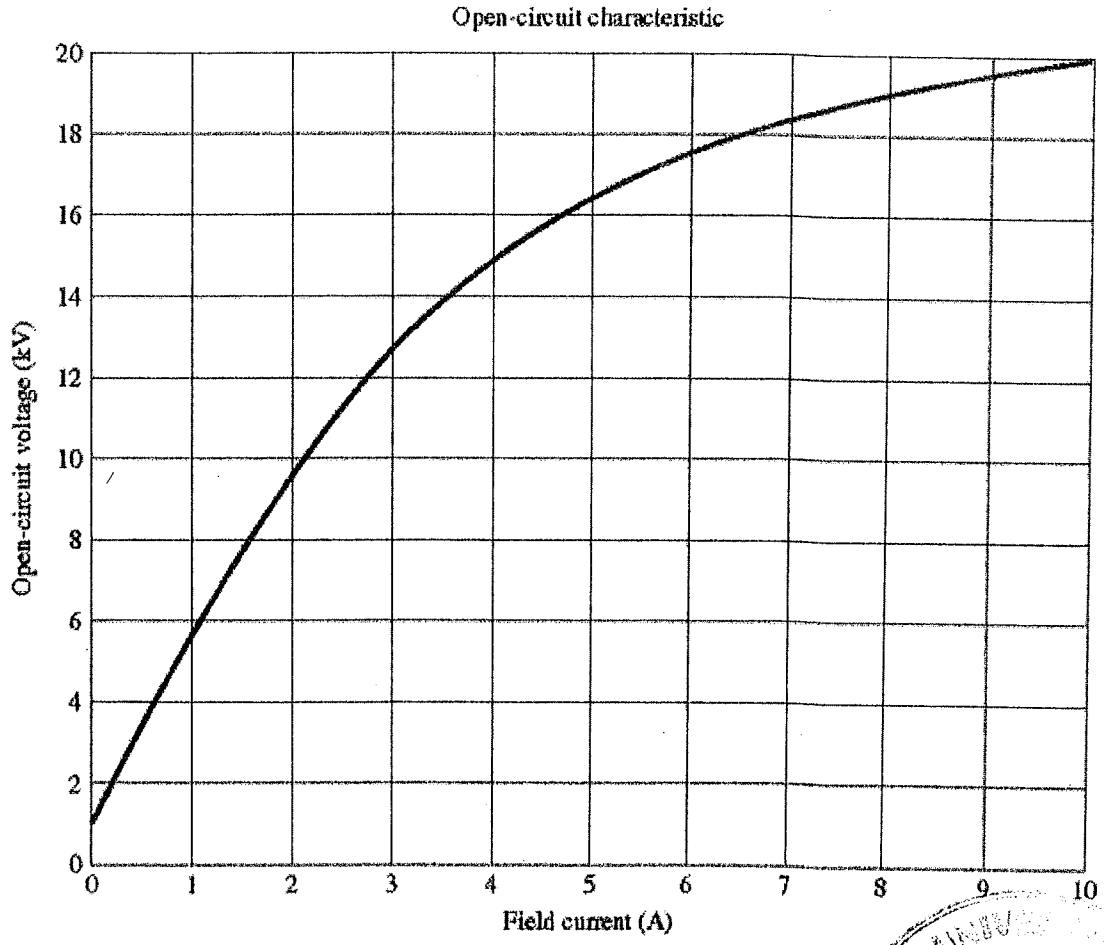

Figure 3