Preliminary Exam
Power and Energy
October 29, 2015

NAME_____ 100 Point Exam

I. A three phase motor draws 20KVA at 0.707 power factor lagging from a 220 V- bus as is shown in figure 1.

(15) a) Find the line current if the motor is connected in a Y configuration.

(5) b) Find the KVAR rating of capacitance that should be connected to the motor to make the combined power factor 0.90 lagging

(5) c) Compute the new line current after adding the correcting capacitors.

Fig. 1 One line diagram

II. A 2400/240 Volt, 75 KVA, single phase transformer has an equivalent reactance Xeq = 0.7 ohms and equivalent resistance of Req = 0.02 ohms referred to the low voltage side as shown in figure 2. The exciting branch (Rc, Xm) impedance is negligible.

(15) a. Calculate the primary transformer voltage Ep if Vs = 240 Volts and the transformer is operating at full load and 0.8 power factor.

(5) b. What is the voltage regulation of the transformer?

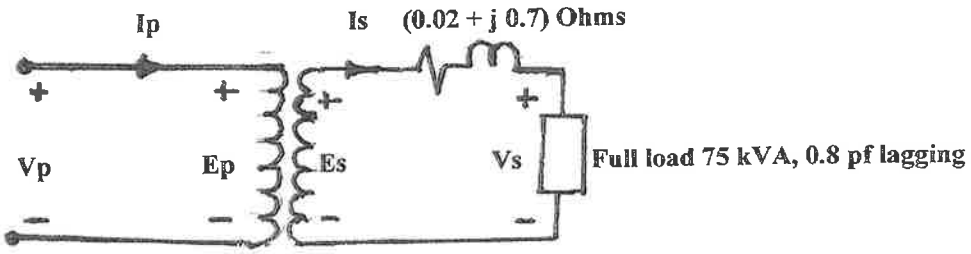


Fig.2 Transformer equivalent circuit

III. A magnetic Actuator is shown in figure 3. Its actions are the same as a transformer with three air gaps as shown. The coil wrapped around the middle leg has 5000 turns and carries a current of 2 amps. The magnetic material can be assumed to have infinite permeability (resulting in reluctance of the core material to equal zero giving only air gap reluctance). $\mu_o = 4\pi \times 10^{-7}$ H/m

(10) a. Draw the equivalent circuit of the actuator showing calculated reluctances and magnetomotive force (This will help you to acquire the value of 'y'in part b.

(10) b. If a flux of 48×10^{-4} Webers is established in the middle center leg and assuming no air gap fringing, for a current of 2 amps in the coil, find the air gap length 'y' as shown in figure of the airgaps.

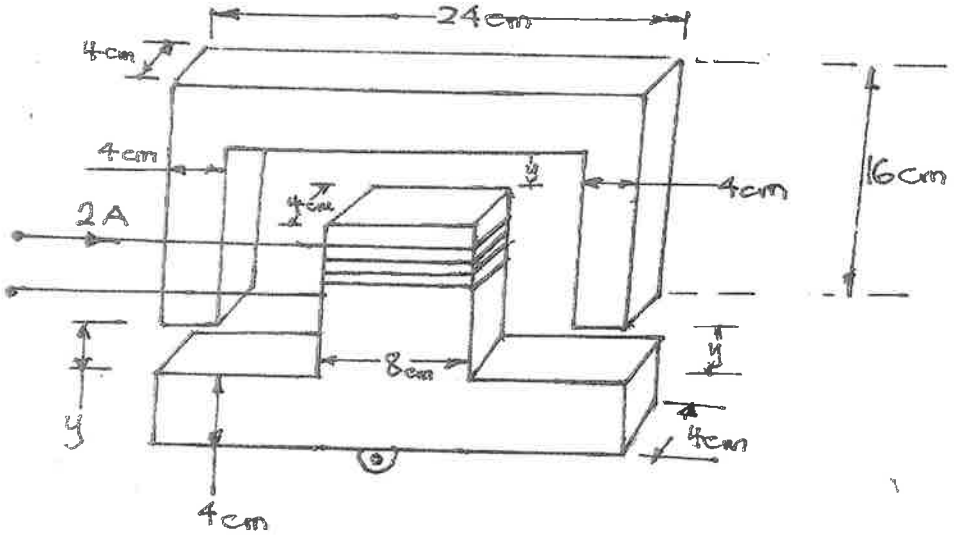
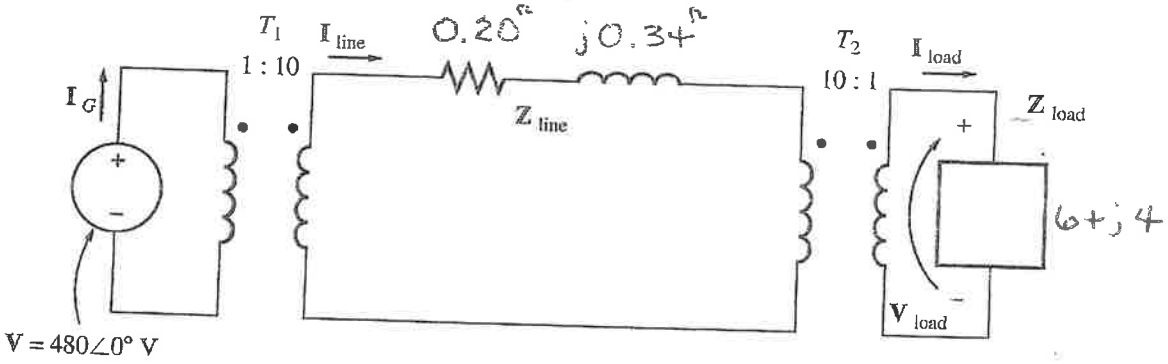


Fig.3 Actuator

IV. A single phase power system consists of a 480-V 60 Hz generator supplying a load $Z_{Load} = 6 + j4$ ohms through a transmission line of impedance $Z_{line} = 0.20 + j0.34$ ohms. At the sending end a step up 1:10 transformer is connected and at the receiving end a step down 10:1 transformer is connected as shown in the following diagram.

(15) a. Derive the per unit equivalent circuit of the transformer circuit if chosen base conditions are Sbase = 10 KVA and Vbase = 480 V at the sending end.

(5) b. Derive the value of the generating current I_G using the derived per unit values.



V. A three phase Y connected synchronous generator, as shown in figure 4, is connected directly to a 13.8 KV three phase Y connected load. The synchronous reactance of the generator is 7.36 ohms per phase and the armature resistance is negligible. The real power output of the generator is 24 MW and the reactive power output is 9 MVAR.

(13) c. Compute the magnitude of the excitation voltage Eg and its angle with respect to the generator terminal voltage Vt

(5) d. Draw the phasor diagram of the system showing all voltages and currents.

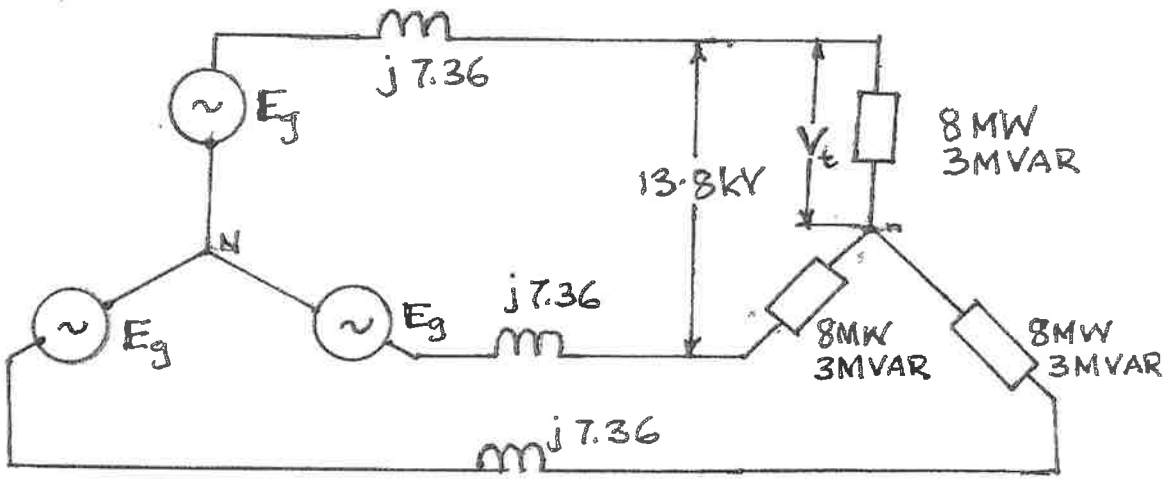


Fig. 4 Three phase generator

POWER

PRELIMINARY EXAM

FALL 2015

Put on Board

Voltage Regulation

$$V.R. = \frac{V_{NL} - V_{FL}}{V_{FL}} \times 100\%$$