APRIL 1, 2016   100 points exam

Name:_____

#1. A set of 3 phase Y-connected load is connected in parallel to a 480V, 60Hz, supply as shown in Fig. 1. **LH is a 50 KW lighting and heating load** (P.F.=1.00); **IM is a 80 hp induction motor** operating at **full load** with an **efficiency of 91%** and power factor of 0.86 lagging (P.F.=0.86); **ML** is a **miscellaneous load that draws 35 kW at 0.83** (P.F.= 0.83) power factor lagging.

(a) Find the **line phasor current** supplied by the source.

(b) Compute the total **real and reactive power** supplied by the source?

© What is the overall **power factor** of the system?

(d) A **synchronous motor** is added to the load to bring the combined **power factor to 0.98 lagging.** Find the **kVAR** that the motor should provide to correct the power factor to 0.98 lagging.
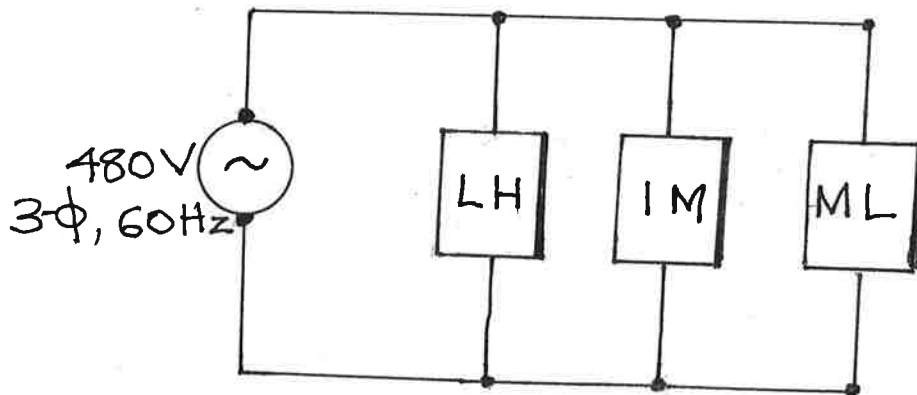

Fig. 1.

#2. Fig. 2 shows a magnetic system of ferromagnetic material with two coils. Neglect the reluctance of the ferromagnetic material.

(a) Draw the magnetic equivalent circuit for the system indicating the values of all parameters.

(b) If the **current in the left coil is 2A**; find the current in the right coil to establish a flux in the right air-gap of **80 milli-Webers**. $\mu_0 = 4\pi 10^{-7}$ **Wb / A-m**.

Fig. 2
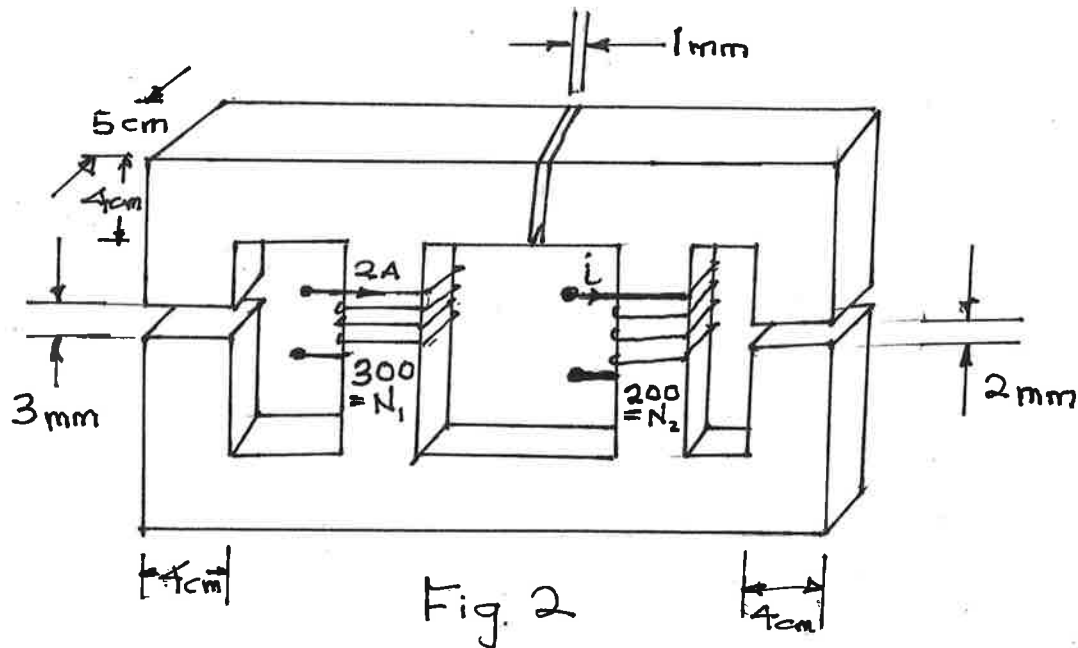
#3. A one-line diagram of a power system is shown in Fig. 3. The 3-phase ratings of the components of the system are as follows:

Generator: 23kV at 240 kVA, X= 0.08 pu

Transformer T1: 23kV/138kV at 360 kVA , X=0.05 pu

Line : Z=(50 + j600) Ohms

Transformer T2: 138kV/12.47 kV at 180 kVA, X=0.04 pu

Load: 150 kVA at 12.47 kV, PF = 0.95 lagging.

Using **23kV** as voltage base in the generator circuit and **360 kVA** as system base power,

(a) Calculate the **per unit impedances** and draw the per unit impedance diagram for the system.

(b) Using the per unit diagram or otherwise, compute the actual line current flowing in (i)the generator, (ii) line and (ii) the load.
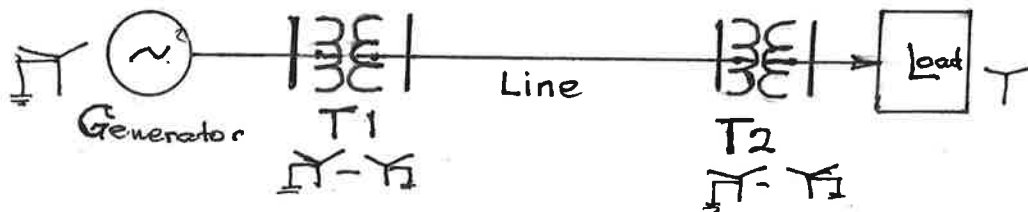

Fig. 3 .

#4. A 250 MVA, 16kV, three-phase synchronous generator with a synchronous reactance, X_s, **of 0.16 pu** based on its ratings,   is connected to a 13.8 kV bus as shown. The armature resistance is negligible. The generator delivers a real power **P, of 80 MW** and a reactive power, **Q, of 50 MVAR** to a load connected to the bus.

(a)Find the excitation voltage, E_a, and the power angle, δ.

(b) Draw the phasor diagram with all values on it showing the Excitation voltage, E_a, the voltage, V_t , the angles, and the armature current, I_a.
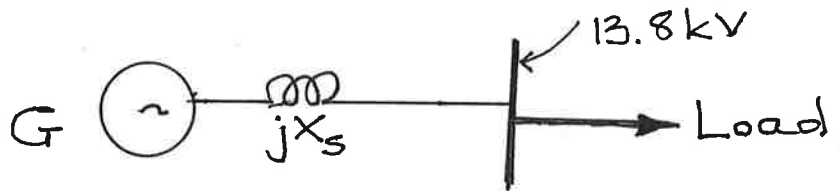

Fig. 4