**EE101:Electrical Sciences, Tutorial-9**

DEPARTMENT OF ELECTRONICS & ELECTRICAL ENGINEERING

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[Q-1 is for pre-tutorial. Solve it in the space provided and submit at beginning of tutorial]

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Name: Roll No.: Tutorial Group:

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1. Two wattmeter method is employed to measure the 3-phase power. A 3-phase line supplies to a balanced inductive delta connected load. The current coil of Wattmeter $W_1$ is in line A and its voltage coil is connected across the line voltage $V_{AC}$.The current coil of Wattmeter $W_2$ is in line B and its voltage coil is connected across the line voltage $V_{BC}$. Derive the expressions for the readings of $W_1$ and $W_2$ in terms of the line voltage ($V_L$) and the line current ($I_L$) and the phase angle $\theta$ (angle between the phase voltage and phase current). Assume the line voltage $V_{AB}$ as the reference. Draw the phasor diagram to explain your derivations.

## Polyphase and Magnetic circuits

2. A 440 volt, 3-phase line supplies to an inductive delta connected load. Two wattmeter method is employed to measure the 3-phase power. If the two wattmeter readings are $W_1$ =15 kW and $W_2$ = 5kW, find

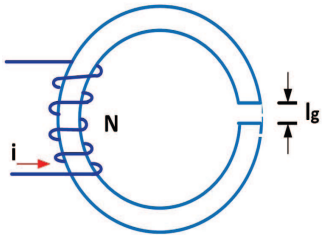
   (a) The line current

   (b) The power factor

   (c) Load resistance per phase and

   (d) Load reactance per phase.

3. An electromagnet of square cross section ($2 \times 2\text{cm}^2$), shown in Fig.Q3(a), has a coil of N=1300 turns. The inner and the outer radii of the core are 10 cm and 12 cm respectively and the air gap length ($l_g$) is 1 cm. If the current in the coil is $i = 5$ A and the relative permeability of the core material is 1200, determine the flux density in the core.



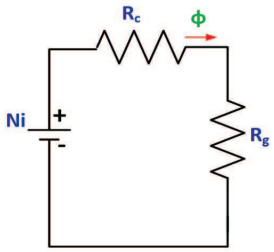




Fig.Q3(a):An electromagnet with air-gap Fig.Q3(b):Eq.magnetic circuit

## Basic Electronics (Theme: Design with Macros)

4. LM35[1] is a low-cost precision centigrade temperature sensor with an analog output voltage proportional to the temperature in °C. The transfer characteristics of the sensor are given by

$$V_{OUT} = 10 \text{ mV}/^{\circ}\text{C} \times T,$$

   where $V_{OUT}$ is the output dc voltage and T is the temperature in °C. For example, the output voltage of the sensor at 25°C is 250 mV and at 100°C is 1000 mV. The sensor can detect the temperature in the range 10°C to 110°C. We want to interface it with a 10-bit Analog-to-Digital Converter (ADC) operating on a 5 V supply voltage. Design an ideal opamp based circuit that maps the output voltage of LM35 (that ranges from 0.1 V to 1.1 V) to the ADC full range (i.e., 0 V to 5 V).

   **HINT:** First find out the transfer function of the circuit that you want to realize.

[1]Why not do an online search about LM35? If possible, see the data sheet once.