UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION 2005/2006

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRONIC ENGINEERING

TITLE OF PAPER: ELECTRIC CIRCUITS

COURSE CODE: E310

TIME ALLOWED: THREE HOURS

INSTRUCTIONS:

1. There are five questions in this paper. Answer any FOUR questions
2. Questions carry equal marks.
3. Graph paper is provided.

THIS PAPER SHOULD NOT BE OPENED UNTIL PERMISSION HAS BEEN GIVEN BY THE INVIGILATOR

THIS PAPER CONTAINS SEVEN (7) PAGES INCLUDING THIS PAGE

QUESTION 1 ***(25 marks)***

(a) Consider the circuit in Fig. 1.1 and do the following:

(i) Determine the equivalent resistance R_T. *(3 marks)*

(ii) Calculate I_S, I_1 and I_2. *(5 marks)*

(iii) Find V_A. *(2 marks)*

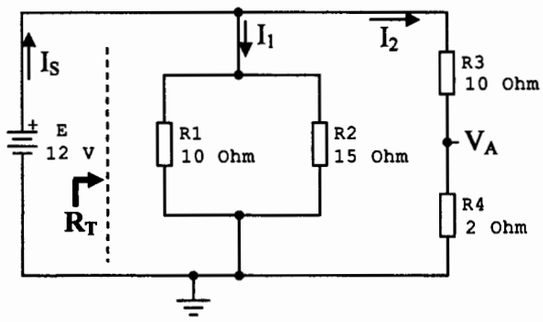

Fig. 1.1

(b) For the network in Fig. 1.2, find the resistance R_3 if the current through it is 2 A.

(5 marks)

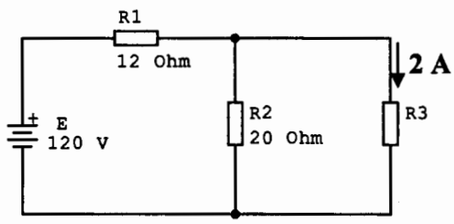

Fig. 1.2

(c) Determine the power delivered to the 10-Ω load in Fig. 1.3. *(10 marks)*

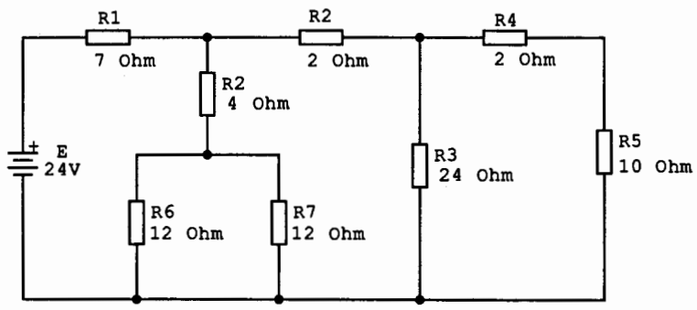

Fig. 1.3

QUESTION TWO *(25 marks)*

(a) Using the principle of superposition, find the magnitude and direction of current through resistor R_1 in the network shown in Fig. 2.1. *(17 marks)*

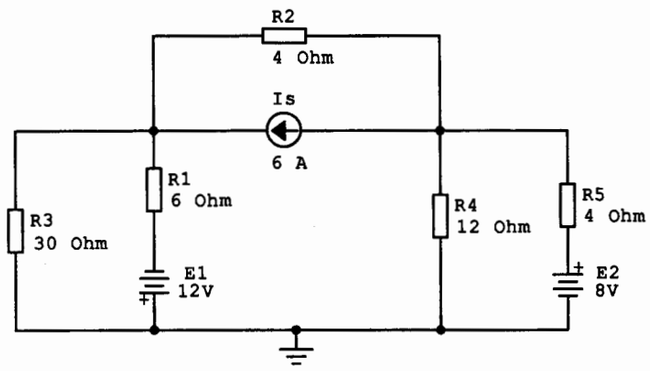

Fig. 2.1

(b) Using Millman's theorem, find the magnitude and direction of current through, and voltage across R_L in the circuit shown in Fig. 2.2. *(8 marks)*

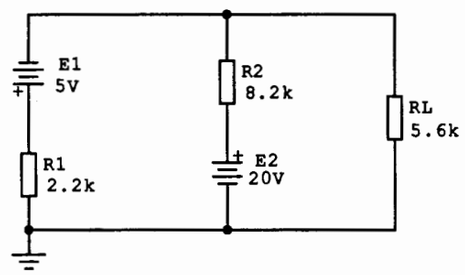

Fig. 2.2

QUESTION THREE ***(25 marks)***

(a) The core in Fig. 3.1 has a relative permeability of 300, mean magnetic path length 8 cm, and cross-sectional area of 2.5×10^{-4} m^2 throughout. The primary winding has 50 turns and the secondary winding has 75 turns. If the current in the primary winding is increased linearly from 0 to 4 A in 0.01 s, find the voltage E induced in the secondary winding. *(6 marks)*

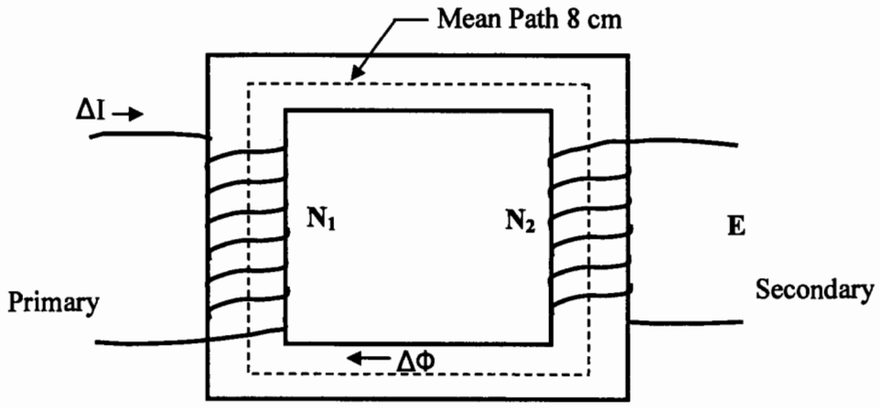

Fig. 3.1

(b) A coil of 100 turns, 4 cm length and 1 cm diameter is wound around a core of relative permeability 400, as shown in Fig. 3.2. Sketch the voltage across it when the current through it changes with time as shown in Fig. 3.3. *(14 marks)*

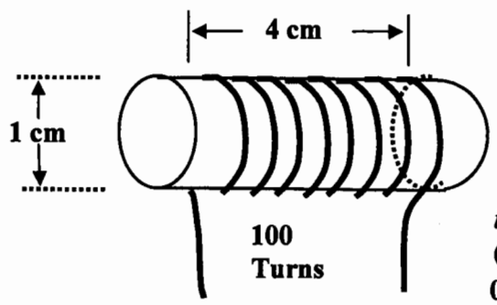

Fig. 3.2

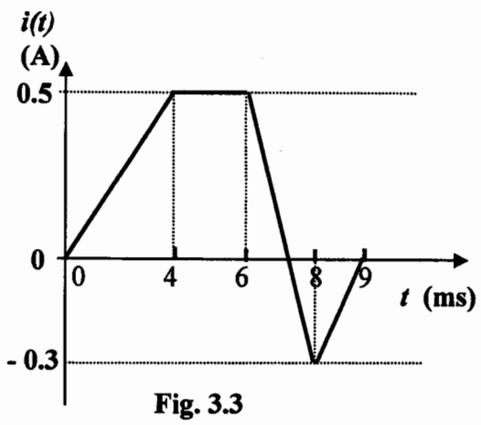

Fig. 3.3

Question 3 (continued)

(c) The switch S in Fig. 3.4 is closed at t=0. Obtain the equation for $v_L(t)$ and find the value of $v_L(t)$ at t = 0.4 ms. *(5 marks)*

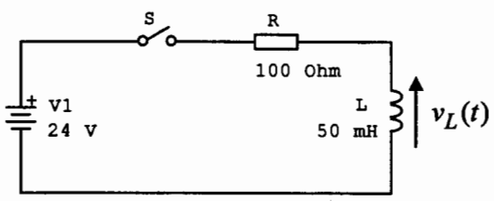

Fig. 3.4

QUESTION FOUR ***(25 marks)***

Consider the circuit shown in Fig. 4.1. Analyze the circuit as follows:

(a) Calculate the phasor current I_T. *(6 marks)*

(b) Find the currents I_1 and I_2. *(4 marks)*

(c) Find the voltage V_{ab}. *(5 marks)*

(d) Determine the average power delivered to the circuit. *(3 marks)*

(e) Find the average power dissipated in each resistor *(4 marks)*

(f) Should the power in (e) be equal to that in (d)? Explain your answer. *(2 marks)*

(g) What is the power factor of this network? *(1 mark)*

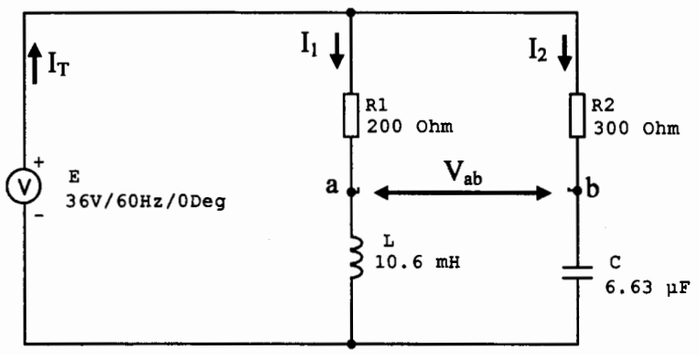

Fig. 4.1

QUESTION FIVE ***(25 marks)***

(a) For the circuit of Fig. 5.1, find the load impedance Z_L for maximum power transfer to the load, and also the maximum power to the same load. ***(15 marks)***

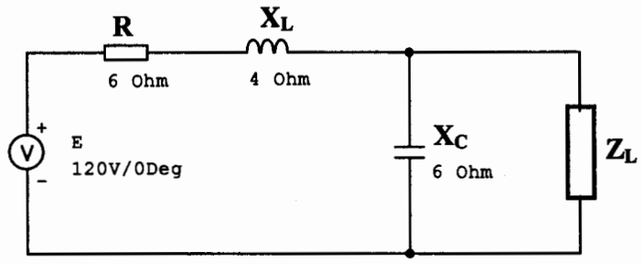

Fig. 5.1

(b) For the system of Fig. 5.2,

(i) Find P_T, Q_T and S_T. ***(6 marks)***

(ii) Find the power factor. ***(2 marks)***

(iii) Draw the power triangle. ***(2 marks)***

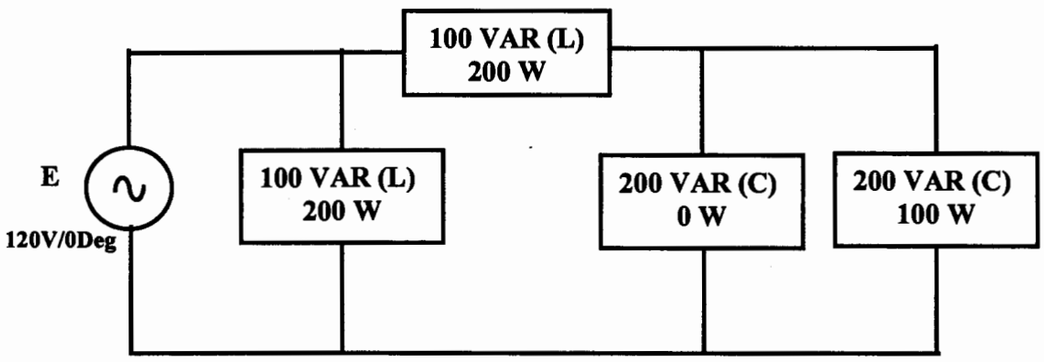

Fig. 5.2

END OF EXAMINATION PAPER