UNIVERSITY OF SWAZILAND

SUPPLEMENTARY EXAMINATION 2006/2007

FACULTY OF SCIENCE

DEPARTMENT OF ELECTRONIC ENGINEERING

TITLE OF PAPER: ELECTRICAL CIRCUITS

COURSE NUMBER: E310

TIME ALLOWED: THREE HOURS

INSTRUCTIONS:

1. Answer any FOUR (4) of the following six questions.
2. Each question carries 25 marks.

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THIS PAPER CONTAINS SIX (6) PAGES INCLUDING THIS PAGE

QUESTION 1

(a) Find the current through R_2 in the circuit of Fig. 1.

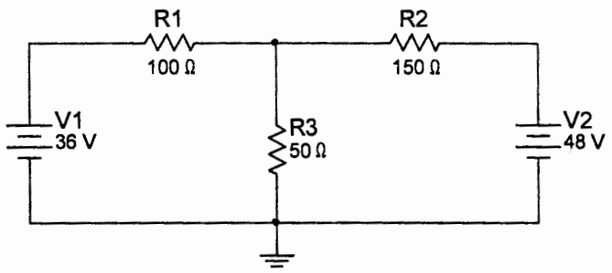

Fig. 1

[12 marks]

(b) Using the format approach (that is, by inspection) write the nodal equations in matrix form for the network of Fig.2. Using determinants (Cramer's rule), solve for the voltage at node A.

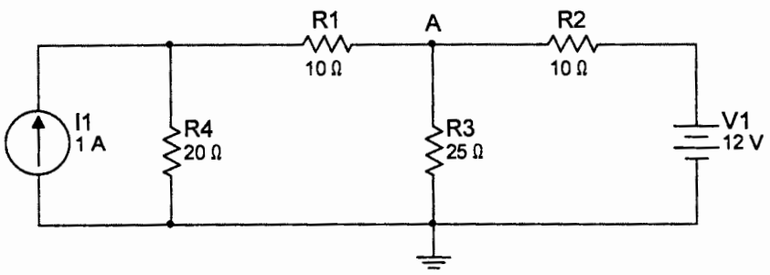

Fig. 2

[13 marks]

QUESTION 2

(a) Find the Norton equivalent circuit for the network external to the resistor R for the circuit of Fig. 3.

[13 marks]

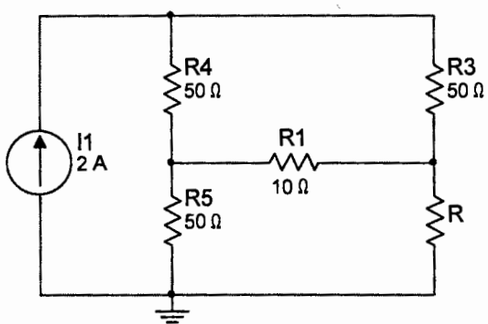

Fig. 3

(b) For the circuit of Fig. 4,

find the value of R for maximum power to R. Determine the maximum power to R.

[12 marks]

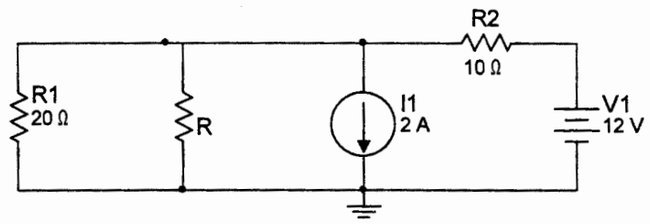

Fig. 4

QUESTION 3

A step voltage is applied to the series RLC of Fig. 5 by closing the switch. Predict and sketch the complete current response.

[25 marks]

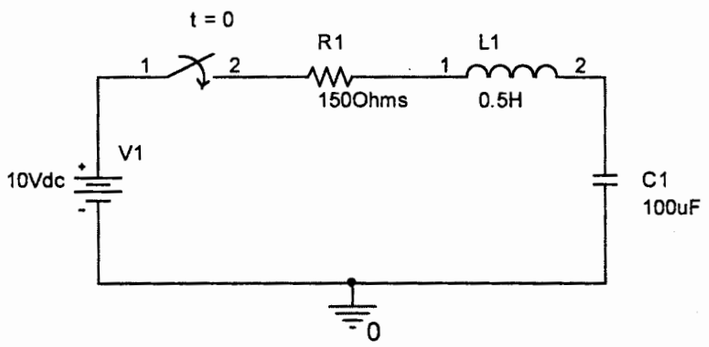

Fig. 5

QUESTION 4

(a) Calculate the currents I1 and I2 of Fig. 6 in phasor form.

[10 marks]

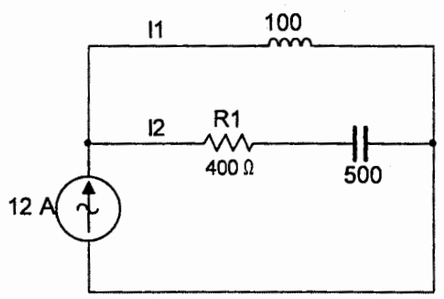

Fig. 6

(b) The lighting and motor loads of a small factory establish a 100-KVA power demand at a 0.75 lagging power factor on a 230-V, 50-Hz supply.

(i) Establish the power triangle for the load.
(ii) Determine the power factor capacitor that must be placed in parallel with the load to raise the power factor to unity.
(iii) Determine the change in supply current from the uncompensated to the compensated system.

[15 marks]

QUESTION 5

The bandwidth of a series resonance circuit is 10 kHz. The resonant frequency is 100 kHz.

(a) What is the value of Q for the circuit?
(b) If R = 20 Ω, what is the value of X_L at resonance?
(c) Find the value of L and C at resonance.
(d) Find the cutoff frequencies.

[25 marks]

QUESTION 6

(a) Determine the magnetic flux established in the series magnetic circuit of Fig. Q3. Assume that for the solid material $\mu_r = 1000$. Total length of solid material $l_s = 0.8$ m; length of air gap $l_g = 8 \times 10^{-4}$ m; area throughout $A = 2 \times 10^{-4}$ m^2.

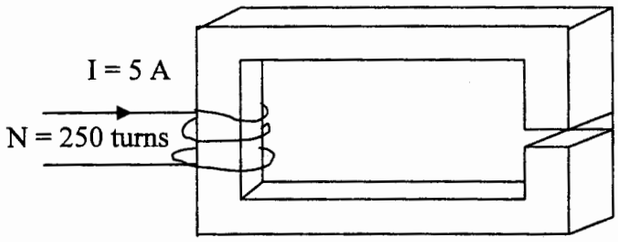

Fig. Q3

(b) For the transformer of Fig. Q4, determine the primary current Ip.

[25 marks]

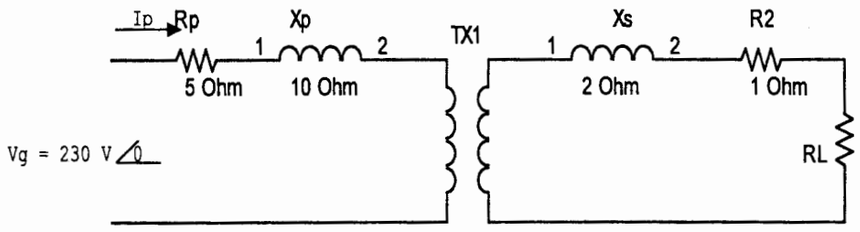

Fig. 11