UNIVERSITY OF SWAZILAND

FIRST SEMESTER 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) Using the format approach (that is, by inspection) write the mesh equations in matrix form for the network of Fig.1. Using determinants (Cramer's rule), solve for the current THROUGH R_3.

[12 marks]

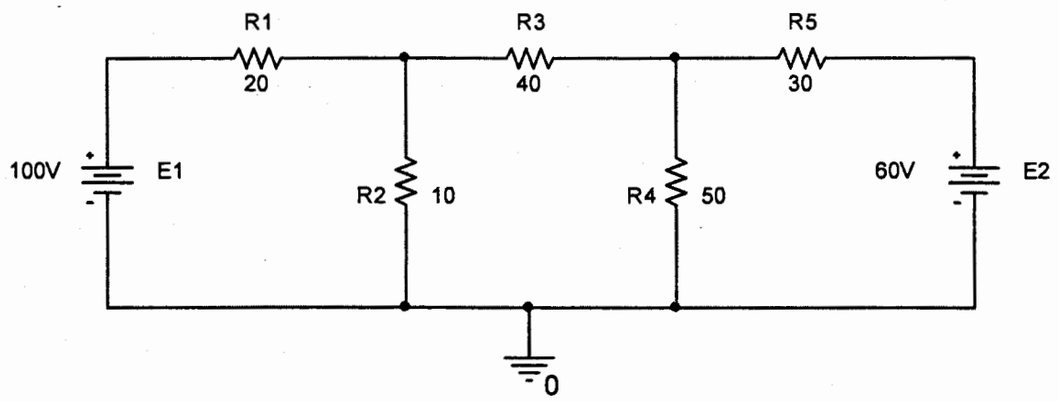


Fig. 1

(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 node voltages V1 and V2.

[13 marks]

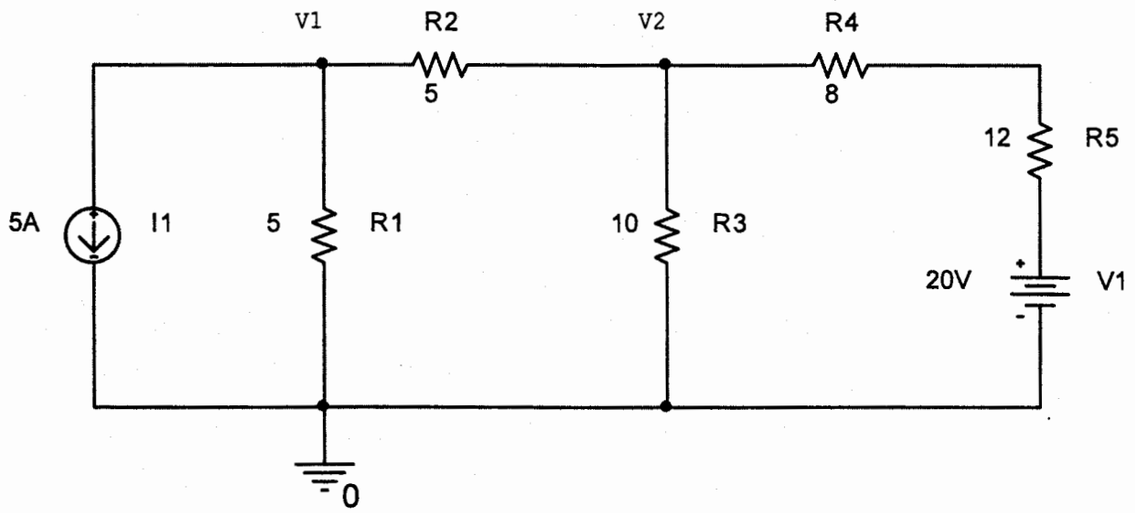


Fig. 2

QUESTION 2

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

[15 marks]

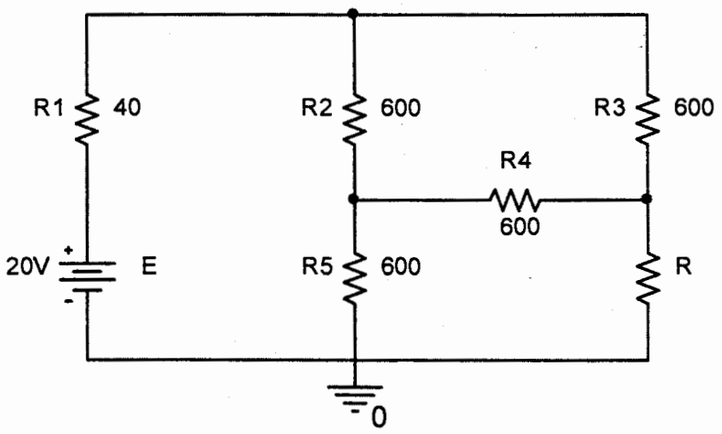


Fig. 3

(b) For the circuit of Fig. 4, find the value of R for maximum power to R. Determine the maximum power to R.

[10 marks]

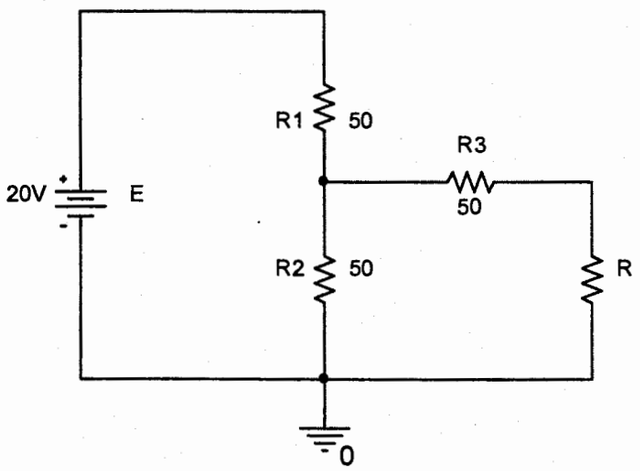
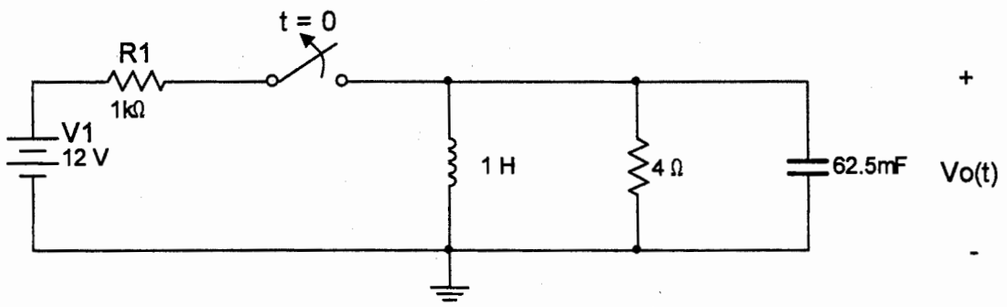


Fig. 4

QUESTION 3

In the circuit of Fig. 5, the switch is opened at t = 0. Find $v_c(t)$ for t > 0. Assume steady state conditions exist at $t = 0^-$.

[25 marks]



QUESTION 4

(a) For the parallel circuit of Fig. 6, find a series circuit that will have the same total impedance.

[10 marks]

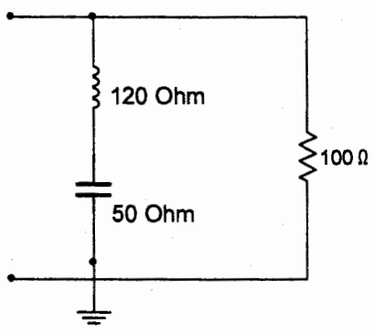


Fig. 6

(b) A single-phase motor draws 5 KW at a power factor of 0.88 when 230 V is applied.

(i) Calculate the apparent and reactive power drawn by the motor and the power factor angle.
(ii) Draw the power triangle.
(iii) Calculate the current drawn by the motor.

[15 marks]

QUESTION 5

(a) Three impedances each Z = (24 + j12) Ω, are connected in delta to a 400 V three-phase source. Calculate the line current, power factor, and total three-phase real and reactive power.

[13 marks]

(b) For the circuit of Fig. 7:

(i) Find the value of X_C at resonance (f_p).
(ii) Find the total impedance Z_{T_p} at resonance (f_p).
(iii) Find the currents I_L and I_C at resonance (f_p).
(iv) Find Q_p.

[12 marks]

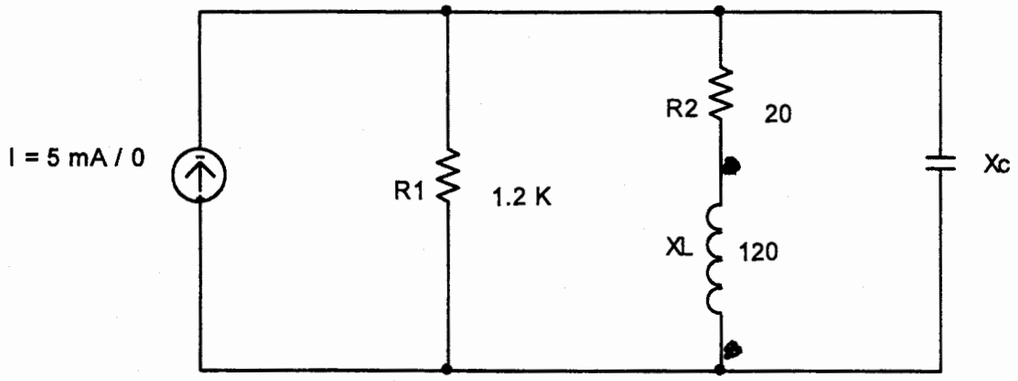


Fig. 7

QUESTION 6

(a) For the circuit of Fig. 8, find the transformation ratio required to deliver maximum power to the speaker. Find the maximum power delivered to the speaker.

[10 marks]

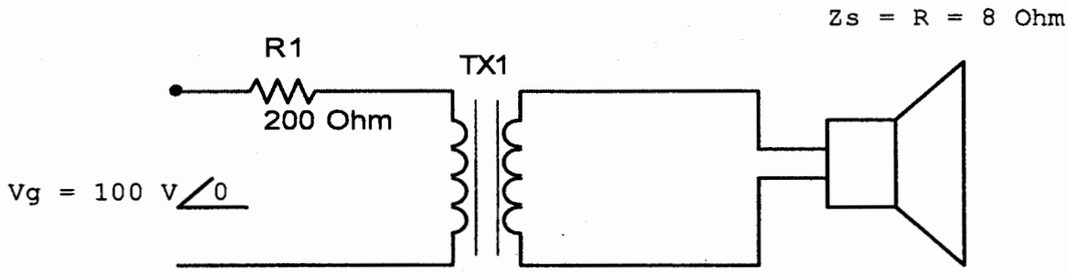


Fig. 8

(b) A magnetic core with an airgap is configured as shown in Fig. 9. The cross-sectional area is 7.5 cm^2, the gap length is 0.065 cm, the mean core length is 28 cm, there are 400 turns and the relative permeability is 10^5. Ignore fringing and leakage flux. In order to maintain a flux density of 1.8 T in the core, calculate the coil current and the magnetic field intensity (H) in the core and the gap.

[15 marks]

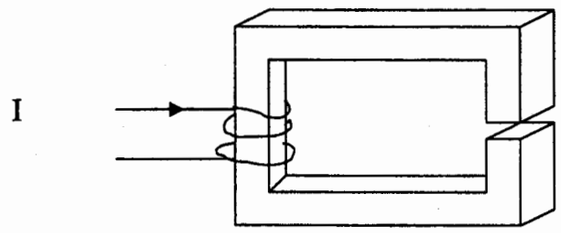


Fig. 9