UNIVERSITY OF SWAZILAND

FIRST SEMESTER EXAMINATION 2007/2008

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.

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

THIS PAPER CONTAINS SIX (5) PAGES INCLUDING THIS PAGE

QUESTION 1

(a) For the circuit of Fig. 1, solve for the current through R_2.

[12 marks]

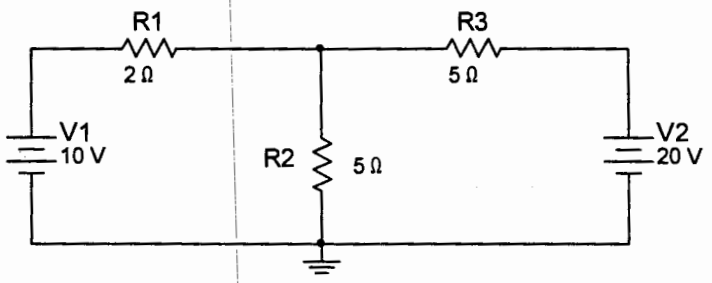

Fig. 1

(b) For the circuit of Fig. 2, find the value of R for maximum power to R. Determine the maximum power to R.

[13 marks]

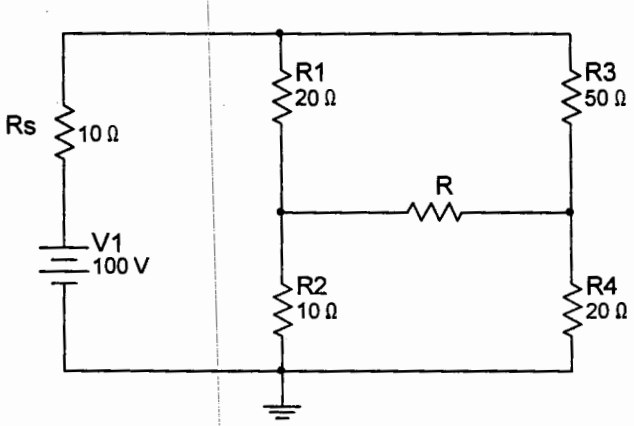

Fig. 2

QUESTION 2

(a) In the circuit of Fig. 3, the switch is moved from position 1 to position 2 at t = 0. Find $v_c(t)$ for t > 0. Assume steady state conditions exist at $t = 0^-$.

[13 marks]

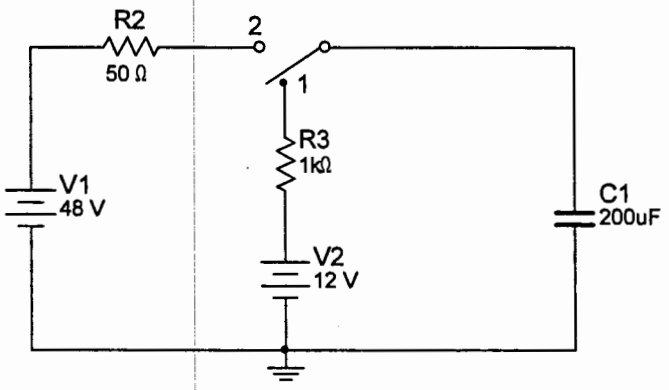

Fig. 3

(b) In the circuit of Fig. 4, the switch is moved from position 1 to position 2 at t = 0. Solve for the current through the inductor L1 for t > 0. Assume steady state conditions exist at $t = 0^-$.

[12 marks]

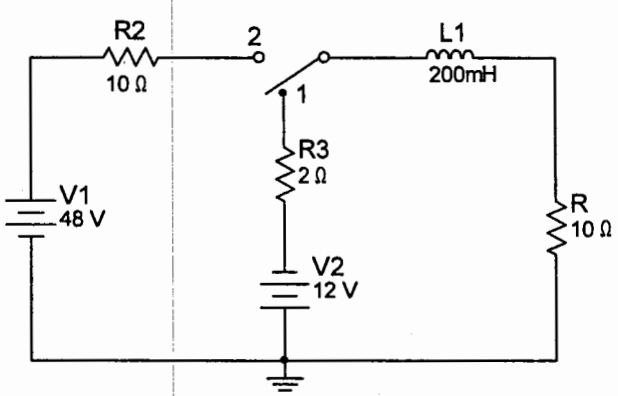

Fig. 4

QUESTION 3

(a) Calculate the current in R2 and L1 in the circuit of Fig. 5.

[10 marks]

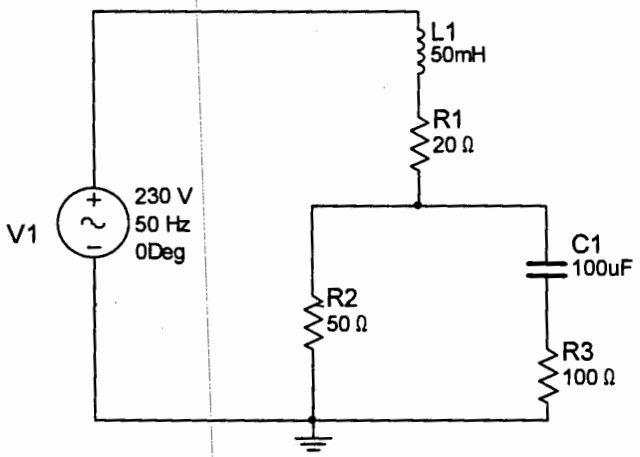

Fig. 5

(b) The loading of a factory on a 400-V, 50-Hz system includes:
10-kW heating load (unity power factor)
10-kW induction motors (0.7 lagging power factor)
2-KW lighting load (0.85 lagging power factor)

(i) Establish the power triangle for the total loading on the supply.
(ii) Determine the power factor capacitor required to raise the power factor to unity.
(iii) Determine the change in supply current from the uncompensated to the compensated system. Assume a single-phase system.

(15 marks)

QUESTION 4

(a) A series R-L-C circuit is designed to resonate at f_o = 10 kHz, have a bandwidth of 0.1 f_o, and draw 5 W from a 100-V source at resonance.

(i) Determine the value of R.
(ii) Find the values of L and C.
(iii) Determine the Q of the circuit.

[16 marks]

(b) For the circuit of Fig. 6, determine the circuit impedance at resonance.

[9 marks]

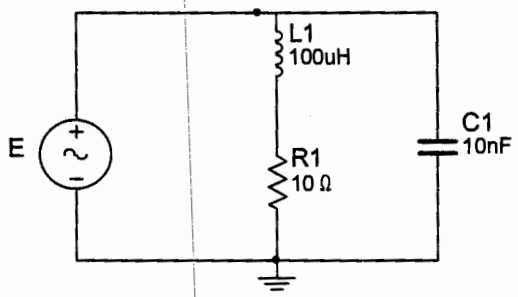

Fig. 6

QUESTION 5

(a) Three impedances each R = 75 Ω and L = 400 mH connected in series, are Y-connected to a 400-V (line-to-line), 50-Hz three-phase source. Calculate the line currents, the power factor, and total three-phase real and reactive power.

[13 marks]

(b) Determine the output voltage from each secondary winding of the transformer in Fig. 7. Determine also the total primary current, assuming that the transformer is 100% efficient. The numbers of turns on each winding are N_p = 375, N_{s1} = 750, and N_{s2} = 500. R_1 = 75 Ω and R_2 = 75 Ω.

[12 marks]

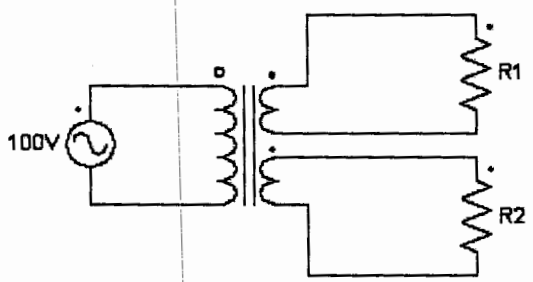

Fig. 7

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]

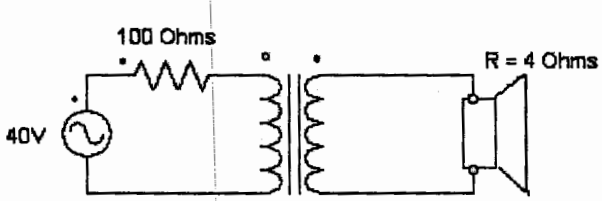

Fig. 8

(b) The magnetic core shown in Fig. 9 has a 1 mm air gap halfway on the right side. It has uniform 2-cm square cross section. The mean core length is 42 cm, there are 900 turns and the relative permeability μ_r = 800. Calculate the coil current required to produce a flux of 800 μWb in the air gap. ($\mu_o = 4\pi \times 10^{-7}$ Wb/A.m)

[15 marks]

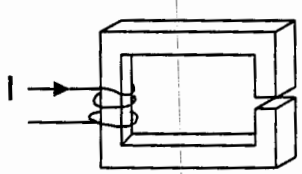

Fig. 9