UNIVERSITY OF TORONTO
DEPARTMENT OF ELECTRICAL & COMPUTER ENGINEERING
FINAL EXAMINATION - DECEMBER 2001
Second Year - Programs 5
ECE250F - CIRCUIT ANALYSIS
EXAMINERS - R. Iravani and H. Kunov

NAME (Please print):		
	Family Name	Given Name
STUDENT NUMBER:		

EXAMINATION TYPE: Type A; Papers for which no data are permitted other than the information printed on the examination paper.

CALCULATORS: Non-programmable scientific type permitted.

DURATION: 2.5 hours.

INSTRUCTIONS:

- **DO NOT UNSTAPLE THIS EXAM BOOK.**
- **Answer all six (6) questions.**
- Answer each question neatly and concisely. Write the final answer in the box provided.
- Answers to all questions must be supported by calculations.
- The back side of each adjacent page may also be used for your answer.

QUESTION	SHEET NUMBER	VALUE	MARKS
1	Page 2	20 marks	
2	Page 3	20 marks	
3	Page 4	20 marks	
4	Page 5-6	20 marks	
5	Page 7-8	20 marks	
6	Pages 9-10	20 marks	
TOTAL:		120	

(Question 1). In the ciruit below, $v_1(t) = 5\cos(1500t + 30°)$ V.

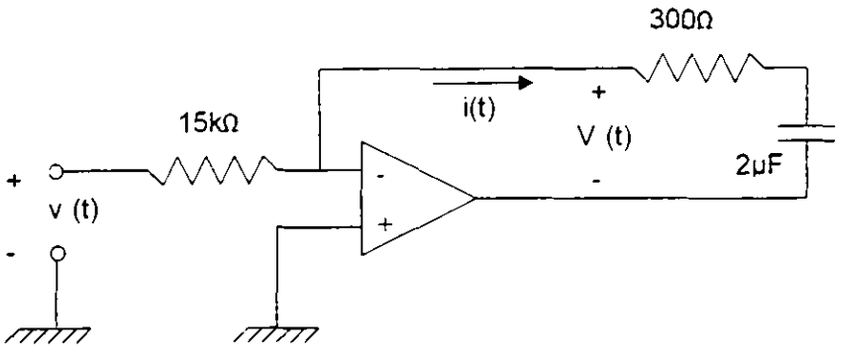


Fig.1

(10 Marks) (a) Find i(t).

(10 Marks) (b) Find $v_2(t)$.

(Question 2). In the circuit below, the resistor labelled 300 Ω can be varied between 0 and 300 Ω, and R_x is the resistance that is part of the circuit.

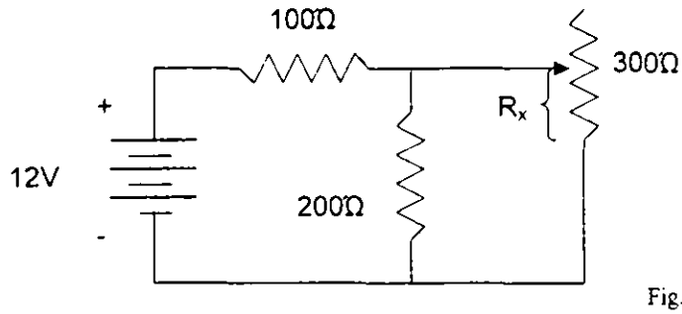
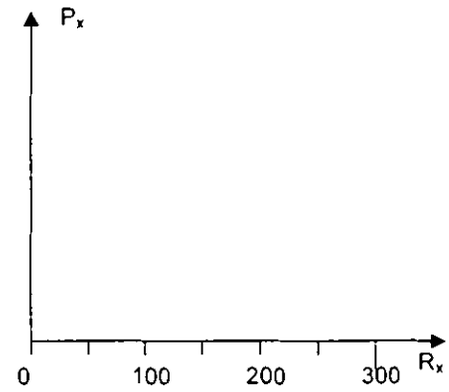
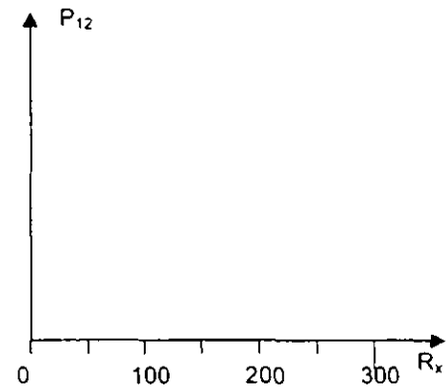


Fig. 2

(10 Marks) (a) Plot the power P_x delivered to R_x as a function of R_x.



(10 Marks) (b) Plot the power P_{12} delivered by the 12 volt source as a function of R_x.



(Question 3). In the circuit below, the terminals on the left side are left open-circuited.

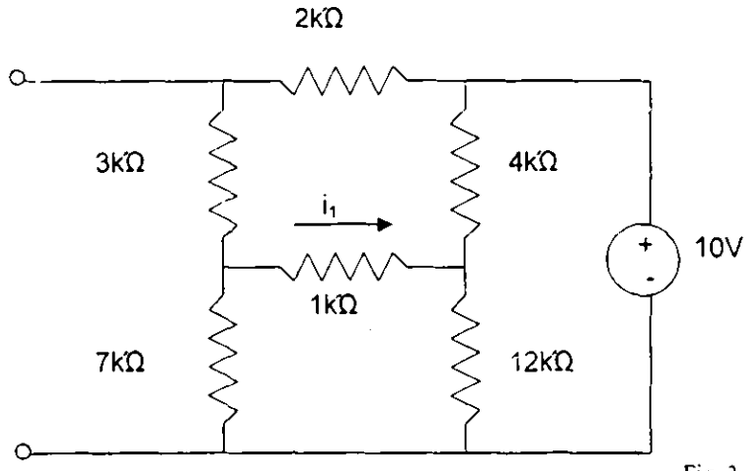


Fig. 3

(10 Marks) (a) Determine the current i_1.

(10 Marks) (b). Find the Thevenin equivalent of the circuit as seen from the terminals on the left.

(Question 4).

(12 Marks) (a) Find the sinusoidal steady-state response $v_x(t)$ in the circuit of Fig. 4.

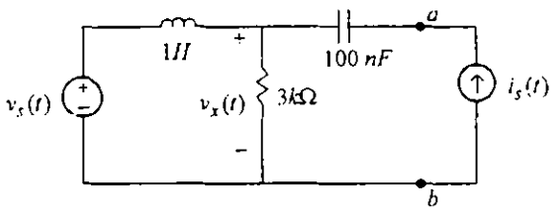


Fig. 4

$$v_s(t) = 20\cos(4000t) \quad V$$

$$i_s(t) = \sqrt{13}\sin(2000t + 45^o) \quad mA$$

$v_x(t) =$

(8 Marks) (b) Source $i_s(t)$ is disconnected from the circuit and terminals a & b are left open. Calculate average power, reactive power, power factor and apparent power of source $v_s(t)$.

P = ...absorbed or supplied;

Q = ...absorbed or supplied;

PF = ...leading or lagging;

| S | =

(Question 5). The switch in the circuit of Fig. 5 has been in position A for a long time and is moved to position B at $t = 0$.

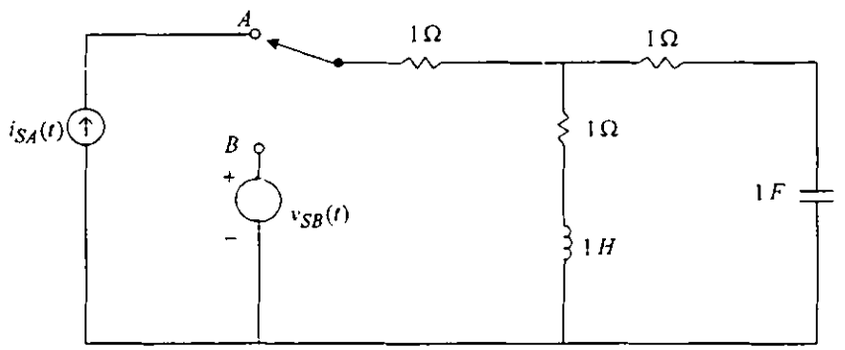


Fig. 5

$$i_{SA}(t) = 2\cos(t + 15^{o}) \qquad A$$

$$v_{SB}(t) = 4(1 - e^{-t}) \qquad V$$

(10 Marks) (a) Calculate the initial values ($i_L(0+)$ and $v_c(0+)$) of the inductor current and the capacitor voltage.

$i_L(o+) = I_o =$
$v_c(o+) = V_o =$

(5 Marks) (b) Transfer the circuit to the s-domain.

(5 Marks) (c) Calculate the steady-state current of source $v_{SB}(t)$.

Steady-State Current =

(Question 6)

(10 Marks) a) Develop the expression for the voltage transfer function $T_V(s)$ of the system shown in Fig. 6.

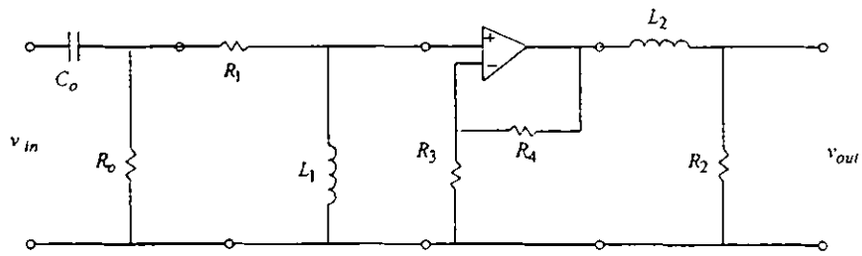


Fig. 6

$T_V(s) =$

(10 Marks) b) Construct a plot of the straight-line approximation to the gain response (20 log |T| verses frequency) of transfer function:

$$T = \frac{(160{,}000)S^2}{(S^2 + 2{,}100\,S + 300{,}000)(S + 40{,}000)}$$