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DEPARTMENT OF ELECTRICAL AND INFORMATION ENGINEERING

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Circuit Theory II (Graphical calculators are permitted)

1. Calculate the inverse Laplace-transformation to function $\dfrac{1}{(s^2+4s+3)(s+2)}$.
   Use Table 1 for help.

2. T(s) is the loop gain of an amplifier with negative feedback.

$$T(s) = \frac{10^{22}}{\left(s+10^8\right)\left(s+10^7\right)(s+100)}$$

Construct a straight-line Bode amplitude and phase plot of T(s). What are the gain and phase margins?

3. Calculate the voltage transfer function $V_2(s)/V_1(s)$ for the circuit shown in Fig.1. Calculate voltage $v_2(t)$, when $t \geq 0$ and $v_1(t) = 10^{-9} \cdot \delta(t)$. No energy is stored in the circuit at t = 0.

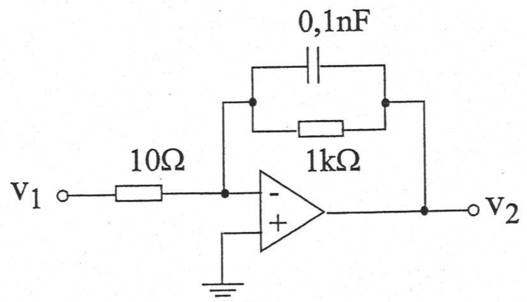

Fig 1.

4. Calculate the z-parameters for the 2-port shown in Fig. 2. Apply instructions shown in the next page.

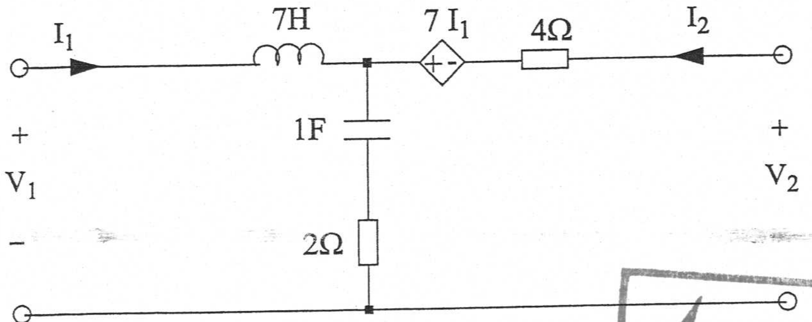

Fig. 2

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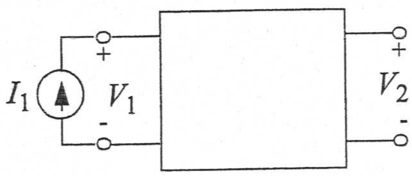
Table 1: Some Laplace-transform pairs

type	x(t)	X(s)
impulse	$\delta(t)$	1
unity-step u(t)	1	1 / s
exponential function	e^{-at}	1 / (s+a)
	$1 - e^{-at}$	a / (s(s+a))
	$t^n e^{-at}$	$n! / (s+a)^{n+1}$

z-parameters:

$$\begin{bmatrix} z_{11} & z_{12} \\ z_{21} & z_{22} \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} V_1 \\ V_2 \end{bmatrix}$$

$$z_{11} = \left.\frac{V_1}{I_1}\right|_{I_2 = 0} \qquad z_{21} = \left.\frac{V_2}{I_1}\right|_{I_2 = 0}$$



$$z_{12} = \left.\frac{V_1}{I_2}\right|_{I_1 = 0} \qquad z_{22} = \left.\frac{V_2}{I_2}\right|_{I_1 = 0}$$