

**University of Saskatchewan
College of Engineering**

EE 214 - System Modeling and Network Analysis

Midterm Examination

This is a Closed-Book Examination

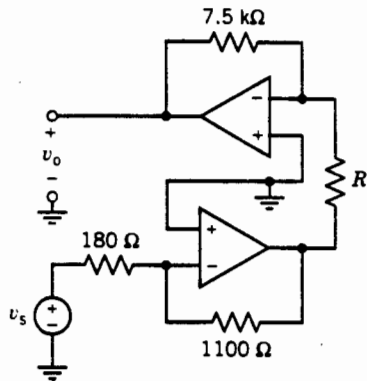
Instructor: S.O. Faried

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Duration: 90 minutes

1. The input voltage is $v_s = 62.4 \text{ mV}$ for the circuit of Figure 1.

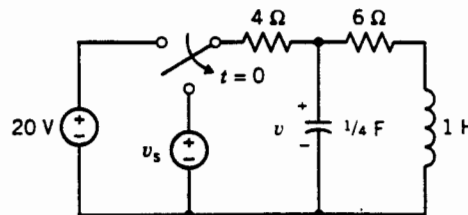
It is desired that $v_o = 13.0 \text{ V}$. Determine R_1 to achieve the desired output. Assume ideal op amps.



$R_1 = 220 \Omega$ ✓

Figure 1

2. Find the complete response $v(t)$ for $t > 0$ for the circuit of Figure 2 when $v_s = 8e^{-4t} \mu(t)$. Assume that the circuit is in steady state at $t = 0^-$.



$v(t) = (-8e^{-4t} + 5.333e^{-2t} + 2.666e^{-5t}) u(t)$

Figure 2

3. The transfer function $G(s)$ for the network shown in Figure 3 can be expressed as

$$G(s) = \frac{Ks}{As^2 + Bs + 1}$$

Determine K, A and B.

$$K = RC$$

$$A = R^2C^2$$

$$B = 3RC$$

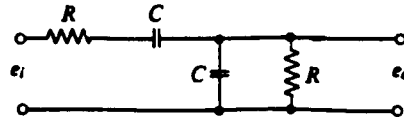


Figure 3

4. Using the Routh's stability criterion, determine the stability of the closed-loop control system that has the following characteristic equation

$$s^6 + 2s^5 + 8s^4 + 15s^3 + 20s^2 + 16s + 16$$

How many roots are in the left-half s-plane?

4 roots in Right.
2 roots in Left

Table 2.1 Laplace Transform Pairs

$f(t)$	$F(s)$
$u(t)$ (step function)	$\frac{1}{s}$
$e^{-at}u(t)$	$\frac{1}{s+a}$
$\sin \omega t u(t)$	$\frac{\omega}{s^2 + \omega^2}$
$\cos \omega t u(t)$	$\frac{s}{s^2 + \omega^2}$
$e^{-at}f(t)u(t)$	$F(s+a)$
$\delta(t)$ (impulse function)	1
$tu(t)$	$\frac{1}{s^2}$
$t^2u(t)$	$\frac{2}{s^3}$
$t^n u(t)$	$\frac{n!}{s^{n+1}}$
$t^n e^{-at}u(t)$	$\frac{n!}{(s+a)^{n+1}}$
$\frac{df(t)}{dt}$	$sF(s) - f(0+)$
$\frac{d^2f(t)}{dt^2}$	$s^2F(s) - sf(0+) - \frac{df(0+)}{dt}$
$f^{(k)}(t) = \frac{d^k f(t)}{dt^k}$	$s^k F(s) - s^{k-1}f(0+) - s^{k-2}f'(0+) - \dots - f^{(k-1)}(0+)$
$\int_{-\infty}^t f(t) dt$	$\frac{F(s)}{s} + \frac{\int_{-\infty}^{0+} f(t) dt}{s}$