NAME SOLUTION

ECE 202

EXAM III

AUG. 11, '06

PROBLEM	POINTS	SCORE
1	25	
2	25	
3	25	
4	25	
	100	

NOTE:

1) YOU MUST PLACE YOUR ANSWERS ON THE LINES PROVIDED.

2) SOME ANSWERS MAY HAVE LITTLE OR NO PARTIAL CREDIT. PLEASE CHECK YOUR WORK.

3) SOME ANSWERS MAY HAVE PARTIAL CREDIT, SO PLEASE SHOW YOUR WORK.

4) THIS EXAM HAS 4 PROBLEMS. CHECK TO SEE YOU HAVE 4 PROBLEMS.

5) ALL ANSWERS THAT HAVE UNITS MUST BE INDICATED. ALL ANSWERS MUST BE IN DECIMAL FORM AND IN ENGINEERING NOTATION.

6) WHEN YOU STAND-UP TO TURN-IN YOUR EXAM, YOU WILL NOT BE ALLOWED TO CHANGE YOUR ANSWERS.

Name

1)

A) If a circuit is stable, what can be said about the natural poles of this circuit? Please answer in a complete sentence.

THE NATURAL POLES OF A STABLE CIRCUIT ARE LOCATED IN THE LEFT HALF OF THE S-PLANE.

B) What is the meaning of the word "port"? Please answer in a complete sentence.

A PORT IS A PAIR OF TERMINALS.

C) A linear circuit has an impulse response

$$h(t) = 4\,e^{-3t}\,u(t)$$

Use the convolution integral to find the zero-state response for

$$x(t) = 6\,e^{-2t}\,u(t).$$

$$y(t) = \int_0^t h(t-\tau)\,x(\tau)\,d\tau = \int_0^t 4e^{-3(t-\tau)} \cdot 6e^{-2\tau}\,d\tau$$

$$= 24\int_0^t e^{-3t}\,e^{+3\tau}\,e^{-2\tau}\,d\tau = 24e^{-3t}\int_0^t e^{\tau}\,d\tau$$

$$= 24e^{-3t}\,e^{\tau}\Big|_0^t = 24e^{-3t}\left[e^{t} - e^{0}\right]$$

$$= 24e^{-3t}\left[e^{t} - 1\right] = 24e^{-2t} - 24e^{-3t} \quad t>0$$

y(t) = $24\left[e^{-2t} - e^{-3t}\right]u(t)$

E) Given a series RC circuit with R = 6Ω and C = 5 F, magnitude scale the impedance of this series circuit by 68 k. What are the new values of R and C?

$R \leftarrow R(68k) = (6)(68k)$

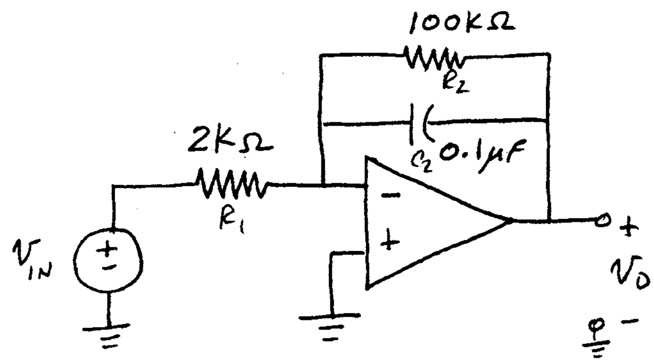
R = $408\,k\Omega$

$C \leftarrow C\,\frac{1}{68k} = \frac{5}{68k}$

C = $73.53\,\mu F$

NAME ______

2) GIVEN



A) FIND $T_V(s) = \dfrac{V_O(s)}{V_{IN}(s)}$

$$\frac{V_O}{V_{IN}} = -\frac{1}{sC_2 + \frac{1}{R_2}}\,\frac{1}{R_1} = -\frac{\frac{1}{R_1C_2}}{s + \frac{1}{R_2C_2}}$$

$$= -\frac{\frac{1}{(2k)(.1\mu)}}{s + \frac{1}{(100k)(0.1\mu)}} \qquad \frac{V_O}{V_{IN}} = -\frac{5K}{s+100}$$

B) FIND $V_O(t)$ FOR A STEP OF 0.1 V

$$V_O = \frac{-5K}{s+100}V_{IN} = \frac{-5K}{s+100}\,\frac{0.1}{s} = \frac{-500}{s(s+100)}$$

$$= \frac{k_1}{s} + \frac{k_2}{s+100}$$

$$k_1 = s\,\frac{-500}{s(s+100)}\bigg|_{s=0} = \frac{-500}{100} = -5$$

← NOTE $k_1 + k_2 = 0$

$$k_2 = (s+100)\,\frac{-500}{s(s+100)}\bigg|_{s=-100} = \frac{-500}{-100} = 5$$

$$V_O = \frac{-5}{s} + \frac{5}{s+100}$$

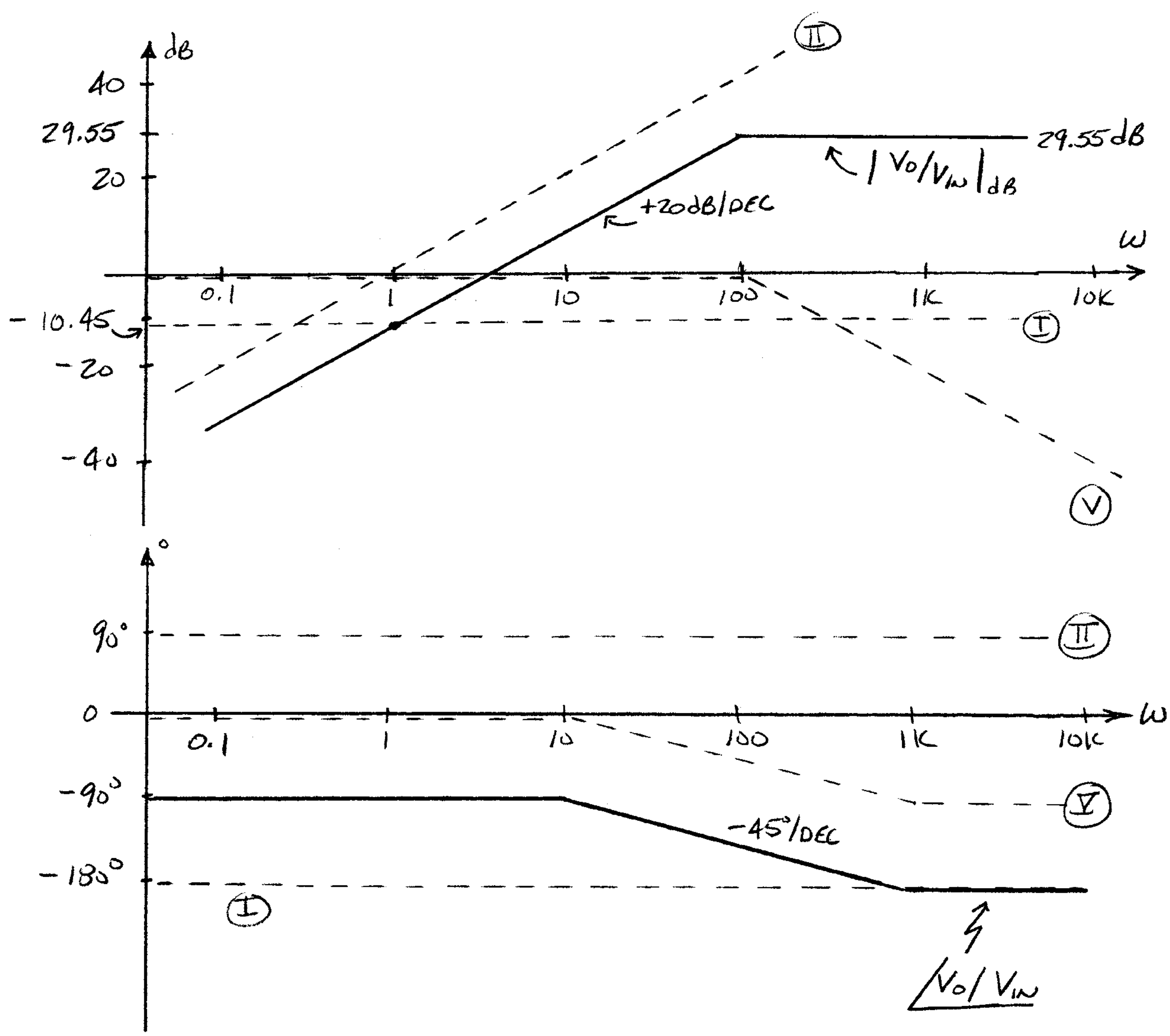
$$V_O(t) = \left[-5 + 5e^{-100t}\right]u(t)$$

$$V_O(t) = \left[-5 + 5e^{-t/10m}\right]u(t)\ \text{V}$$

NAME

3) GIVEN $\dfrac{V_O}{V_{IN}} = \dfrac{-30\,s}{s+100}$. PLOT $\left|\dfrac{V_O}{V_{IN}}\right|_{dB}$ AND $\angle V_O/V_{IN}$ VERSUS ω. MAKE YOUR OWN LOG PAPER. PLOT FORMS WITH A --- LINE AND THE FINAL PLOT WITH A SOLID LINE. LABEL ALL FINAL SLOPES AND LEVELS.

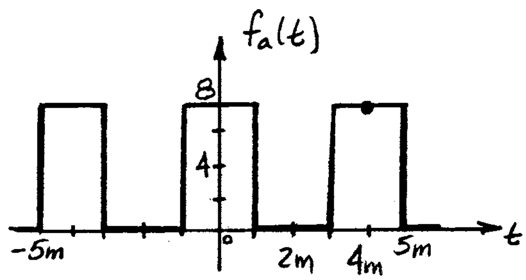
$$\left.\frac{V_O}{V_{IN}}\right|_{s=j\omega} = \frac{-30j\omega}{j\omega+100} = \underbrace{\frac{-30}{100}}_{\text{I}}\ \underbrace{j\omega}_{\text{II}}\ \underbrace{\frac{1}{1+j\,\omega/100}}_{\text{V}}$$



NAME ______________________

4) GIVEN THE FOLLOWING WAVEFORMS, DETERMINE IF THERE IS A) NO SYMMETRY, B) ODD SYMMETRY, C) EVEN SYMMETRY AND/OR D) HALF-WAVE SYMMETRY. EXPLAIN WHY BY USING THE POINT • INDICATED.

a)



$T_0 = 4m$

SYMMETRY:

EVEN

WHY:

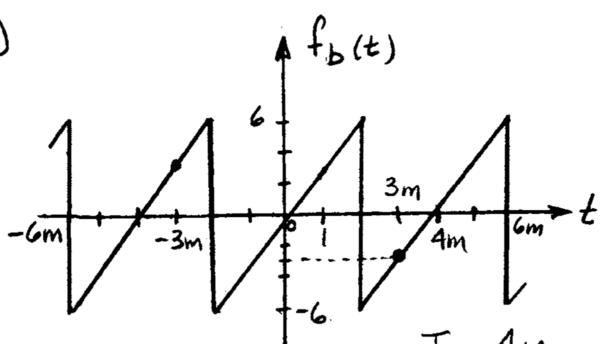
$f(t) = f(4m) = 8$

$f(-t) = f(-4m) = 8$

$\therefore f(t) = f(-t)$

NOT REQUIRED
$$\left\{\begin{array}{l} f(t - T_0/2) = f(4m - \frac{4m}{2}) \\ f(2m) = 0 \\ \therefore f(t) \neq -f(t - T_0/2) \end{array}\right.$$

b)



$T_0 = 4m$

SYMMETRY:

ODD

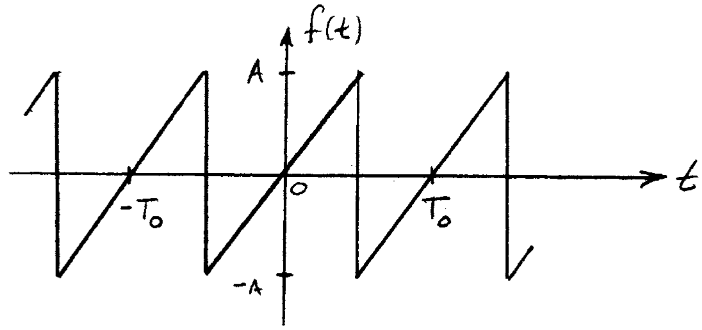
WHY:

$f(t) = f(3m) = -3$

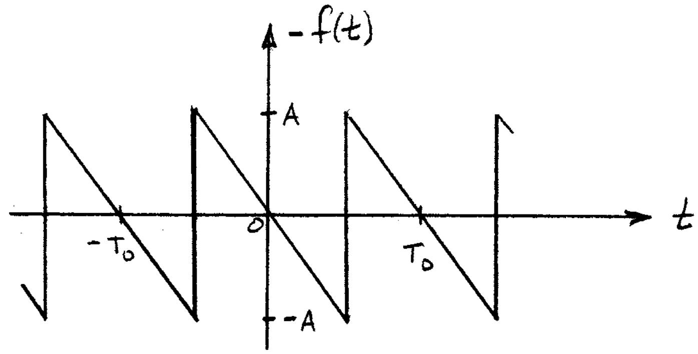
$-f(-t) = -f(-3m) = -\boxed{3}$

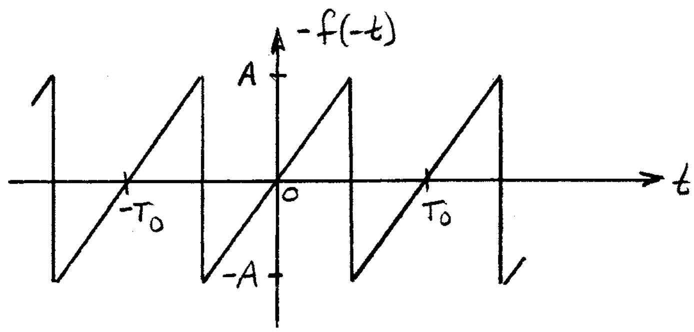
$\therefore f(t) = -f(-t)$

S13.4) GRAPHICALLY SHOW THAT $f(t)$ HAS ODD SYMMETRY AND DOES NOT HAVE HALF-WAVE SYMMETRY.



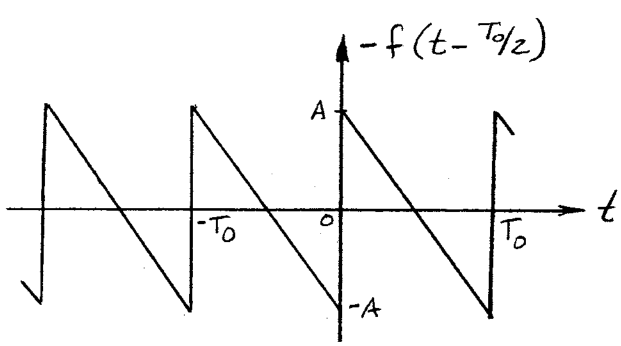
SOLUTION:





$= f(t)$

∴ ODD SYMMETRY



$\neq f(t)$

∴ NO HALF-WAVE SYMMETRY