ASSIUT UNIVERSITY
FACULTY OF ENGINEERING
DEPT. OF ELECTRICAL ENG.

E222 CIRCUIT THEORY(2)

First Term Examination, 2015/2016

2nd Year Elect.

الامتحان مكون من أربع صفحات، الإجابة فى نفس ورقة الأسئلة، النهاية العظمى ١٠٠ درجة.
الإجابة النهائية يجب أن تكون مكتوبة فى المكان المخصص لها وخطوات الحل تكون فى الصفحة المقابلة.

Attempt all questions, full mark: 100 Points **Time: 3 Hours**

Question #1: (12 Points)

The feedback resistance R_f in the circuit of Fig.1 is variable. Assuming ideal op-amp find:

a) The range of values for R_f in which the op-amp does not saturate. (2 Points)
b) V_{out}, I_o, I_1, and I_2 for R_f = 50 KΩ. (4 Points)
c) V_{out}, V_1, I_o, I_1, and I_2 for R_f = 360 KΩ. (6 Points)

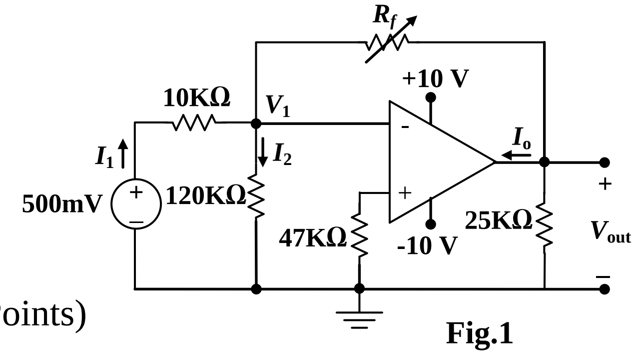


Fig.1

a) $0 \le R_f \le 200$ KΩ

b)

$V_{out} = -2.5$ V	$I_o = 150$ μA	$I_1 = 50$ μA	$I_2 = 0$

c)

$V_{out} = -10$ V	$V_1 = 200$ mV	$I_o = 428.3$ μA	$I_1 = 30$ μA	$I_2 = 1.67$ μA

Question #2: (16 Points)

Both switches in the circuit in Fig.2 have been closed for a long time. At $t = 0$, both switches open simultaneously.

a) Find $i_o(t)$ for $t \ge 0^+$. (8 Points)
b) Find $v_o(t)$ for $t \ge 0^+$. (4 Points)
c) Calculate the energy (in micro joules) trapped in the circuit. (4 Points)

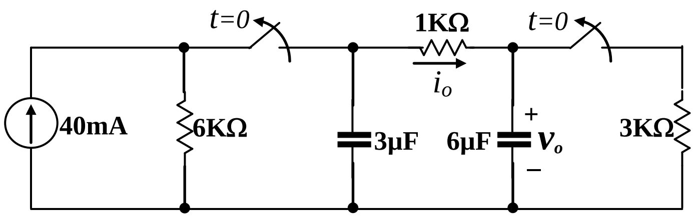


Fig. 2

$i_o(0^+) = 24$ mA	$i_o(\infty) = 0$	$\tau = 2$mS

$i_o(t) = 24\, e^{-500t}$

$v_o(t) = 80 - 8\, e^{-500t}$

Energy trapped in the circuit = 28800 μJ

Question #3: (12 Points)

The switch in the circuit shown in Fig.3 has been closed for a long time. The switch opens at $t = 0$. Find $v_c(0^+)$, $i_L(0^+)$, $[dv_c/dt]_{0+}$, the roots of the characteristic equation s_1, s_2 and $v_c(t)$ for $t \geq 0$.

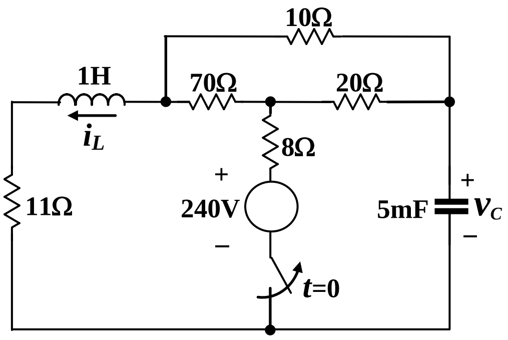


Fig. 3

$v_C(0^+) = 108$ V

$i_L(0^+) = 6$ A

$[dv_c/dt]_{0+}$= - **1200 V/S**

$s_1 = -10 - j10$ **$s_2 = -10 + j10$**

$$v_c(t) = (108\cos 10t - 12\sin 10t)e^{-10t}\text{volts}$$

Question #4: (12 Points)

A three-phase Y-connected +ve sequence source having the phase voltage V_a=220∠0°V. The source resistance is 1 Ω/Phase. The source supplies a balanced Δ-connected load having an impedance of (30 + j12) Ω/Phase. The three lines connecting the source to the load have an impedance of 1+j1 Ω/Line. Find the following:

The Line current $\overline{I_B}$ =	**16.9 ∠-142.6° A**
The phase current $\overline{I_{AB}}$ at the load=	**9.77 ∠7.4° A**
The Line voltage $\overline{V_{BC}}$ =	**315.6 ∠-90.8° V**
The phase voltage $\overline{V_a}$ at the source terminals=	**204.5 ∠1.8° V**
The Line voltage $\overline{V_{ab}}$ at the source terminals=	**354.2 ∠31.8° V**
The total power dissipated in the load =	**8.592 KW**

<u>Question #5</u>: (12 Points)

Use the Laplace transform to find v_o and v_1 in the circuit shown in Fig.5 if $i_g = 10u(t)$ **mA** and $\alpha = 75$ **mA/V**. There is no energy stored in the circuit at t=0.

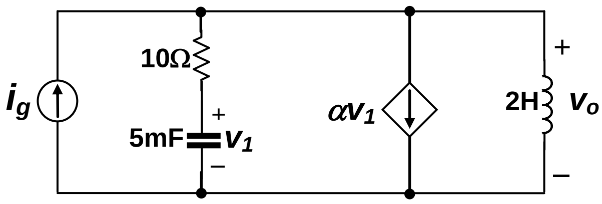


Fig.5

$$V_o(s) = \frac{0.1(s+20)}{s^2+20s+100} = \frac{0.1}{s+10} + \frac{1}{(s+10)^2}$$

$$V_1(s) = \frac{2}{(s+10)^2}$$

$v_o(t) = (t + 0.1)e^{-10t}$ **volts**

$v_1(t) = 2te^{-10t}$ **volts**

<u>Question #6</u>: (12 Points)

The linear transformer used in the circuit of Fig.6 has a coupling coefficient k = 0.5.

a) Calculate the impedance reflected into the primary winding Z_r. (4 Points)

b) Calculate the impedance seen looking into the primary terminals of the transformer Z_{ab}. (2 Points)

c) Calculate the Thevenin equivalent with respect to the terminals ***c,d***. (6 Points)

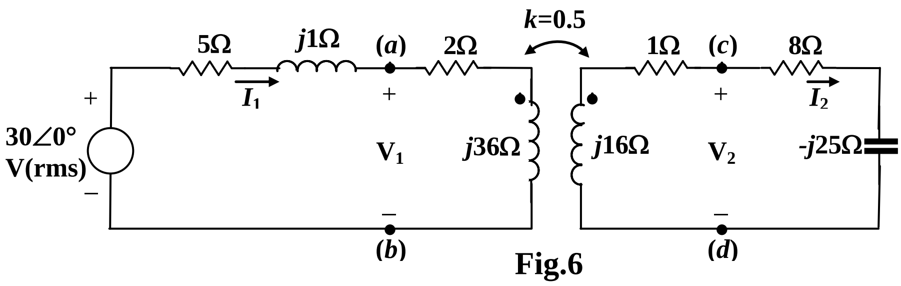


Fig.6

Z_r = 8 + j8 = 11.31∠45° Ω

Z_{ab} = 10 + j44 = 45.12 ∠77.2° Ω

Z_{Th} = 1.71 + j12.24 = 12.36∠82° Ω

V_{Th} = 9.39 + j1.77 = 9.56∠10.7° V

Question #7: (8 Points)

Fig.7 shows an ***R-L*** high pass filter.

a) What is the transfer function, $H(s) = V_o(s)/V_i(s)$, of this filter? (4 Points)
b) What is the cutoff frequency of this filter? (2 Points)
c) What is the maximum value of the transfer function; and at what frequency does it occur? (2 Points)

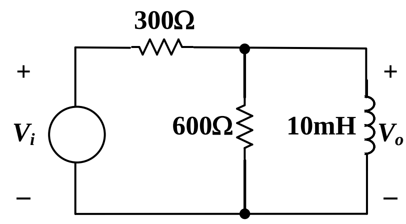


Fig.7

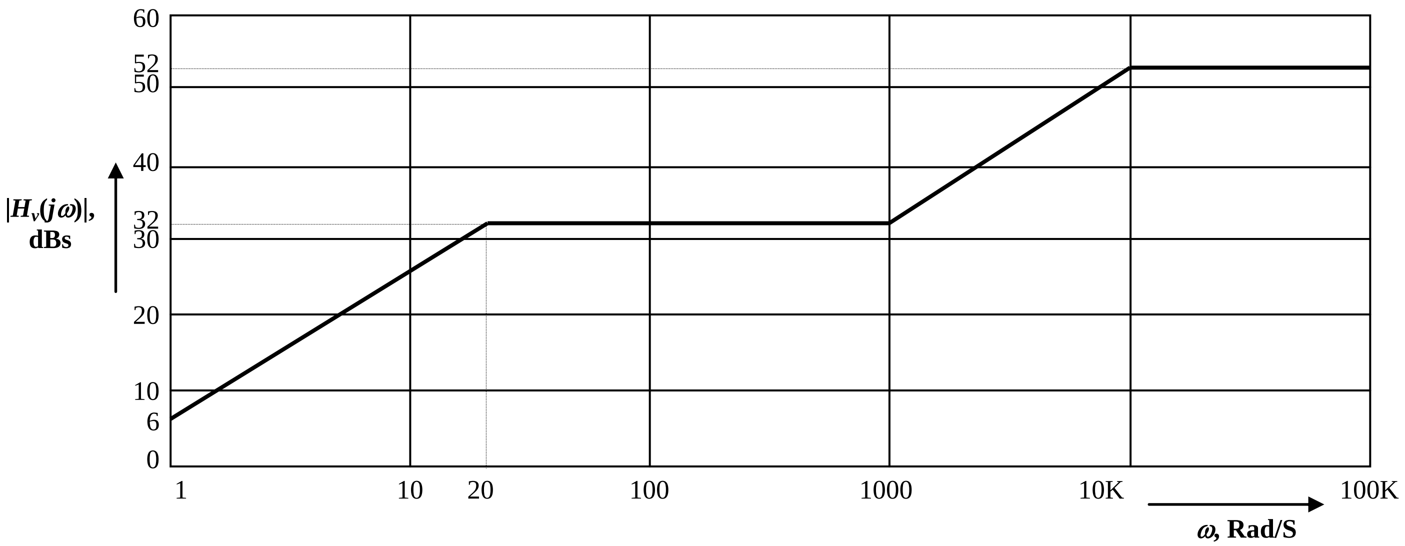
$$H(s) = \frac{2s}{3s + 6 \times 10^4}$$

$\omega_c = 2 \times 10^4$ **Rad/Sec**

$H_{max} = 2/3$ **at** $\omega = \infty$

Question #8: (8 Points)

Sketch the Bode Diagram of the voltage transfer function: $H_v(s) = \dfrac{400s(s+1000)}{(s+20)(s+10000)}$



Question #9: (8 Points)

Find the ***h*** parameters of the two-port circuit shown in Fig.9.

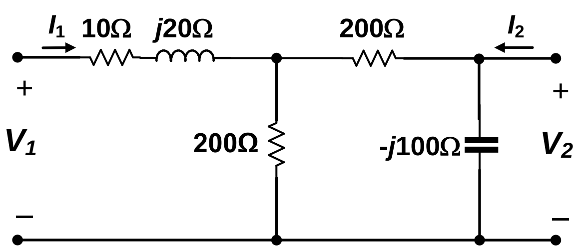


Fig.9

$h_{11} = 110 + j20\ \Omega$

$h_{12} = 0.5$

$h_{21} = -0.5$

$h_{22} = 2.5 + j10$ **mS**

******************** **Best Wishes, Prof. Magdy M. Doss** ********************