National Chiao Tung University
Computer Science Department

INTRODUCTION TO ELECTRIC AND ELECTRONIC CIRCUITS

Assignment [1] : Circuit Models and Coupling

Instructor:	Prof. John K. Zao
Issuing date:	Tuesday, November 27, 2012
Submission due date:	Tuesday, December 11, 2012

Homework Reading

- Zao & Peng, "EE Circuit Notes", 2008. pp. 7 – 15
- Strum & Ward, "Electric Circuits and Networks", 1985. Ch. 2, pp. 38 – 48; Ch. 10, pp. 338 - 384

Part 1. Conceptual Questions

1.1 Please define the following *characteristic parameters* of two-port electrical circuits.

- *Input Impedance under no load condition* 2%
- *Output Impedance with respect to voltage and current inputs* 2×2%
- *Voltage Gain* 2%
- *Current Gain* 2%

Please specify the *necessary voltage/current conditions* at the output in order to measure current and voltage gains properly. Please give the reason why. 4%

1.2 Please describe the ways to determine *output impedance* of a linear electrical circuit based on the *law of reciprocity*. 4%

1.3 Please define *DC* and *AC voltage coupling* between two circuits. Why AC coupling is also known as *capacitive coupling*? 6%

1.4 Please define *voltage* and *current coupling* between two circuits. 4%

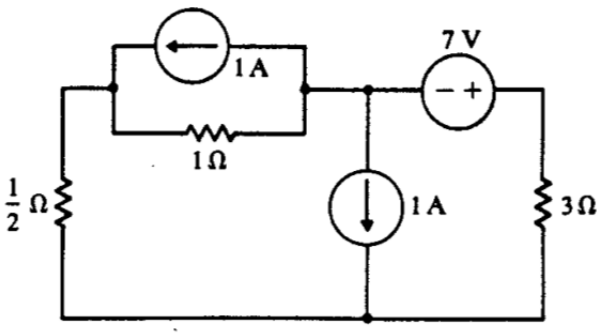
Please explain the concept of *perfect coupling*. 2%

What are the necessary conditions of *perfect voltage* and *current coupling* in terms of *input/output impedances* of the coupled circuits? 2×4%

Where are the implications of *perfect voltage/current coupling* towards the design of *ideal voltage or current amplifiers*? 2×2%

Part 2. Analytical Questions

2.1 Given the linear electrical circuit on the next page, please use *KVL loop analysis* to determine the *current* through the 3Ω resistor. 10%

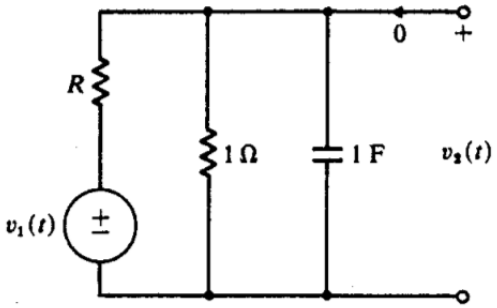


Then, use *KCL nodal analysis* to determine the *voltage* across the 0.5Ω resistor. 10%

2.2 In the following *RC circuit*, the voltages $v_1(t)$ and $v_2(t)$ at $t = t_0$ are given:

$$v_1(t_0) = +2\text{V},\ \ v_2(t_0) = +5\text{V},\ \ \frac{dv_2}{dt}|_{t=t_0} = -10\text{V/s}$$

Please determine the value of resistor *R*. 15%



2.3 Given the following Π-circuit, please determine the characteristics of this *two-port circuit*:

- *Input impedance* R_{in} with *no load* attached to v_0; 6%
- *Input impedance* R_{in} with *load* R_L attached to v_0; 2%
- *Output impedance* R_{out} observed across v_0; 6%
- *Thevenin equivalent* of the entire circuit; 8%
- *Voltage transfer function* $A_v \stackrel{\text{def}}{=} v_o/v_i$ of the circuit. 4%