

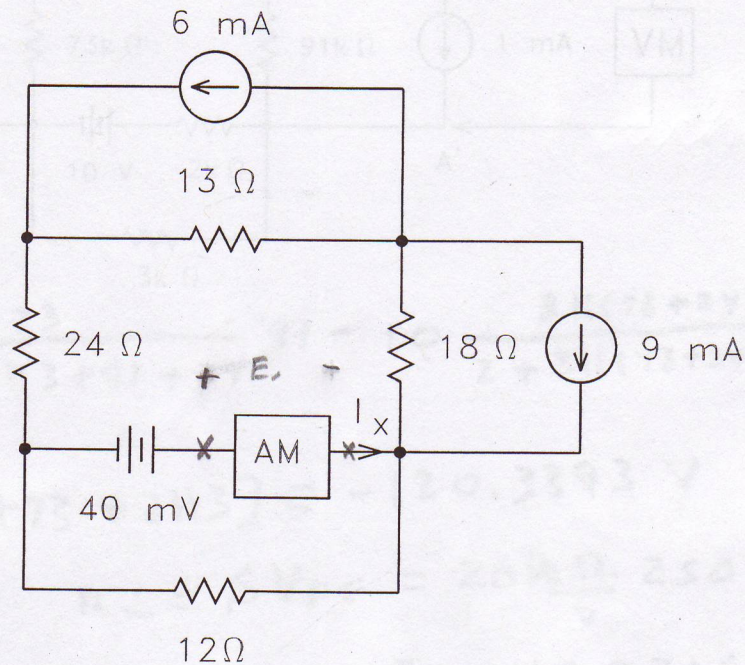
# ECE 3041 Exam No. 1 Spring 2012

FRIDAY FEBRUARY 10, 2012 4 PM GTID No. 9

Name Key

**Instructions. Totally Closed Book and Note. Calculator Permitted. Four Equally Weighted Problems. All Work Must Be Shown for Credit.**

1. Determine the percentage error due to dc ammeter loading in the measurement of the dc current  $I_x$  in the circuit shown below. The ammeter has an internal resistance or input impedance of  $7.3\Omega$ . As an intermediate step in the solution determine the Thévenin equivalent circuit with respect to the ammeter.



$$E_{th} = +6 \frac{13}{13+24+12+18} 12 - 9 \frac{18}{18+12+24+13} 12 + 40 = 24.9552 \text{ mV}$$

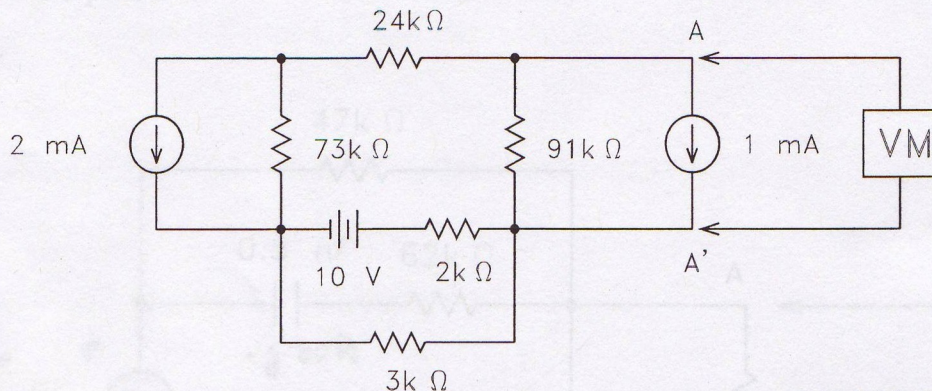
$$R_{th} = 12 \parallel (24+13+18) = 9.8507 \Omega$$

$$\% \text{ error} = -100 \frac{R_{in}}{R_{in} + R_{th}} = -42.5637\%$$

S	$E_{th} =$	<u>25 mV</u>
S	$R_{th} =$	<u>9.85 <math>\Omega</math></u>
S	$\% \text{ error} =$	<u>-42.6 %</u>

10 try

2. Determine the percentage error due to dc voltmeter loading in the measurement of the dc voltage  $V_{AA'}$  in the circuit shown below. The dc voltmeter is a Simpson Meter Model 260-7 set to the range just larger than the Thévenin voltage with respect to the voltmeter. The available ranges for the Simpson meter are 1 V, 2.5 V, 10 V, 50 V, 250 V, 500 V, and 1,000 V. As an intermediate step in the solution determine the Thévenin equivalent circuit with respect to the meter.



$$E_{th} = -2 \frac{73}{73 + 24 + 91 + 24} 91 - 10 \frac{3 \parallel (73 + 24 + 91)}{2 + 3 \parallel (73 + 24 + 91)} \frac{91}{91 + 73 + 24}$$

$$-1, 91 \parallel [24 + 73 + 24] = -120.3393 \text{ V}$$

$$V_{FS} = 250 \text{ V} \quad R_{in} = \frac{250 \text{ V}}{20 \frac{\mu\text{A}}{\text{V}}} = 5,000 \Omega$$

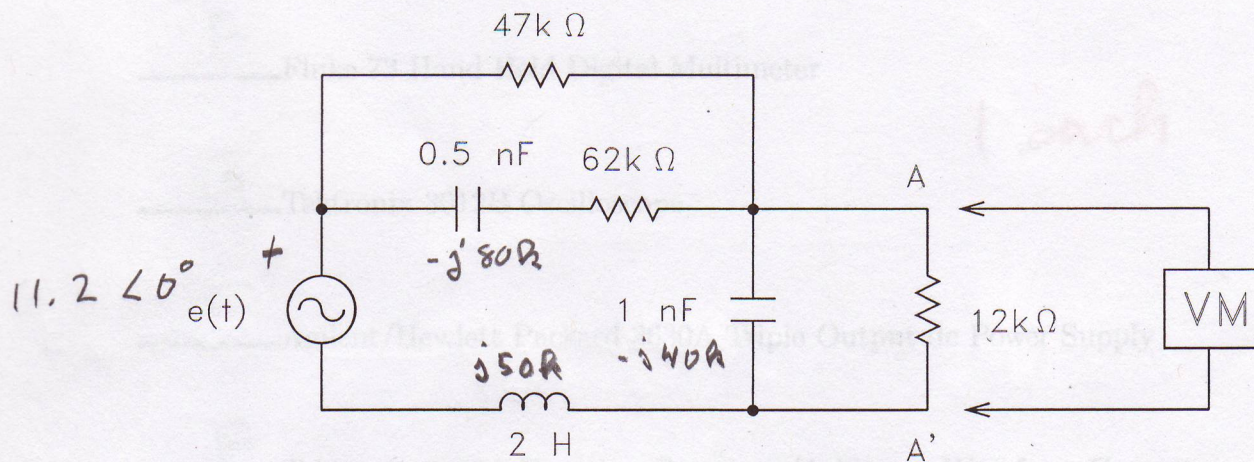
$$R_{th} = 91 \parallel [24 + 73 + 24] = 47.2315 \Omega$$

$$\% \text{ error} = -100 \frac{R_{th}}{R_{th} + R_{in}} = -0.9358 \%$$

S	$E_{th} =$	<u>-120 V</u>
S	$R_{th} =$	<u>47.2 <math>\Omega</math></u>
S	$\% \text{ error} =$	<u>-0.936 %</u>

10 try

3. Determine the percentage error due to ac voltmeter loading in the measurement of the rms magnitude of the ac voltage  $\bar{V}_{AA'}$  in the circuit shown below. Assume that the upper terminal of the voltage source is positive. The ac voltmeter is a Simpson Meter Model 260-7 set to the range just larger than the Thévenin voltage with respect to the voltmeter. The available ranges for the Simpson meter are 1 V, 2.5 V, 10 V, 50 V, 250 V, 500 V, and 1,000 V. The voltage source is  $e(t) = 11.2\sqrt{2}\cos\omega t$  V where  $f = 4$  kHz. As an intermediate step in the solution determine the Thévenin equivalent circuit with respect to the meter. Use rms phasors to solve the problem. Express all complex answers in polar form using degrees as the units for phase.



$$\bar{E}_{oc} = 11.2 \frac{12 \parallel (-j40)}{47 \parallel (62 - j80) + 12 \parallel (-j40) + j50} = 2.2 \angle -56.5737^\circ$$

$$V_{FS} = 2.5 \text{ V} \quad \bar{Z}_{in} = 5 \frac{\Omega \cdot \Omega}{\text{V}} \cdot 2.5 \text{ V} = 12.5 \Omega$$

$$\bar{Z}_{oc} = 12 \parallel (-j40) \parallel \left( (j50) + [47 \parallel (62 - j80)] \right) = 10.4172 \angle -6.3251^\circ \Omega$$

$$\% \text{ error} = 100 \left[ \frac{1}{\left| 1 + \frac{\bar{Z}_{oc}}{\bar{Z}_{in}} \right|} - 1 \right] = -45.36613\%$$

$$\begin{aligned} \bar{E}_{th} &= \underline{2.2 \angle -56.6^\circ \text{ V}} \\ \bar{Z}_{th} &= \underline{10.4 \angle -6.33^\circ \Omega} \\ \% \text{ error} &= \underline{-45.4\%} \end{aligned}$$

10 try

4. Indicate with an F (floating) or G (grounded) whether the following laboratory instruments input or output connectors are floating or grounded with respect to the ac power line ground

F Agilent/Hewlett Packard 34401A Digital Multimeter

F Hewlett Packard 3311A Function Generator

F Fluke 73 Hand Held Digital Multimeter

G Tektronix 3012B Oscilloscope

*1 each*

F Agilent/Hewlett Packard 3630A Triple Output dc Power Supply

F Tektronix 3022A Function Generator/Arbitrary Waveform Generator

F Simpson Model 260-7 Multimeter

F Fluke/Philips 6303 LCR Meter

The names of the three wires connected to a standard 120 Volt AC outlet are the hot wire which is covered with black colored insulation, the neutral wire which is covered with white colored insulation, and the ground which is covered with green colored insulation.

*2 each*

*5 try*

## ECE 3041 Lecture Exam 1 Spring 2012

