MEEN 2210 Electromechanical Engineering Systems Spring 2011

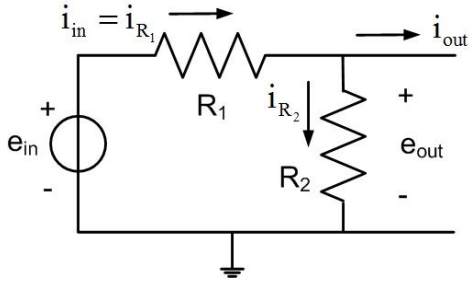
Class Quizzes #3 & #4 Class Period #8 February 14, 2011

Name: _____ Section: _____

Closed-Note, 40-Minute Quiz – **Answer each question succinctly**.

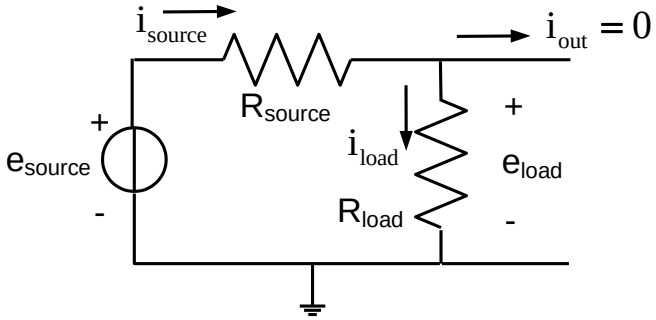
Point Values: Questions #1-12: 5 points each + Questions #13-17: 10 points each = 110 points

1. Once one identifies the specific physical system for investigation, what is the first step in the investigation process?
2. If pure and ideal elements are not real components, how do we use them?
3. What is the difference between a Law of Nature and a constitutive relation? Give an electrical example of each.
4. In general, how is the mathematical model obtained?
5. For the RC circuit differential equation $RC\dot{e}_{out} + e_{out} = e_{in}$,we represent it in the standard form $\tau\dot{e}_{out} + e_{out} = Ke_{in}$. Why?
6. Draw a diagram of a real voltage source. When does the real voltage source approximate the ideal voltage source?
7. Draw a diagram of a real voltage meter. When does the real voltage meter approximate the ideal voltage meter?
8. Use the D-operator notation and state the impedance of a resistor and a capacitor.
9. For the voltage divider shown, the 2 × 2 input-output matrix is given.. If the resistor R_2 is replaced with a capacitor C, how does the 2 × 2 matrix change? Show the result.



$$\begin{bmatrix} e_{out} \\ i_{out} \end{bmatrix} = \begin{bmatrix} 1 & -R_1 \\ \dfrac{-1}{R_2} & \dfrac{R_2 + R_1}{R_2} \end{bmatrix} \begin{bmatrix} e_{in} \\ i_{in} \end{bmatrix}$$

10. For maximum power transfer to occur between a source and a load in the diagram shown, what must the relationship be between R_{source} and R_{load}?



11. How does a capacitor behave at low frequency? How does a capacitor behave at high frequency?
12. State the difference in the energy characteristics between a resistor and a capacitor.
13. Why do resistors in series and capacitors in parallel combine according to the same formula?
14. How would you plot the equation $y = ae^{bx}$ so it appears as a straight line? Why is this important to know?
15. For the first-order differential equation $\tau\dot{e}_{out} + e_{out} = Ke_{in}$, sketch the unit step response showing on the sketch what τ and K represent.
16. For the first-order differential equation $\tau\dot{e}_{out} + e_{out} = Ke_{in}$, sketch the frequency response (amplitude ratio vs. frequency and phase angle vs. frequency) showing the bandwidth and its relationship to τ, the amplitude low-frequency asymptote and its slope, the amplitude high-frequency asymptote and its slope, and the phase angles at low frequency, bandwidth, and high frequency.
17. For the frequency response shown, sketch the relationship between the input and output sinusoids in amplitude and phase angle at a frequency of 3000 Hz.