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ECE 110  

October 6, 2014

Hour Examination #1

1) Write your official:
   Last Name (use capital letters):_________________________________
   First Name (use capital letters):______________________________
   NetID:________________________________________________
   UIN:____________________________________________________

2) Fill in the Orange bubble sheet with all the information requested:
   a. LAST NAME, FIRST INITIAL example: SCHMITZ C
   b. STUDENT NUMBER (UIN) example: 678912345
   c. SECTION (AL4 9am enter 444, AL1 10am - 111, AL2 1pm - 222, AL3 2pm - 333)
   d. NETWORK ID (NetID) example: cdschmit
   e. Also, fill out the hand-written center of the sheet with course, instructor, section and your signature.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD

A. Write or print clearly in this exam booklet for your own benefit. Circle the correct answer within the exam booklet and then mark it on the orange bubble sheet. You may not argue for points because you marked one answer in the exam and another on the bubble sheet, so be careful when marking your answers.

B. All problems are equally weighted.

C. Your grade will be determined based on the answers submitted on your bubble sheet. Submit both the bubble sheet AND the complete exam booklet.

Students caught cheating on this exam will earn a grade of F for the entire course. Other penalties may include suspension and/or dismissal from the university.

I have read and acknowledge the above statements. Furthermore, I promise not to give or receive help on this or any other exam.

________________________________________________________________________

Signature
You have TEST FORM:

A

Please enter this in the lower right corner of the orange bubble sheet in the location marked TEST FORM.
1. Which is not a main point of the IEEE Code of Ethics?
   a. Professional development
   b. Avoiding conflicts of interest
   c. Providing and accepting honest criticism
   d. Building financial success of the company
   e. Avoiding injuring others with malicious actions

2. A 60 kg student runs up 20 m of stairs in 24 seconds. The best estimate of the average power produced by the student during this 24 second exercise?
   a. 50 W
   b. 100 W
   c. 500 W
   d. 800 W
   e. 1.5 kW

3. Consider a moving hybrid car that has 600 kJ of kinetic energy. If regenerative braking recovers 20% of this energy when the car stops, what is the total charge added to the car’s 240 V battery?
   a. 250 C
   b. 500 C
   c. 1000 C
   d. 2000 C
   e. 2500 C

4. How many 4 µF capacitors charged to 100 V are needed to store the same amount of energy as two 4 µF capacitors charged to 200 V?
   a. One
   b. Two
   c. Four
   d. Eight
   e. Sixteen
5. What is the power consumed by an electromagnet’s coil with a 10 Ω resistance which is drawing 2 A of current?
   a. 0.4 W
   b. 2 W
   c. 4 W
   d. 20 W
   e. 40 W

6. What is the maximum voltage that can be applied across a 300 Ω resistor without risking damage, if the resistor’s maximum power rating is \( \frac{1}{4} \) W?
   a. 5 V
   b. \( 5\sqrt{3} \) V
   c. 10 V
   d. \( 10\sqrt{3} \) V
   e. 25 V

7. A thin 50 m wire has a 4 Ω resistance. Four of these wires are twisted together to make a thicker four-strand 50 m wire. What is the best estimate of the new wire’s resistance?
   a. 1 Ω
   b. 2 Ω
   c. 4 Ω
   d. 8 Ω
   e. 16 Ω
8. If \(v_2 = 0.7 \text{ V}, v_4 = 0.3 \text{ V}, v_5 = 0.5 \text{ V}\) in the circuit below, what is \(v_1\)?

- a. 0.1 V
- b. 0.5 V
- c. 0.8 V
- d. 1.0 V
- e. 1.5 V

9. If \(i_1 = -10 \text{ mA}, i_3 = 5 \text{ mA}, i_6 = 2 \text{ mA}\) in the circuit below, what is \(i_4\)?

- a. 2 mA
- b. 3 mA
- c. 5 mA
- d. 7 mA
- e. 13 mA
10. Which of the following KCL and KVL equations is incorrect for this circuit?

- a. \( I_1 = I_4 \)
- b. \( I_2 = I_3 + I_4 \)
- c. \( I_2 R_2 + I_3 R_3 - V_2 = 0 \)
- d. \( I_1 R_1 + I_2 R_2 + I_4 R_4 = V_1 \)
- e. \( V_1 - I_1 R_1 - I_3 R_3 - V_2 - I_4 R_4 = 0 \)

11. What happens to the brightness of light bulbs #2 and #3 when the switch is closed, thus connecting light bulb #1 to the circuit, in parallel with light bulb #2, as shown below? You may assume that all of the bulbs have the same resistance and that brightness increases when current increases (and brightness decreases when current decreases).

- a. #2 and #3 get dimmer
- b. #2 and #3 get brighter
- c. #2 and #3 are not affected
- d. #2 gets dimmer, #3 gets brighter
- e. #2 gets brighter, #3 gets dimmer
12. What is the value of resistance between $a$ and $b$?

a. $R = 245 \, \Omega$

b. $R = 81.7 \, \Omega$

c. $R = 35 \, \Omega$

d. $R = 23.3 \, \Omega$

e. $R = 20 \, \Omega$

13. What is the expression for resistance between $a$ and $b$?

a. $R = R_1 + R_2 + R_3$

b. $R = R_1 + \frac{R_2 R_3}{R_2 + R_3}$

c. $R = \frac{R_1 (R_2 + R_3)}{R_1 + R_2 + R_3}$

d. $R = \frac{R_3 (R_1 + R_2)}{R_1 + R_2 + R_3}$

e. $R = \frac{R_1 R_2 R_3}{R_1 + R_2 + R_3}$
14. What are the voltages $V_1$ and $V_2$ in the circuit below?

   a. $V_1 = 2 \text{ V}$ and $V_2 = 4 \text{ V}$  
   b. $V_1 = 3 \text{ V}$ and $V_2 = 3 \text{ V}$  
   c. $V_1 = 4 \text{ V}$ and $V_2 = 2 \text{ V}$  
   d. $V_1 = 6 \text{ V}$ and $V_2 = 6 \text{ V}$  
   e. Not enough info to tell

15. What are the values of the currents $I_1$ and $I_2$ in the circuit below?

   a. $I_1 = 10 \text{ mA}$ and $I_2 = 30 \text{ mA}$  
   b. $I_1 = 30 \text{ mA}$ and $I_2 = 10 \text{ mA}$  
   c. $I_1 = 40 \text{ mA}$ and $I_2 = 40 \text{ mA}$  
   d. $I_1 = 20 \text{ mA}$ and $I_2 = 60 \text{ mA}$  
   e. $I_1 = 60 \text{ mA}$ and $I_2 = 20 \text{ mA}$
16. What is the value of resistance R needed to make $V_o = 4.5 \, \text{V}$?

a. 3 kΩ  
b. 4.5 kΩ  
c. 6 kΩ  
d. 9 kΩ  
e. 18 kΩ

17. How much power is absorbed by the 6 Ω resistor if the voltage source supplies 60 W when it is connected to the resistors as shown?

a. 15 W  
b. 20 W  
c. 30 W  
d. 40 W  
e. 60 W

18. How can one describe the IV characteristics line of an ideal ammeter (aka ideal current meter)?

a. Horizontal line going through the origin  
b. Vertical line going through the origin  
c. Any line going through the origin  
d. Any horizontal line  
e. Any vertical line
19. Which is the correct IV equation for the circuit below?

a. \( I = \frac{1}{600} V - 0.02 \)
b. \( I = -\frac{1}{600} V + 0.02 \)
c. \( I = \frac{1}{200} V - 0.02 \)
d. \( I = -\frac{1}{200} V + 0.02 \)
e. \( I = -0.02 \)

20. If the open circuit voltage of a circuit containing a source and some resistors is measured at 8 V, while the current through the short circuit across the circuit is 400 mA, what would be the power absorbed by a 20 \( \Omega \) resistor placed across the terminals?

a. 3.2 W  
b. 1.6 W  
c. 0.8 W  
d. 0.4 W  
e. 0.2 W
21. What is the resistance of the Thevenin or Norton equivalent of the circuit C, which IV characteristics are plotted below?

![Circuit C with IV characteristics](image)

- a. 45 Ω
- b. 200 Ω
- c. 500 Ω
- d. 2000 Ω
- e. 5000 Ω

22. Find the Thevenin equivalent of a circuit below:

![Circuit with Thevenin equivalent](image)

- a. $V_T = 3.0 \text{ V}, R_T = 10 \Omega$
- b. $V_T = 2.4 \text{ V}, R_T = 10 \Omega$
- c. $V_T = 3.0 \text{ V}, R_T = 8 \Omega$
- d. $V_T = 2.4 \text{ V}, R_T = 1.6 \Omega$
- e. $V_T = 3.0 \text{ V}, R_T = 1.6 \Omega$
23. What is the node voltage $V_A$?

- 1.5 V
- 3.0 V
- 4.2 V
- 4.7 V
- 6.0 V
24. What is the ideal source current, $I_s$, for which the 12V ideal voltage source is neither supplying nor absorbing energy (its power is zero)?

a. 1.0 A  
b. 1.5 A  
c. 2.0 A  
d. 2.5 A  
e. 3.0 A

25. If a certain PWM waveform with a 20% duty cycle has an RMS voltage of 2 V, what will be the RMS voltage if the duty cycle increases to 60%?

a. 2 V  
b. $2\sqrt{2}$ V  
c. $2\sqrt{3}$ V  
d. 4 V  
e. 6 V