ET Mi 109: Electrical Engineering for Autonomous Exploration Robots

ET3033TU Circuit Analysis

Self-test

In the following, for each question, check those and only those statements that are correct.

1. Kirchhoff's current law is:
- ☐ always true provided the circuit has only ideal sources
- ☐ is only true for circuits for capacitors when the circuit is at rest. If the circuit is not at rest, the charging or discharging of the capacitor disrupts the current balance
- ☐ is only true when there are no controlled voltage sources
- ☐ is true with linear controlled sources but not with non-linear ones
- ☑ is true independent of the kind of sources and possible non-linearities of the circuit

2. Tick the expressions that are correct:
- ☑ $U = I \times R$
- ☐ $P = I^2 / R$
- ☑ $I = C\, dV / dt$
- ☑ $R = \rho\, L / A$

3. The output impedance of an ideal current source:
- ☐ Is always zero
- ☐ Can never be zero
- ☑ Is always infinite
- ☐ Can never be infinite
- ☐ Can neither be zero nor infinite
- ☐ Can't be known in general without knowing more details
- ☐ Depends on the rest of the circuit that is connected to the source

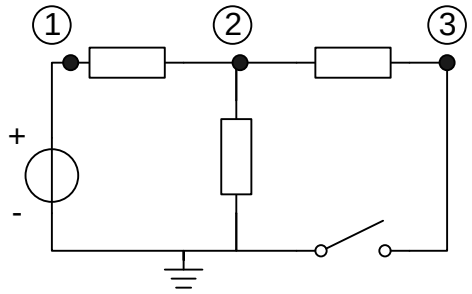
4. Consider the following statements, indicate which one is/are true:
- ☐ All circuits have Thévenin and Norton equivalent circuits
- ☐ All circuits have Thévenin and/or Norton equivalent circuits
- ☐ All linear circuits have Thévenin and Norton equivalent circuits
- ☑ All linear circuits have a Thévenin and/or Norton equivalent circuits
- ☐ For a circuit to have a Thévenin equivalent, it is sufficient that the voltage sources are linear.
- ☐ If a circuit has a Thévenin equivalent circuit, it cannot have a Norton equivalent, and vice-versa

Please, turn over for more questions

5. VCCS means
- ☐ Variable current control system

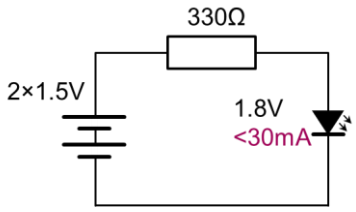
☑ Voltage-controlled current source
☐ Virtual-current color schematic
☐ Voltage-current control system

6. Consider the circuit on the right. The switch is initially open. When the switch closes, the effect on the voltages and the power delivered by the source is as follows (tick what applies)



	increase	decrease	Remains unchanged	Need component values to decide
V_{12}	X			
$V_{2\text{-GND}}$		X		
V_{23}	X (V_{23} was 0 and becomes $V_{2\text{-GND}}$)			
P_{source}	X			

7. You are given a LED and a number of 1.5 V batteries. All resistors from the E6 series (100, 150, 220, 330, 470, 680) are available. Design a circuit for this LED. What is the overall power dissipation and how much is wasted in the resistor? For the LED, the following is given (typical values): V_F=1.8V, I_{MAX} = 30mA



The source must supply at least 1.8V → the lowest number is 2x1.5V=3V. The excess 3-1.8=1.2V must be dissipated by a resistance. The maximum current is 30mA → all resistors are acceptable. For the chosen R=330Ω, I=1.2/330=3.6mA and $P_{dissipated}=1.2^2/330=4.4$mW.

My confidence level with these 7 questions:

☐ Completely or almost sure
☐ Not completely, but sufficient
☐ 50/50
☐ I was guessing for some of the questions
☐ I was guessing for most of the questions