02/19/03

EECS 42 – Introduction to Electronics for Computer Science

Spring 2003, **Prof. A. R. Neureuther**
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Problem Set # 5 Due 2:30 PM Feb 26th, 240 Cory

Reading: Week #5 Section 2.3, 2.5, 2.6 Schwarz and Oldham. Node Analysis. Week #6 Applications of Node Analysis and Digital Logic. **Wed 2/26 Quiz**. **Midterm 3/5.**

5.1 Basic node equations. Consider the circuit in Fig. P5.1.

a) Write equations for the unknown voltages V_b and V_c.
b) Simplify the circuit by combining R_1 and R_3 and write a node equation for node V_c.
c) Show that the equations in a) give the same equation in b).
d) Use the equation in b) and the values given to find V_c.
e) Find the value of voltage V_b.

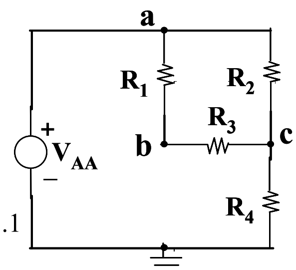

Fig. P5.1

$V_{AA} = 3V$
R1 = 1kΩ
R2 = 2kΩ
R3 = 3kΩ
R4 = 4kΩ

5.2 Node equations with a supernode. Use the circuits in Fig. P5.2.

a) Write a node equation for V_a in circuit 5.2a.
b) Solve for the voltage V_a.
c) Write a node equation for V_b in circuit 5.2b.
d) Solve for the voltage V_b.

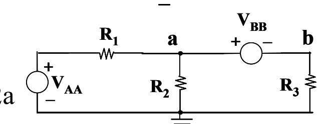

Fig. P5.2a

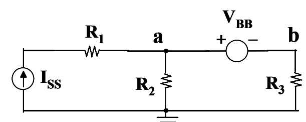

Fig. P5.2b

$V_{AA} = 2V$
$V_{BB} = 1V$
R1 = 1kΩ
R2 = 2kΩ
R3 = 3kΩ
Iss = 1 mA

5.3 Advanced circuit. The circuit in Figure P5.3 cannot be simplified by combining resistors in series or parallel. This circuit is known as the Wheatstone bridge and is the symbol of the EECS HKN Honor Society.
It is used to measure ratios of resistors as shown in part d).

a) Write node equations for V_a and V_b.
b) Using the vlues given solve for the voltage V_a.
c) Using the vlues given solve for the voltage V_b.
d) Use a voltage divider approach to show that when $\frac{R_1}{R_2} = \frac{R_3}{R_4}$, $V_a = V_b$ and there is no current through R_5.

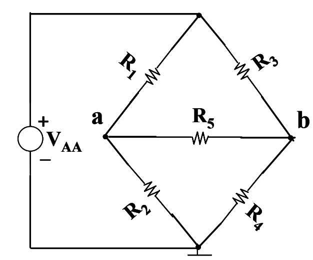

Fig. P5.3

$V_{AA} = 3V$
R1 = 1kΩ
R2 = 2kΩ
R3 = 2kΩ
R4 = 4kΩ
R5 = 5kΩ

5.4 Self Quiz 10 minutes: Basic Circuit Analysis. Use the circuit in Fig. P5.4.

a) Find V_b.
b) Find the Thevenin resistance seen looking into the output terminals.

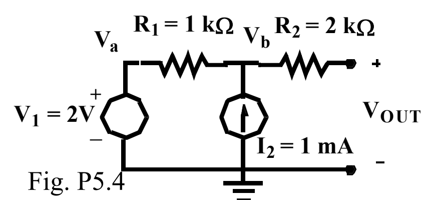

Fig. P5.4

5.5 Self Quiz 10 minutes: Transients. Use the circuit in Fig. P5.5. The switch in the circuit is opened at t = 0. Find an equation for the voltage on the capacitor as a function of time $V_C(t)$.

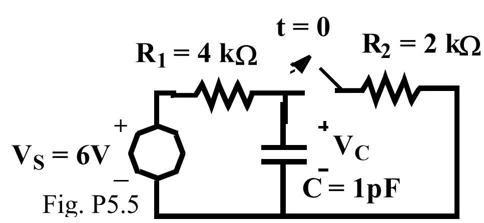

Fig. P5.5