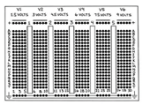
Pratt



MSCI 222C – Fall 2021
Introduction to Electronics

Charles Rubenstein, Ph. D.
Professor of Engineering & Information Science

Session 4: Tues 09/28/2021
Tuesdays 5:00-7:50pm
Online – *Revision 2*

Not Permitted in Class

Be sure to have all cellphones **OFF**
(unless used as calculator…)
Although NOT required
please turn on your cameras

 2

21 Fall Class Roster : 222C-01 (TUES 5pm)

MSCI222C – 01 Intro to Electronics

Last Name	First Name	Call Me	Time Zone
Bhargava	Mehul	MEHUL	ET
Briggs	Darius	DARIUS	ET
Chen	Yian	YIAN	ET
Ferreris	Angelica	ANGIE	ET
Gomez	Vladdimir	VLADDY	ET
Li	Xiaokun	BROOK	"+12"
Lin	Zili	ZILI	ET
Nam	Hae Ji	LYLA	"+13"
Park	Dong Jun	GEORGE	ET
Tolentino	Lenard Christian	LENARD	ET
Yu	Quin	GLORIA	"+12"
Zhong	Hanxiao	HAN	"+12"
Zhou	Amy	AMY	ET

 3

Instructor Contact Information

Dr. Charles Rubenstein <crubenst@pratt.edu>
Professor of Engineering & Information Science
Brooklyn Campus Faculty Office: ARC G-49

Fall 2021 VIRTUAL Office hours ONLY
Thursdays: **10:00am - 1:00pm *Via Zoom***
Meeting ID: 569 176 2059
Passcode: Office

To make your appointment Send me an email at least one day in advance:
crubenst@pratt.edu
Subject line: 222 Office Hour

 4

US Citizens – Student Alert!

To vote in November you must register. Contact dkahn@nypirg.org

 5

MSCI 222C – Fall 2021 - *ONLINE Schedule*

TUESDAY	NOTES
31 August (1)	Session 1. Introduction, Review of Syllabus, Basic Concepts
7 September	*NO CLASSES – Instructor's Religious Holiday*
14 September (2)	Session 2. Basic Electronic Devices (Homework #1 Due)
21 September (3)	Session 3. Semiconductor Materials & Semiconductor Diodes (H2, R1)
28 September (4)	Session 4. Transistors as Switches and Amplifiers (H3, R2, L1) *Paper Topic Due*
5 October (5)	Session 5. Analog and Digital Concepts (H4, R3, L2)
12 October	*NO CLASSES – PRATT FALL BREAK*
19 October (6)	Session 6. The Operational Amplifier (H5, R4, L3) *Midterm Draft Paper Due*
26 October (7)	Session 7. Digital Integrated Circuit Logic Gates (H6, R5, L4) *Paper Returned*
2 November (8)	Session 8. Flip-Flops & "Clocks" (H7, R6, L5) *Midterm Exam – 10/31*
9 November (9)	Session 9. Digital Counters (H8, R7, L6) *Exam Reviewed*
16 November (10)	Session 10. Digital Shift Registers (H9, R8, L7)
23 November (11)	Session 11. Using Analog & Digital ICs Together (H10, R9, L8) *Final Paper Due*
30 November (12)	Session 12. Interfacing Computers and Embedded Devices (R10, L9) *Paper Returned*
7 December (13)	Session 13. Review of Coding Basics and RFID Concepts (L10) *Paper Due*
14 December (14)	Session 14. - FINAL Exam

NOTE: Class is ONLINE – delay in setting up homework quizzes on Canvas…
Quizzes one week after homework session reviewed
Labs 1 through 5 are electronics measurement labs.
Beginning with Session 9 – Arduino Labs with Instruction/IDE Installation, etc.

 6

MSCI 222C – *Class Readings Schedule*

Session	Readings
2	***EW1**: Pp 1 - 27; **Armstrong**: Chapters 1 - 3*
3	***EW1**: Pp 28 - 65; **Armstrong**: Chapters 4 - 6*
4	***EW1**: Pp 66 - 76; **Armstrong**: Chapters 7 - 9*
5	***EW1**: Pp 77 -End; **Armstrong**: Chapters 10 - 11*
6	***EW2**: Pp 1 - 50 and Page 90; **Armstrong**: Chapters 12 - 13*
7	***EW2**: Pp 51 - 79, Review Page 12; **Armstrong**: Chapters 14 - End*
8	***EW2**: Pp 80 - End, Review Page 12 (**CD4013**, **CD4017**)*
9	***EW2**: Review Page 12 (**CD4013**, **CD4017**)*
10	***EW2**: Review Page 37 (**555 Timer**)*
11	*Review **EW1** and **EW2** as necessary, **Sensors** Lab Manual – if interested*
12 and on	*Review **EW1** and **EW2** as necessary*

KEY	
	EW1 = Basic Electronics: Transistors and Integrated Circuits, Workbook I by Forrest M. Mims, III (ew1.pdf)
	EW2 = Digital Electronic Projects, Workbook II by Forrest M. Mims, III (ew2.pdf)
	Armstrong = Man of High Fidelity (armstrong2.pdf)
	Sensors = Radio Shack Electronic Sensors Lab by Forrest M. Mims, III (sensors.pdf)

 7

In Today's Class: Session #4

DUE: Research Paper Topic;
DUE: **Homework Set #*03* (Quiz #03)***
Readings: **Electronics Workbook 1 (ew1.pdf): Pp 66-76**
Armstrong: Chapters 7-9
Lecture: **Transistor Switches and Amplifiers**
Reviewed: **Homework Set #*02***
To Do: **Pick up Learning Kit *(Meter plus Envelope) Next Week!***

Assignments now DUE by 12:00Noon ET MONDAYS!!!

For our next class – Session Five:
DUE: **Homework Set #*04* (Quiz #04)***
Readings: **Electronics Workbook 1 (ew1.pdf): Pp 77-end**
Armstrong: Chapters 10-11
Lecture: **Analog and Digital Concepts**
Reviewed: **Homework Set #*02***
To Do: Hands-on Module #01: ***Measuring Resistance and Voltage***
(*) NOTE: Filenames must be lastname_hwk0#.docx, etc.)

 8

Class Session Archives

www.CharlesRubenstein.com/222

TermPaper.pdf
Info on your Term Paper

Photo2Doc_Process.pdf
How to convert photo into doc file

21fa04.pdf *(this slide set)**

21fa04_h.pdf *(slide set as handouts)**

**Available by Thursday evenings…*

 9

Revised MSCI 222C Hands-on Lab Modules

#01: Measuring Resistance and Voltage
#02: Voltage Sources, LEDS, Diodes & Characteristic Curves

NEW VERSIONS OF THESE AS WELL AS ARDUINO LABS:
#03: Capacitors, Time Constants & Transistor Gain
#04: Voltage Regulation & Transistor Switching
#05: Analog IC Voltage Comparator
#06: Basic Digital Logic
#07: Set-Reset Latches & Type "D" Flip-Flops
#08: Decade Counter and 'One Shot' Switch Debouncer
#09: NE555 IC Timer Circuits
#10: Seven Segment Display Decoder-Driver Circuit
Arduino Labs #1 through #?

 10

Questions?

 11

IV. Supplemental Materials

The Pratt Electronics Learning Kit

The kit contains a Digital Multimeter and special leads, a power supply, and an Arduino Basic Startup Kit.

If you are local to Pratt you will be instructed when/where to pick up your kit.

If you are outside of the US…

We have other arrangements which have been emailed to you which review what you need to do to get reimbursed for a kit for your hands-on lab modules. ***Please try to obtain these LOCALLY so you can begin the lab by end of September.***

 12

The Pratt Electronics Learning Kit

Pick up your Electronics Learning Kit NEXT WEEK in ARC G-39

Name of Item	US$ Cost	Part URL:
Digital Multimeter	6.99	https://www.harborfreight.com/7-function-digital-multimeter-63759.html
HiLetgo Red/Black 4MM Banana Plug to Test Hook Clip Test Lead (3 pairs – you only receive ONE!)	7.39	https://www.amazon.com/dp/B073SP3G6D
ELEGOO UNO Project BASIC Starter Kit	17.99	https://www.amazon.com/dp/B01DGD2GAO
9VDC @ 1Amp Power adapter	6.99	https://www.amazon.com/dp/B018OLREG4
JBtek Breadboard Power Supply Module 3.3V/5V	6.99	https://www.amazon.com/dp/B010UJFVTU

The Elegoo Arduino Starter Kit

EL-KIT-004 Elegoo Arduino Basic Starter Kit Component listing:

UNO R3 Controller Board and USB Cable
1pcs Breadboard
1pcs 65 Jumper Wires and 5pcs Female-to-male DuPont Wire
1pcs 74HC595 (*8-bit Serial IN, Parallel OUT Latching Shift Register Integrated Circuit*)
1pcs EACH: Active Buzzer and Tilt Switch
1pcs Photoresistor
5pcs EACH: Red, Yellow, Green, Blue and White LEDs
1pcs RGB LED
5pcs SPST Button (small)
10pcs Resistor (10R = 10 Ω)
10pcs Resistor (100R = 100 Ω)
10pcs Resistor (220R = 220 Ω)
10pcs Resistor (330R = 330 Ω)
10pcs Resistor (1K = 1,000 Ω)
10pcs Resistor (2K = 2,000 Ω)
10pcs Resistor (5K1 = 5,100 Ω)
10pcs Resistor (10K = 10,000 Ω)
10pcs Resistor (100K = 100,000 Ω)
10pcs Resistor (1M = 1,000,000 Ω)

Questions?

V. Method of Assessment & Grading

Hands-on Lab Work **40%** ***(4% each)***
Ten Homework Quizzes **20%** ***(2% each)***
MidTerm Exam **10%**

Research Papers:

MidTerm Review of Paper **10%**
(Proposal 5%; Draft 5%)
Final Paper **20%**
(Draft 5%, Final Paper 10%, Bibliography 5%)

Submitting Your Assignments

Homework Set #XX **as well as all other submissions are due to me, via email, not later than 12:00pm Noon ET MONDAY the day before class.**

The filename for homework submissions is:
lastname_hwkXX.doc* or *lastname_hwkXX.docx* or *lastname_hwkXX.pdf

The filename for the Midterm Exam is:
***lastname_midterm.doc* (etc.)**

The filename for the various Paper submissions is:
***lastname_topic.doc* (etc.)**

NOTE: ***If you are creating hand-written pages as a picture, please see the instructions on the next page and in the file: Photo2Doc_Processing.pdf***

V.a. Hands-On Labs

Hands-on Lab Work **40% (4% EACH)**

Hands-on work involves actually wiring of working electronic circuits without soldering. The hands-on work score is based on completion of the hands-on work opportunities.

Student grades are not downgraded for requesting help, so if try 2 or 3 or 4 works - full credit is earned.

There are ten (10) *REQUIRED* and up to two (2) *OPTIONAL* labs.
Optional Labs are worth an additional 5% each!
Also see POLICIES in the Syllabus.

Special Note:
Lab work will ONLY be accepted up to the week before the last week of classes

V.b. Homework, Quizzes & Midterm

Homework Quizzes 20%

HOMEWORK IS DUE NOT LATER THAN 12:00Noon ET ON THE MONDAY BEFORE OUR CLASS SESSION

There will be a Quiz on one homework problem worth 2%

Homework quizzes count for 20% of your final grade.

- *Homework assignments MUST be emailed to me not later than 12:00pmNoon ET the **MONDAY** before our class.*
- I will grade one question on the week's homework as a 'quiz'.
- *Homeworks will be reviewed the week they are due, **thus if NOT emailed to me, they will receive a grade of 0%.***

NOTE: There are no make up quizzes or exams.

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About the Midterm Exam

Two hour Midterm Exam (10%)

This will be an Exam on electronics theory and common calculations in analog electronics – similar to homework – covering Ohm's Law, voltage dividers, power, resistors, diodes, transistors, etc., emailed to all not later than **9:00am ET** on **Sunday 31 October** and due back to me by email not later than **1:00pm ET** on that same day.

NOTE: These will be the Same DUE date/times for BOTH US and International Students

The filename for the Midterm Exam is:
lastname_midterm.doc* or *lastname_midterm.docx* or *lastname_midterm.pdf

 20

V.c. Midterm Research Paper (10%)

This is a term paper on an electronic component, device or system you are interested in.

The DRAFT 'midterm' paper consists of:

1. *3-page Draft paper.*
2. *PLUS one additional bibliography page - with **four or more** references.*

*DEADLINE (Due not later than 12:00pmNoon ET **MONDAYS**)*

- *Proposed Paper Topic Paragraph Due **(5%): 9/28***
- *3-page Midterm Draft Paper Due **(5%): 10/18***
- *Returned with my Comments: **10/25***

The filename for the various Paper submissions is: *lastname_topic.doc* (rtf, docx, etc.)

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21 Fall Term Paper Topics

MSCI222C – 01 Intro to Electronics

As of 12:00pm Noon ET 28 September

Last Name	First Name	Call Me	Topic
Bhargava	Mehul	MEHUL	Resistors
Briggs	Darius	DARIUS	AM and FM Radio
Chen	Yian	YIAN	3D Printers/Augmented Reality
Ferreris	Angelica	ANGIE	NFTs
Gomez	Vladdimir	VLADDY	Elektrosluch 3+
Li	Xiaokun	BROOK	*Yet Not Submitted*
Lin	Zili	ZILI	Temperature Sensors
Nam	Hae Ji	LYLA	Interactive Sensors
Park	Dong Jun	GEORGE	Virtual Reality
Tolentino	Lenard Christian	LENARD	LED Strips
Yu	Quin	GLORIA	Controlling LEDs
Zhong	Hanxiao	HAN	Ohm's Law
Zhou	Amy	AMY	Transistors

 22

V.d. Final Research Paper (20%)

*This is a **continuation** of your midterm paper.*

The SIX (6) page draft paper final materials consist of:

1. *Revised and expanded Midterm Paper*
2. *Plus a bibliography page - with **four or more** references - NOT included in the page count above.*

*DEADLINE (Due not later than 12:00pmNoon ET **MONDAYS**)*

- *6-page Final Paper Draft Due **(5%): 11/22***
- *Returned with my Comments: **11/29***
- *Final Paper Due: **12/6***
  (Final Paper 10%, Bibliography Page 5%)

The filename for the various Paper submissions is:
lastname_Draft.doc* (docx, rtf, etc.) *or
***lastname_Final.doc* (docx, rtf, etc.)**

 23

Questions?

 24

MSCI 222C Electronics Review

The basics are essential

Ohms Law
eMath Calculations
Combining Resistors
Voltage Divider Equation

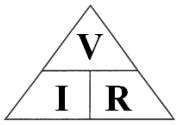
 25

Ohms Law

There are three forms for the Ohms Law equation:

V = I R
R = V / I
I = V / R

and a convenient figure to remember it by…

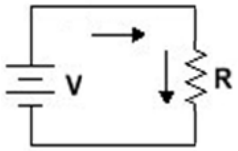


 26

About Electronics Math Calculations…

Ohms Law equation: **V=IR**

and **I = V / R**



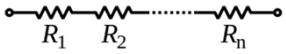
1. *If* **R is 1 Ohm = 1 Ω and V is 1 volt:**
   then *I* = *1 Ampere*
2. *If* **R is 1MΩ = 1,000,000 Ω and V is 1 volt:**
   then *I* = *1 microampere* = *(1 uA = 1 μA)*

3. *If* **R is 1k Ohm = 1kΩ = 1000Ω and V is 1 volt:**
   then *I* = *1 milliampere* *(= 1 mA)*

This is the most common calculation for our labs…

 27

Series Resistors: REVIEW



1. Resistors in SERIES add

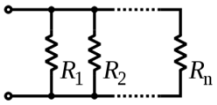
$$R_{ab} = R_1 + R_2 + \ldots + R_n$$

2. For 'n' Like Resistors in SERIES:

$$R_{ab} = n \cdot R$$

 28

Parallel Resistors: REVIEW



1. The Inverse of Resistances in PARALLEL add

$$1/R_{ab} = 1/R_1 + 1/R_2 + \ldots + 1/R_n$$

2. For TWO Resistors in Parallel;

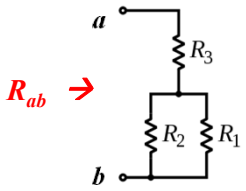
$$R_{ab} = R_1R_2/(R_1 + R_2)$$

3. For 'n' Equal Resistances in Parallel;

$$R_{ab} = R / n$$

 29

Simple Series/Parallel Resistor Circuits

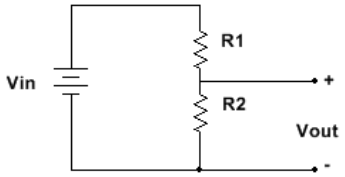


The Equivalent Resistance of the circuit above:

$$R_{ab} = [\, R_1R_2/(R_1 + R_2)\,] + R_3$$

 30

The Voltage Divider Equation



The Voltage Divider Equation

$$Vout = Vin\ [\ R_2 / (R_1 + R_2)\ ]$$

When a voltage is applied to two (or more) resistors in series, the voltage across a particular resistor is the applied voltage times the selected resistor, divided by the sum of the resistors

 31

Kirchhoff's First Law: KCL, the Current Law

KCL: Kirchhoff's First Law

We call **X** and **Y** 'nodes.'

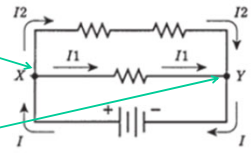
Kirchhoff noted that ***the current into node X*** *(or node **Y**)* *is the* ***same as the current out of that node***:

KCL@ node x:

$$I = I_1 + I_2$$

KCL@ node y:

$$I_1 + I_2 = I$$



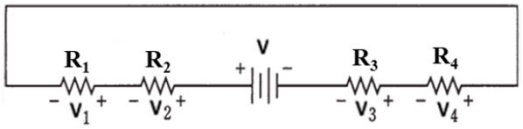
 32

Kirchhoff's Second Law: KVL, the Voltage Law

Consider what you already learned about ***series circuits***:

The *voltages across* all the individual resistors (R_1 R_2 R_3 R_4) add up to the supply voltage. **BUT** the polarities of the EMFs across the resistors are opposite to that of the battery.

It becomes clear when a series circuit is drawn with all the components, including the battery source, in line with each other:



The sum of all the voltage rises and voltage drops = zero

$$\text{KVL} \rightarrow (-V_1) + (-V_2) + V + (-V_3) + (-V_4) = 0$$

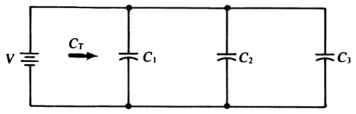
 33

Capacitors in Parallel

Although we will **not** go through the mathematics at this time, note that the capacitor symbol shows two separated plates.

It makes sense then to consider the connection of two or more capacitors in PARALLEL would yield more plate area and thus it makes sense that **Capacitor Values in Parallel ADD**

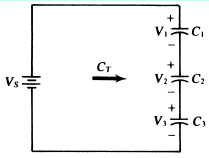
(in the same way resistors add in series):



$$C_T = C_1 + C_2 + C_3$$

 34

Capacitors in Series



As with resistors in parallel,

for "**n**" capacitors in series ***their inverses add***:

$$1/C_T = 1/C_1 + 1/C_2 + \ldots + 1/C_n$$

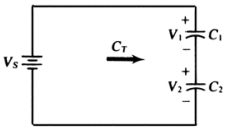
And the equivalent capacitance for "**n**" ***equal valued capacitors*** in series is **1/n** times the individual value of capacitance:

$$C_T = C_1/n$$

 35

TWO Capacitors in Series

Similarly, when capacitors are connected in SERIES their voltages add but the current is the same, again, without doing the math, let's accept that **Capacitor values in Series are calculated in the same way as resistors in parallel**…



For two capacitors in series, the product of their values over the sum of their values equals the effective capacitance:

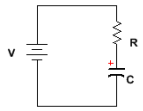
$$C_T = (\ C_1 \bullet C_2\ ) / (\ C_1 + C_2\ )$$

 36

τ - Charging a Capacitor

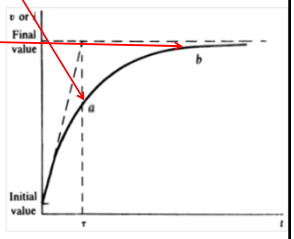
$$\tau = R\,C$$

For any given ***RC*** combination, after **one Tau (τ)** the capacitor voltage will reach ***63% of V*** (point **a** in Figure 11).



After ***5 x Tau*** (***5τ***) the capacitor voltage will exceed ***99% of V*** (point **b** in Figure 11).

In other words:
a capacitor will be more than half charged in one Tau and for all practical purposes will be seen as fully charged after 5 Tau.



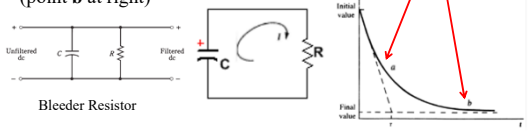
 37

Discharging Capacitors: Tau (τ)

When a capacitor is initially charged to some voltage $V_{initial}$ and is allowed to discharge into a resistor **R**, once again

Tau = $\tau = R\,C$ controls the timing.

After ***one Tau*** the capacitor voltage will be down to **37% of Vinitial** (point **a** at right) and after ***5 Tau*** it will be less than **1% of Vinitial** (point **b** at right)



Bleeder Resistor

Figures 12. Capacitor Timing When DISCHARGING (*into R w/no Voltage source*)

The capacitor will be more than half discharged after one Tau and for all practical purposes fully discharged after 5 Tau.

 38

Time Constant NOTES

The time required to charge or discharge a capacitor requires calculating:

$$\tau = R \bullet C$$

With: τ in seconds,

R in ohms, and

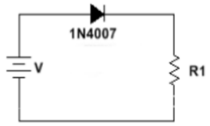
C in Farads

 39

Forward/Reverse Biasing of Diodes REVIEW

Semiconductor diodes have the ability to pass the flow of current in only one direction. This occurs when the diode is

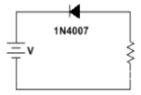
Forward Biased:



$I_{R1} \approx V / R_1$

$I_{R1} = (V - 0.6) / R_1$

Similarly, semiconductor diodes have the ability to block the flow of current in one direction. This occurs when the diode is **Reverse Biased**:



$I \approx 0$

 40

Diode Circuit Problems - 1

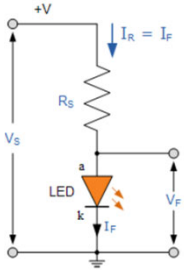
Basic Ohms Law Calculation: $R_S = (V_S - V_F) / I_F$

1. What is R_S if $V_S = 5$ *and* $V_F = 2$ volts @ 10 mA:

$R_S = (V_S - V_F) / I_F$

$R_S = (5v - 2v) / 10mA$

$R_S = 3 / 10x10^{-3} = 3 / 0.010 =$ **300 ohms**



2. If $R_S = 100$ ohms, what is I_F :

$R_S = (V_S - V_F) / I_F$ ***and thus,***

$I_F = (V_S - V_F) / R_S$

$I_F = (5v - 2v) / 100 = 0.030A =$ **30mA**

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Diode Circuit Problems - 2

Now consider a three LED Circuit

Once again, using Ohms Law:

$R_S = (V_S - V_{LED}) / I_F$

If $V_F = 1.2$ *volts*

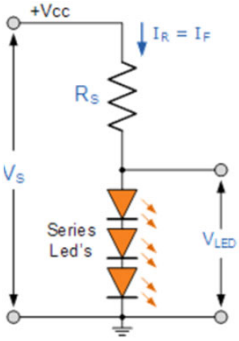
then $V_{LED} = [3 \times 1.2v]$

and therefore

$R_S = (V_S - [3.6]) / I_F$

If we knew I_F and V_S

we could calculate R_S



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Questions?

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MSCI 222C Electronics

Homework #02 / Quiz #02
Resistors in Series & Parallel

Average Grade: %
(does not include those NOT submitting their work)

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Homework 2.A Armstrong Questions

Armstrong Reading Questions:

2.A1) What was Armstrong's Mother's maiden name?

Page 7:

Armstrong's Mother's maiden name was ***Emily Smith***

2.A2) By 1917, Armstrong was receiving invention royalties of about $500/month (*same buying power as $10,350/month today*!). What circuit was this for?

Page 2:

The royalties were from amateur radio operators using Armstrong's ***Regenerative/Feedback Amplifier Circuit***

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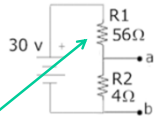
Homework 2.B1

2.B1) Find the voltage from **a** to **b** (across $\mathbf{R_2}$) in Figure 1, *on the right*, using the voltage divider equation.

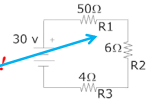


$$V_{R2} = R_2 \bullet (V / [R_t])$$

$$V_{R2} = 4 \text{ ohms} \bullet (30 \text{ volts} / [56+4] \text{ ohms})$$

$$V_{R2} = 4 \bullet (1/2) \text{ volt-ohms} / \text{ohms} = 2 \text{ Volts}$$

Compare HW#2 Figure 1 to HW#1 Figure 4 until it is clear to you why the answer to HW#1.4b must be the same as the answer to HW#2.1 here.



HWK 1 Figure 4 has a 50 ohm and 6 ohm in series with the 4 ohm resistor: 50+6 = 56 ohms !

Thus the circuits are the same with $R_1 + R_2$ of Fig. 4 = R_1 of Fig. 1 above, and R_3 of Fig. 4 = R_2 of Fig. 1

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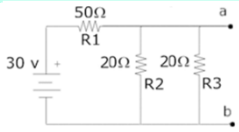
Homework 2.B2

2.B2a) Find the ***current*** leaving the **30V source** in Figure 2, *on the right*.

(Hint-start by combining the two **20 ohm** resistors).



$$R_2 // R_3 = [(R_2 \bullet R_3)/(R_2 + R_3)] = (400/40) = 10 \text{ Ohms}$$

$$R_T = R_1 + [R_2 // R_3] = 50 + 10$$

$$R_T = 60 \text{ Ohms}$$

Using **Ohms Law:**

$$I_t = V / R_t = 30 \text{ volts} / 60 \text{ Ohms} = 0.5A \ (= 500 \text{ mA})$$

2.B2b) Now find the voltage from **a** to **b** (across $\mathbf{R_3}$)

$$V_{R3} = I_t \bullet [R_2 // R_3] = 0.5A \bullet 10 \text{ ohms}$$

$$V_{R2} = 5 \text{ Volts}$$

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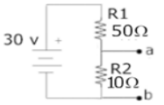
Homework 2.B3

2.B3)Find the voltage from **a** to **b** (across $\mathbf{R_2}$) in Figure 3 using the voltage divider equation.



$$V_{R2} = R_2 \bullet (V/R_t)$$

$$V_{R2} = 10 \text{ ohms} \bullet (30 \text{ volts} / [50+10] \text{ ohms})$$

$$V_{R2} = 10 \bullet (1/2)$$

$$V_{R2} = 5 \text{ Volts}$$

Then examine & compare Figures 2 and 3 until it is clear to you why the answer to #2b must be the same as the answer to #3.

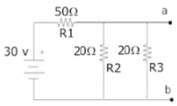


Figure 3 is the same as Figure 4 after we combine the two parallel resistors, R_2 and R_3.

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Homework 2.C4

2.C4) Find the power dissipated in a **130 ohm** resistor carrying **60mA** (*recall that **1 mA = 0.001 Amp***).

Using the Power Law Formula:

$$P = I^2R$$

$$P = (0.060\ Amps)^2 \times 130\ Ohms$$

$$P = 0.0036 \times 130$$

$$P = 0.468\ Watts = 468\ mW$$

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Homework 2.C5

2.C5a) (3 Points)

Find the power dissipated in a **100 ohm** resistor carrying **60mA** (*recall that **1 mA = 0.001 Amp***).

$$P = I^2R = (0.060\ Amps)^2 \times 100\ Ohms$$

$$P = 0.0036 \times 100$$

$$P = 0.360\ Watts = 360\ mW$$

2.C5b) (3 Points)

Is this power level within the ratings of a **1/2 watt** resistor?

(**Yes**, No)

BUT, barely as 50% of power rating = 250 mW, is the preferred maximum value

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Questions?

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MSCI 222C Electronics

Hands-On Lab
Module 1:
Measuring Resistance and Voltage
POSTPONED UNTIL NEXT WEEK!

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In Class Session #5

Assignments now DUE by 12:00Noon ET MONDAYS!!!

DUE and Reviewed: **Homework Set #*04* (Quiz #04)**
Readings: **Electronics Workbook 1 (ew1.pdf): Pp 77 - end**
Armstrong: Chapters 10-11
Lecture: **Analog and Digital Concepts**
Reviewed: **Homework Set #*03, #04***
To Do: Hands-on Module #01: ***Measuring Resistance and Voltage***

12 OCTOBER – MIDTERM BREAK – NO CLASSES

In Session 6:
DUE and Reviewed: **Homework Set #*05* (Quiz #05); Lab #01**
Readings: **Electronics Workbook II (ew2.pdf): Pp 1 – 50, Page 90**
Armstrong: Chapters 12-13
Lecture: **Operational Amplifier Concepts**
To Do: Hands-on Module #02: ***Voltage Sources, LEDs, Characteristic Curves***

NOTE: Hands-on Module #03+: ***Under Development, to be distributed***

(*) NOTE: Filename must be lastname_hwk0#.docx, etc.)

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Any Questions?
Send me an email …

crubenst@pratt.edu

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End

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