



# <u>Engineering M20 Syllabus</u> Moorpark College

Fall 2021

Fridays 4-7 pm Lecture (CRN 70123) Fridays 7-10 pm LAB (CRN 70146)

Instructor: Hadi Darejeh

805-907-8526 Cell

Office Hours: Same day after class

**Textbook:** Introduction to Electric Circuits 9<sup>th</sup> edition by Svoboda/Dorf

Locations: Physical Sciences 207

Free Program required:

https://www.ema-eda.com/products/cadence-orcad/orcad-academic-

program?utm\_source=google&utm\_medium=cpc&utm\_campaign=SEM\_OrCAD\_Training&\_bk =orcad%20for%20students&\_bt=388026863982&\_bm=e&\_bn=g&\_bg=62658746852&gclid=Cj wKCAiAuoqABhAsEiwAdSkVVIu4v6AEp3oSTg6KEe\_qucrvcRfDFjQvqJm4y\_z0ShaOa8f6ej-K8hoCxQYQAvD\_BwE

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## Grading :

Quiz #1	25%
Quiz #2	25%
Homework	20%
Final exam	30%

The grading scale will closely follow the traditional 90+% = A, 80-89% = B, 70-79% = C, etc. 60-69% = DHomework is assigned weekly and due the following week.



# ENGR M20 INSTRUCTOR: Hadi Darejeh Ph# (818) - 586 - 0216

Page 1 of 3

WEEK #	CHAPTERS	HOMEWORK PROBLEMS
1	1.Electric circuit variables	HW set 1 worth 20 pts.
1	2. Circuit elements	HW included in HW set1
2	3.Resistive circuits	HW set 2 worth 20 pts.
3	4. Methods of analysis of resistive circuits	HW set 3 worth 20 pts.



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Page 2 of 3

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WEEK #	CHAPTERS	HOMEWORK PROBLEMS WITH ANSWERS
4&5	5. Circuit theorems	HW set 4 worth 20 pts.
6	6. Operational Amplifiers	HW set 5 worth 20 pts.
7	7. Energy storage elements	HW set 6 worth 20 pts.
8	8. The complete responses of RL and RC circuits	HW set 7 worth 20 pts.
9	9. The complete responses of circuits with two energy storage elements	HW set 8 worth 20 pts.



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Page 3 of 3

WEEK #	CHAPTERS	HOMEWORK PROBLEMS WITH ANSWERS
10	10. Sinusoidal Steady- State Analysis	HW set 9 worth 20 pts.
11	11. AC steady-state Power Analysis	HW set 10 worth 20 pts.
12	12. Magnetically Coupled Circuits	HW set 11 worth 20 pts.

Additional Chapters will be assigned later on this semester.

# <u>HW set 1 for CH1 and CH2 (20 pts), 5 problems. Perform HWs on</u> separate sheets, not on this handout. Show work and draw a box around the answer. If diagrams are shown in problems, Make sure to redraw them and include them as part of your solutions.

**Prob1.** A resistor absorbs an instantaneous power of  $20\cos^2(t)$  mW when connected across  $v = 10 \cos(t) V$ , voltage source. Find i and R.

*Prob2.* Find V<sub>0</sub> for the circuit below:



### Prob3.

If the current flowing through an element is given by

$$i(t) = \begin{cases} 3tA, 0 < t < 6s \\ 18A, 6 < t < 10s \\ -12A, 10 < t < 15s \\ 0, t > 15s \end{cases}$$

Plot the charge stored in the element over 0 < t < 20s.

### Prob4.

Specify the resistance R in Figure below so that both of the following conditions are satisfied:

**1.** 
$$v > 10 \text{ V}.$$

2. The power absorbed by the resistor is less than 25W.



Use the resistor table to just choose resistor(s) nominal values that satisfy the design.

1st Band (F) 2nd Band (S) Multiplier (M) F S M	Color V Black Brown	Value Band 3 D 0 Gold 1 Silver	10 100	Resist	or Co	lor Co	ode
22 ohm	Red	2			Quick G	uide	
27 ohm	Orange	3				Tole	rance
33 ohm	Yellow	4 4-	Band Code			Brown	+ 196
39 ohm 000	Green	2	123 4		08	Red	+ 296
47 ohm	Modet	7			<u>un</u>	Gold	+ 5%
56 ohm	Grav	8		/		Silver	+ 10 %
68 ohm	White	9 -	100.0 + 50			None	+ 20%
82 ohm	- mines	<u> </u>	100 10 2 51	•			1
1.0 ohm	10 ohm	100 obm	108	10 10	100 k	1 10	10 M
1.1 ohm	11 ohm	110 ohm	114	114	110 4	114	
1.2 ohm	12 ohm	120 ohm	124	124	120 4	124	
1.3 ohm	13 ohm	130 obm	13400	13 4 800	130 k	1.3 M	
1.5 ohm	15 ohm	150 ohm	1.5 8	15 k	150 k	1.5 M	
1.6 ohm	16 ohm	160 ohm	164	16 +	160 k	1.6 M	
1.8 ohm	18 ohm	180 ohm	1.8 4 11	18 k	180 k	1.8 M	
2.0 ohm	20 ohm	200 ohm	204	20 k	200 k	204	
2.2 ohm	22 ohm	220 ohm	2.2 4	22 k	220 k	2.2 M	
2.4 ohm	24 ohm	240 ohm	2.4 k	24 k	240 k	2.4 M	Resistor
2.7 ohm	27 ohm	270 ohm	2.7 k	27 8	270 k	2.7 M	Values
3.0 ohm	30 ohm	300 ohm	3.0 k	30 k	300 k	3.0 M	
3.3 ohm	33 ohm	330 ohm	3.3 k	33 k 000	330 k	3.3 M	
3.6 ohm	36 ohm	360 ohm	3.6 k	36 k	360 k	3.6 M	
3.9 ohm	39 ohm	390 ohm	3.9 k	39 k	390 k	3.9 M	
4.3 ohm	43 ohm	430 ohm	4.3 k	43 k 🔲 🔲	430 k	4.3 M	
4.7 ohm	47 ohm 🛛	470 ohm	4.7 k	47 k	470 k	4.7 M	
5.1 ohm	51 ohm	510 ohm	5.1 k	51 k	510 k	5.1 M	
5.6 ohm	56 ohm	560 ohm 🛛 🗖	5.6 k	56 k	560 k 🛯 🗖	5.6 M	
6.2 ohm	62 ohm	620 ohm	6.2 k	62 k	620 k	6.2 M	
6.8 ohm	68 ohm	680 ohm	6.8 k	68 k 00	680 k	6.8 M	
7.5 ohm	75 ohm	750 ohm	7.5 k	75 k	750 k	7.5 M	
8.2 ohm	82 ohm 🛛 📕	820 ohm	8.2 k	82 k 🛛 🗖 🗖	820 k 🛛 🗖	8.2 M	
9.1 ohm	91 ohm 🛛 🖬	910 ohm 🛛 🗖 🗖	9.1 k	91 k 🛛 🗖 🗖	910 k 🛛 🗖 🗖	9.1 M 000	

**Prob5.** In a household, a 120-W PC is run for 4 hours/day, while a 60-W bulb runs for 8 hours/day. If the utility company charges \$0.12/kWh, calculate how much the household pays per year on the PC and the bulb.

# HW set 2 for CH3 (20 pts), 4 problems. Perform HWs on separate sheets, not on this handout. Show work and draw a box around the answer. If diagrams are shown in problems, Make sure to redraw them and include them as part of your solutions.

**Problem1.** Determine the value of the voltage that is measured by the meter in circuit below:



**Problem2.** The voltage input to the circuit 10mV. Determine  $v_0(t)$ .



*Problem3.* Find R in the CKT below:



**Problem4.** Calculate V<sub>o</sub> and I<sub>o</sub> in the circuit below:



## <u>HW set 3 for CH4 (20 pts), 4 problems. Perform HWs on separate sheets,</u> <u>not on this handout. Show work and draw a box around the answer. If</u> <u>diagrams are shown in problems, Make sure to redraw them and include</u> <u>them as part of your solutions.</u>

*Prob1.* Find *V*<sub>0</sub>, across the 2k resistor, using nodal analysis.



**Prob2.** Find  $V_0$ , across the 6k resistor, using nodal analysis.



**Prob3.** Although scientists continue to debate exactly why and how it works, the process of utilizing electricity to aid in the repair and growth of bones—which has been used mainly with fractures—may soon be extended to an array of other problems, ranging from osteoporosis and osteoarthritis to spinal fusions and skin ulcers.

An electric current is applied to bone fractures that have not healed in the normal period of time. The process seeks to imitate natural electrical forces within the body. It takes only a small amount of electric stimulation to accelerate bone recovery. The direct current method uses an electrode that is implanted at the bone. This method has a success rate approaching 80 percent.

The implant is shown in Figure *a* and the circuit model is shown in Figure *b*. Find the energy delivered to the cathode during a 24-hour period. The cathode is represented by the dependent voltage source and the 100-k $\Omega$  resistor. Use Mesh analysis to solve this problem.



*Prob4.* Apply mesh analysis to find  $v_o$  across  $4\Omega$  in the circuit below:



# HW set 4 for CH6 (20 pts), 4 problems. Perform HWs on separate sheets, not on this handout. Show work and draw a box around the answer. If diagrams are shown in problems, Make sure to redraw them and include them as part of your solutions.

**Problem1.** Find v and i in the CKT below:



**Problem2.** Find  $v_0$  and  $i_0$  in the CKT below:



*Problem3*. Find *V*<sup>0</sup> in the following CKT:







<u>HW set 5 for CH5 (20 pts), 4 problems. Perform HWs on separate sheets,</u> not on this handout. Show work and draw a box around the answer. If diagrams are shown in problems, Make sure to redraw them and include them as part of your solutions.

*Problem1.* Find *i* using superposition.



**Problem2.** Find *i*<sub>a</sub> using source transformation.



Problem3. Find the Theveinen equivalent between the A-B terminal.



**Proble4.** For the circuit below, what resistor connected across terminals *a*-*b* will absorb maximum power from the circuit? What is that power?

