CAMOSUN COLLEGE

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Trades and Technology

ELECTRONICS & COMPUTER ENGINEERING DEPARTMENT

ELEN 181
Pulse Techniques

Summer 2020

COURSE OUTLINE

CREDIT:	3
IN-CLASS WORKLOAD:	2 hours lecture, 2 hours lab
OUT-OF-CLASS WORKLOAD:	2 hours
PREREQUISITES:	Reserved for DND students

1. Instructor Information

(a) Instructor	Dr. Mozhgan Moazzen zadeh-Bacon		
(d) Phone	250 370 4623		
(e) E-mail	baconm@camosun.bc.ca		
(f) Website	online.camosun.bc.ca	**Alternative:**	

2. Intended Learning Outcomes

This course introduces the student to non-sinusoidal waveforms. Emphasis is placed on the use of integrated circuits to generate these waveforms. The operation of comparator circuits, switching circuits and timers will be investigated. Appropriate laboratory exercises will support investigation of these circuits.

Upon successful completion of this course a student will be able to:

- Apply pulse fundamentals;
- Explain the principles of capacitive-resistive circuits;
- Explain the principles of diode switching;
- Explain the principles of transistor switching;
- Explain the principles of IC operational amplifiers in switching circuits;
- Explain the principles of Schmitt trigger circuits (op amp only) and voltage comparators;
- Explain the principles of IC timer circuits; and
- Explain the principles of ramp generators.

3. Required Materials

- Access to D2L (Course Notes, Labs, Assignments, Quizzes, Tests)
- **"Solid State Pulse Circuits"** by David A. Bell ***(Required)***
- **"Introduction to Circuit Analysis"** by Walls and Johnstone ***(Optional)***

4. Course Content

Topics

1. DC Theory Review

1.1 Resistor color code, SI units and prefixes
1.2 Ohm's law
1.3 Series resistive circuits
1.4 Voltage divider rule
1.5 Parallel resistive circuits
1.6 Current divider rule
1.7 Kirchhoff's voltage and current rules
1.8 Thevenin's theorem
1.9 Superposition theorem
1.10 Mesh current method

2. Waveform Fundamentals

2.1 Types of Waveforms
- 2.1.1 AC Waveform Fundamentals
- 2.1.2 Repetitive waveforms
- 2.1.3 Transients
- 2.1.4 Sinusoidal waveforms
- 2.1.5 Rectangular waveforms
- 2.1.6 Ramp waveforms
- 2.1.7 Triangular waveforms
- 2.1.8 Sawtooth waveforms
- 2.1.9 Exponential waveforms
- 2.1.10 Spikes

2.2 Waveform Calculations
- 2.2.1 Average value of a rectangular and sawtooth waveform
- 2.2.2 Effective values (DC) of rectangular and sawtooth waveforms
- 2.2.3 Ramp voltages
- 2.2.4 The period given the slope of a ramp
- 2.2.5 Average and effective values of ramp waveforms
- 2.2.6 Exponential voltages
- 2.2.7 Rectangular waveforms
- 2.2.8 Duty cycle of a rectangular waveform

2.3 The Ideal Pulse Waveform
- 2.3.1 Leading edge, rising edge, positive going edge
- 2.3.2 Trailing edge, falling edge, negative-going edge
- 2.3.3 Pulse width, PW, pulse duration, mark length
- 2.3.4 Pulse repetition frequency (PRF)
- 2.3.5 Space width
- 2.3.6 Duty cycle, mark to space ratio
- 2.3.7 Rise time
- 2.3.8 Fall time
- 2.3.9 Tilt
- 2.3.10 Ideal Waveform
- 2.3.11 Practical waveform

2.4 Harmonic Content of Waveforms
- 2.4.1 Frequency synthesis
- 2.4.2 Harmonic Analysis [Square waveform, Rectangular waveform (Pulse train)]

2.5 Waveform Distortion
- 2.5.1 High frequency distortion
- 2.5.2 Low frequency distortion
- 2.5.3 Low and high frequency distortion
- 2.5.4 Overemphasis of high frequencies (ringing)

3. Resistive-Capacitive (RC) Circuits

3.1 Capacitor Charging
- 3.1.1 How capacitors charge and discharge
- 3.1.2 Time constant

3.2 Universal Time Constant Curves
- 3.2.1 Finding charge and discharge times using normalized curve
- 3.2.2 Rise time and fall time relationships

3.3 RC Circuit response to Square Waves
- 3.3.1 Integrator
- 3.3.2 Differentiator

4. Diode Switching Circuits

4.1 Review of diode operation
4.2 Diode Clipper circuits
4.3 Diode Clamper circuits
4.4 Voltage multipliers

5. Transistor Switching

5.1 Review of transistor operation
5.2 The transistor switch
5.3 Speed-up capacitor
5.4 The transistor inverter

6. IC Operational Amplifiers

6.1 Op-Amp basics
- 6.1.1 Linear non-inverting amplifier
- 6.1.2 Linear inverting amplifier
- 6.1.3 Voltage follower
- 6.1.4 Summing network
- 6.1.5 The op-amp integrator and differentiator

6.2 Op-amps in switching
- 6.2.1 Logic inverter
- 6.2.2 Clipper

7. Schmitt Trigger Circuit

7.1 Schmitt trigger basics
7.2 Op Amp comparator circuit
7.3 Op-Amp Schmitt Trigger circuit
7.4 The IC Schmitt Trigger circuit

8. Multivibrator Circuits
- 8.1.1 Monostable multivibrator
- 8.1.2 Intro to multivibrators
- 8.1.3 Waveforms for the monostable multivibrator
- 8.1.4 Emitter coupled monostable multivibrator
- 8.1.5 Op-amp monostable multivibrator
- 8.1.6 IC monostable multivibrator

8.1.7 Applications of the monostable multivibrator

8.2 Astable multivibrator
- 8.2.1 Waveforms for the transistor astable multivibrator
- 8.2.2 Calculating frequency of the output
- 8.2.3 Symmetrical and asymmetrical outputs for the transistor astable
- 8.2.4 Op-amp astable multivibrator
- 8.2.5 Applications of the astable multivibrator
- 8.2.6 Synchronizing the astable multivibrator

8.3 Bistable multivibrator
- 8.3.1 The 555 IC timer and its applications

9. Ramp Generators
- 9.1 Desirable characteristics of a ramp generator
- 9.2 RC ramp generator
- 9.3 Constant current ramp generators
- 9.4 Bootstrap ramp generator
- 9.5 Free-Running ramp generator
- 9.6 Miller integrator ramp generator
- 9.7 Pulse generator circuit
- 9.8 Function generators

Lab Exercises *(Subject to Change)*

Lab 1 - Breadboard, Resistive Series Circuits
Lab 2 - Parallel and Series-Parallel Resistive Circuits
Lab 3 - DC Network Theorems
Lab 4 - AC Measurements
Lab 5 - Capacitor Charging Circuits
Lab 6 - RC Circuits and Pulse Waveforms
Lab 7 - No formal Lab **(Term Test I- Week 7th -09/June/2020)**
Lab 8 - Diode Circuits
Lab 9 - **Holiday (Canada Day-01/July/2020)**
Lab 10 - Transistor Switching Circuits
Lab 11 - No formal Lab **(Term Test II- Week 11th -15/July/2020)**
Lab 12 - Op-Amp Circuits
Lab 13 – Op-Amp Comparator Circuits
Lab 14 – Op Amp-Window Comparator-Schmitt trigger
555 Timer and Free-running Oscillators

Holidays
- Mon-May 18 - Victoria Day - College closed (Week 3)
- Wed-July 1 – Canada Day - College Closed (Week 9)
- Mon-August 3 - British Columbia Day, College closed (Week 14)

5. Basis of Student Assessment (Weighting)

Assignments	10%
Quizzes	10%
Term Tests (x2)	30%
Final Exam	40%
Total theory	**90%**
Laboratory Evaluation	10%
Total	**100%**

*Students must obtain a minimum of 60% in both the theory and practical portions of the course and a minimum of 50% on the final exam.

*Laboratory marks will be based on the completeness of each lab exercise, report and an instructor evaluation of the student's work habits and attitude.

6. Grading System

[X] Standard Grading System (GPA)

[ ] Competency Based Grading System

7. Recommended Materials or Services to Assist Students to Succeed Throughout the Course

LEARNING SUPPORT AND SERVICES FOR STUDENTS

There are a variety of services available for students to assist them throughout their learning. This information is available in the College Calendar, Student Services or the College web site at http://www.camosun.bc.ca

STUDENT CONDUCT POLICY

There is a Student Conduct Policy. It is the student's responsibility to become familiar with the content of this policy. The policy is available in each School Administration Office, Registration, and on the College web site in the Policy Section.
http://www.camosun.bc.ca/policies/policies.html

A. GRADING SYSTEMS *http://www.camosun.bc.ca/policies/policies.php*

The following two grading systems are used at Camosun College:

1. Standard Grading System (GPA)

Percentage	Grade	Description	Grade Point Equivalency
90-100	A+		9
85-89	A		8
80-84	A-		7
77-79	B+		6
73-76	B		5
70-72	B-		4
65-69	C+		3
60-64	C		2
50-59	D		1
0-49	F	Minimum level has not been achieved.	0

2. Competency Based Grading System (Non GPA)

This grading system is based on satisfactory acquisition of defined skills or successful completion of the course learning outcomes

Grade	Description
COM	The student has met the goals, criteria, or competencies established for this course, practicum or field placement.
DST	The student has met and exceeded, above and beyond expectation, the goals, criteria, or competencies established for this course, practicum or field placement.
NC	The student has not met the goals, criteria or competencies established for this course, practicum or field placement.

B. TEMPORARY GRADES

Temporary grades are assigned for specific circumstances and will convert to a final grade according to the grading scheme being used in the course. See Grading Policy at http://www.camosun.bc.ca/policies/E-1.5.pdf for information on conversion to final grades, and for additional information on student record and transcript notations.

Temporary Grade	Description
I	*Incomplete*: A temporary grade assigned when the requirements of a course have not yet been completed due to hardship or extenuating circumstances, such as illness or death in the family.
IP	*In progress*: A temporary grade assigned for courses that are designed to have an anticipated enrollment that extends beyond one term. No more than two IP grades will be assigned for the same course.
CW	*Compulsory Withdrawal*: A temporary grade assigned by a Dean when an instructor, after documenting the prescriptive strategies applied and consulting with peers, deems that a student is unsafe to self or others and must be removed from the lab, practicum, worksite, or field placement.