



CAMOSUN COLLEGE

Trades and Technology

ELECTRONICS & COMPUTER ENGINEERING DEPARTMENT

ELEN 144
SEMICONDUCTOR DEVICES 1

Summer 2022

COURSE OUTLINE

CREDIT:	6
IN-CLASS WORKLOAD:	4 hours lecture, 2 hours lab
OUT-OF-CLASS WORKLOAD:	6 hours
PREREQUISITES:	ELEN 142

1. INSTRUCTOR INFORMATION

(a) Instructor	Dr. Mozghan Moazzen zadeh-Bacon
(b) Office hours	Email for an appointment
(c) Location	TEC 206
(d) Phone	250 370 4623 Alternative: _____
(e) E-mail	BaconM@camosun.ca
(f) Website	online.camosun.bc.ca

2. INTENDED LEARNING OUTCOMES

This course is an introduction to semiconductor devices. It includes such topics ranging from semiconductor theory, diodes, transistors, and thyristors, to analogs IC's including op-amps and linear regulators. The focus of this course is in the application of these devices and troubleshooting circuits containing these devices.

Upon completion of this course, the student will understand commonly used analog electronic components and circuits.

3. REQUIRED MATERIALS

- **Electronic Devices** 6th Edition (or newer)
Floyd Thomas L. ISBN 0-13-028484-X
- **Laboratory Exercises, Handouts and Course Outline**
Typically, available both online and in class

Optional Book available: (Used for ELEN 142 – Circuit Analysis)

- **Circuit Analysis with Devices** 2nd Edition (or newer)
Robbins and Miller ISBN 140187984-5

4. COURSE CONTENT

- 1. Diodes** (6 hrs)
- 1.1. The conductor and insulator
 - 1.2. Doping –The semiconductor
 - 1.3. N and P type materials
 - 1.4. Biasing the PN Junction
 - 1.5. Diode characteristics
 - 1.6. Zener Diode characteristics
 - 1.7. Light-emitting diodes
 - 1.8. Photo diodes and laser diodes
 - 1.9. Schottky diodes
 - 1.10. Varactor, Tunnel and other miscellaneous diodes
 - 1.11. Varistor and other commonly used diodes
 - 1.12. Half and full wave rectifier circuits
 - 1.13. Diode Applications
- 2. Introduction to Bipolar Transistors (BJTs)** (4 hrs)
- 2.1. BJT construction
 - 2.2. Biasing BJT's
 - 2.3. BJT characteristics
 - 2.4. Temperature effects on biasing voltages
 - 2.5. Troubleshooting transistor bias circuits
- 3. BJT Transistor AC Amplifiers** (6 hrs)
- 3.1. Common emitter amplifier
 - 3.2. Common collector amplifier
 - 3.3. Common base amplifier
 - 3.4. Class A amplifiers
 - 3.5. Class B amplifiers
 - 3.6. Class C amplifiers
 - 3.7. Types of distortion
- 4. Field Effect Transistors (FETs)** (6 hrs)
- 4.1. JFET characteristics
 - 4.2. JFET biasing
 - 4.3. JFET amplifiers
 - 4.4. D type MOSFETs
 - 4.5. E type MOSFETs
 - 4.6. MOSFET amplifiers
- 5. Amplifier Frequency Response** (4 hrs)
- 5.1. Low Frequency Amplifier Response
 - 5.2. High Frequency Amplifier Response
 - 5.3. Total Amplifier Frequency Response
 - 5.4. Frequency Response of Multistage Amplifiers
 - 5.5. Switching characteristic
- 6. Introduction to Operational Amplifiers (Op-Amps)** (6 hrs)
- 6.1. Differential amplifier (with a pair of transistors)
 - 6.2. Ideal Op-amps versus practical Op-amps

- 6.3. Block diagram versus integrated circuit
- 6.4. Op-Amp characteristics - *signal mode, CMRR, impedance, slew rate, etc.*
- 6.5. Three basic Op-Amp configurations
 - Inverting input amplifier
 - Non-inverting input amplifier
 - Voltage follower

7. Op-Amp Circuit Applications (6 hrs)

- 7.1. Summing amplifier
- 7.2. Averaging amplifier
- 7.3. Scaling adder
- 7.4. Comparators
- 7.5. Active filters

8. Oscillators (6 hrs)

- 8.1. Feedback Oscillators
- 8.2. Wien bridge oscillator
- 8.3. RC phase shift oscillator
- 8.4. The Twin-T Oscillator
- 8.5. Colpitts oscillator
- 8.6. Harley and other oscillators
- 8.7. Crystal controlled oscillators
- 8.8. Relaxation oscillator

9. Unregulated and Regulated Power Supplies (6 hrs)

- 9.1. Zener regulator
- 9.2. Emitter follower regulator
- 9.3. Variable feedback regulator
- 9.4. Linear and Switching regulator
- 9.5. Other IC regulators
- 9.6. Basic power supply design
- 9.7. Determining power supply component values

10. Thyristors and Unijunction Devices (6 hrs)

- 10.1. Introduction to thyristors
- 10.2. Shockley diodes (or Four-layer diodes)
- 10.3. SCR characteristics
- 10.4. Diac's characteristics
- 10.5. Triac's characteristics
- 10.6. SCS, UJT, PUT, and IGBT

11. Miscellaneous Devices (as time permits)

- 11.1. Solar cells
- 11.2. Light-emitting diodes (LEDs)
- 11.3. Liquid crystal displays (LCDs)
- 11.4. Rechargeable batteries
- 11.5. Audio amplifier ICs
- 11.6. Motor control ICs

(Total In-Class Theory Hours *: **56 hours**)
 * *including quizzes, Midterm exam, and review time*

LAB TOPICS (Subject to Change)

There will be 13 lab exercises to be completed, one per week of the semester. Each exercise will be of 2 hours duration and all must be completed satisfactorily in order to gain a credit for ELEN 144. Labs will be available on D2L on Monday every week. Preparation must be completed by the student before the start of the lab.

Lab 01	Get Ready for Online Labs with MULTISIM
Lab 02	Introduction to Diodes and Diode Characteristics
Lab 03	Zener Diodes and Their Characteristics
Lab 04	Introduction to Bipolar Junction Transistors (BJTs)
Lab 05	A Simple DC-biased BJT Amplifier Design
Lab 06	Voltage-divider Biased BJT Circuits
Lab 07	BJT ac Amplifiers
Lab 08	Introduction to Field-Effect Transistors (FETs)
Lab 09	FET Amplifiers Design
Lab 10	Introduction to Operational Amplifiers (Op-amps)
Lab 11	Op-amps Applications
Lab 12	Oscillator Circuits
Lab 13	Introduction to Voltage Regulation Circuits
Lab 14	Introduction to Thyristors Circuits

HOLIDAYS

- Monday - **May 23th** - Victoria Day - College closed (Week 4)
- Friday - **July 1st** - Canada Day - College Closed (Week 9)
- Monday - **August 1nd** - British Columbia Day - College closed (Week 14)

5. STUDENT ASSESSMENT (WEIGHTING)

Problem Sets	15%
Quizzes	5%
Mid-Term	20%
Final Exam	40%
Total theory	80%
Laboratory Evaluation	20%
Total	100%

*Students must achieve a passing grade in both the theory and lab portions of the course in order to pass the entire course. Lab attendance is compulsory and all labs must be completed satisfactorily to pass this course. 40% of the lab mark will be based on preparation, performance and successful completion of each lab.

*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.

6. Grading System

- 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	<i>Incomplete:</i> 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	<i>In progress:</i> 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	<i>Compulsory Withdrawal:</i> 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.