

# COURSE SYLLABUS



COURSE TITLE: ECET250 – Analog Communications  
CLASS SECTION: 002  
TERM: Fall 2022  
COURSE CREDITS: 3  
DELIVERY METHOD(S): in-person

Camosun College campuses are located on the traditional territories of the Ləkʷəŋən and W̱SÁNEĆ peoples. We acknowledge their welcome and graciousness to the students who seek knowledge here.  
Learn more about Camosun's [Territorial Acknowledgement](#).

For COVID-19 information please visit <https://camosun.ca/about/covid-19-updates>

---

*Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable explanation in advance, you will be removed from the course and the space offered to the next waitlisted student.*

## INSTRUCTOR DETAILS

---

NAME: Ryan Lidstone  
EMAIL: [lidstoner@camosun.ca](mailto:lidstoner@camosun.ca)  
OFFICE: TEC204

*As your course instructor, I endeavour to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me. Camosun College is committed to identifying and removing institutional and social barriers that prevent access and impede success.*

## CALENDAR DESCRIPTION

---

Students will study analog voice and data communications. They will also learn radio frequency analysis, radio frequency (RF) components, amplitude modulation (AM) and frequency modulation (FM) techniques, single side band (SSB) transmission, transmission lines, RF propagation and noise. Students will make extensive use of RF test equipment, including spectrum analyzers, and simulation techniques during lab exercises.

PREREQUISITE(S): ECET 141  
CO-REQUISITE(S): none  
EXCLUSION(S): none

## COURSE LEARNING OUTCOMES / OBJECTIVES

---

Upon completion of this course the student will be able to:

1. Understand basic elements of a communication system
2. Conduct analysis of baseband signals in time domain and frequency domain
3. Demonstrate understanding of various analog modulation and demodulation techniques
4. Analyse the performance of modulation and demodulation techniques in various transmission environments
5. Describe signal power by using power spectral characteristics in AM and FM systems
6. Analyzing/understanding the importance of synchronisation in communication systems
7. Make extensive use of RF test equipment, including spectrum analyzers, and simulation techniques during lab exercises

## RECOMMENDED MATERIALS

---

1. Beasley and Miller, Modern Electronic Communication, 9th Ed.
2. Labs for ECET 250 Analog Communications (available on D2L)
3. ECET 250 Introduction to Analog Communications Part 1 (Available on D2L)
4. ECET 250 Introduction to Analog Communications Part 2 (Available on D2L)
5. Various online resources as needed.

## COURSE SCHEDULE, TOPICS, AND ASSOCIATED PREPARATION / ACTIVITY / EVALUATION

---

The following schedule and course components are subject to change, as deemed appropriate by the instructor.

### Topics

1. Introduction
  - 1.1. Communication overview
  - 1.2. Terminology
2. Frequency analysis
  - 2.1. Spectrum analysis
  - 2.2. Introduction to Fourier analysis and Fourier tables<sup>1</sup>
  - 2.3. Spectrum analyzer parameters (span, amplitude, dB, dBm)
3. RF components
  - 3.1. Review of filter types and characteristics<sup>2</sup>
  - 3.2. Transfer functions<sup>3</sup>
  - 3.3. Oscillator types and characteristics
  - 3.4. Mixers and mixer transfer functions
4. Amplitude modulation (AM)
  - 4.1. AM waveform
    - 4.1.1. Modulation factor
    - 4.1.2. Bandwidth
    - 4.1.3. Overmodulation
    - 4.1.4. Harmonic distortion
    - 4.1.5. Power
  - 4.2. AM transmitters
    - 4.2.1. Mixers
    - 4.2.2. Filters

- 4.2.3. Oscillators
- 4.2.4. Low- and high-level modulation topologies
- 4.3. AM receivers
  - 4.3.1. Tuned radio frequency (TRF) receiver
  - 4.3.2. Superheterodyne block diagram and operation
  - 4.3.3. Frequency conversion
  - 4.3.4. Image frequency
  - 4.3.5. Diode (peak) detector
  - 4.3.6. Bandwidth
- 5. Noise
  - 5.1. Types and sources of noise
  - 5.2. Thermal noise
  - 5.3. Cascaded noise calculations
  - 5.4. Noise factor and signal-to-noise ratio
  - 5.5. Cascaded noise factor
  - 5.6. Automatic gain control (AGC) in receivers
  - 5.7. Signal-to-noise and distortion (SINAD) ratio
- 6. Frequency modulation (FM)
  - 6.1. FM waveform
    - 6.1.1. Frequency sensitivity
    - 6.1.2. Frequency deviation
    - 6.1.3. Modulation factor
    - 6.1.4. Bandwidth
    - 6.1.5. Bessel tables
    - 6.1.6. Carson's rule
    - 6.1.7. Narrowband and wideband FM
  - 6.2. FM transmitters
    - 6.2.1. Frequency mixing and multiplying
    - 6.2.2. Phase-locked loop (PLL) modulator
    - 6.2.3. Direct and indirect transmitters
  - 6.3. FM receivers
    - 6.3.1. Slope detector
    - 6.3.2. PLL detector
    - 6.3.3. Limiter
    - 6.3.4. Frequency control
    - 6.3.5. Noise and FM
    - 6.3.6. Pre-emphasis and de-emphasis
- 7. Single Side Band (SSB)
  - 7.1. SSB transmission
    - 7.1.1. Variations on AM modulation
    - 7.1.2. Power characteristics of a SSB signal
    - 7.1.3. SSB filter method
    - 7.1.4. SSB phase method
  - 7.2. SSB reception
    - 7.2.1. Beat frequency oscillator (BFO)

### 7.2.2. Double conversion and frequency inversion

8. Transmission lines
  - 8.1. Transmission line model
    - 8.1.1. Types of transmission lines
    - 8.1.2. Distributed transmission line model
    - 8.1.3. Characteristic impedance
    - 8.1.4. Velocity of propagation
    - 8.1.5. Reflections and termination impedance
  - 8.2. Time domain reflectometry (TDR)
  - 8.3. Standing waves
    - 8.3.1. Incident and reflected waves
    - 8.3.2. Standing wave ratio (SWR)
    - 8.3.3. Reflection coefficient
    - 8.3.4. Standing wave power calculations
    - 8.3.5. Input impedance of unmatched lines
    - 8.3.6. Importance of impedance matching
    - 8.3.7. Transformer matching
    - 8.3.8. Quarter-wave ( $\lambda/4$ ) impedance transformer
    - 8.3.9. Matching stub
  - 8.4. Applied transmission line theory
    - 8.4.1. Balanced and unbalanced lines
    - 8.4.2. Baluns
    - 8.4.3. Impedance matching techniques
    - 8.4.4. Transmission line attenuation
9. RF propagation
  - 9.1. Power density
  - 9.2. Gain
  - 9.3. Reflection, refraction and scattering
  - 9.4. Line of Sight, surface wave and ionospheric propagation
10. Antennas
  - 10.1. Antenna characteristics
    - 10.1.1. Radiation pattern
    - 10.1.2. Antenna gain
    - 10.1.3. Antenna impedance
    - 10.1.4. Half-wave ( $\lambda/2$ ) dipole antenna
    - 10.1.5. Quarter-wave ( $\lambda/4$ ) monopole antenna
    - 10.1.6. Counterpoise
    - 10.1.7. Antenna loading
    - 10.1.8. Reciprocity
  - 10.2. Additional antenna types
    - 10.2.1. Folded dipole
    - 10.2.2. Long wire antenna
    - 10.2.3. Loop antennas
    - 10.2.4. Broadside and end-fired arrays
    - 10.2.5. Yagi array

- 10.2.6. Log periodic array
- 10.2.7. Phased array and steered beam
- 10.2.8. Parabolic reflector

### Labs

- LAB 1 - Introduction to Spectrum Analyzer
- LAB 2 - Amplitude Modulation via Function Generator
- LAB 3 - Class C Mixer and Modulator
- LAB 4 - AM Transmitter with Multisim
- LAB 5 - AM Receiver with Multisim
- LAB 6 - AM Receiver
- LAB 7 - Frequency Modulation
- LAB 8 - PLL and FM Analysis
- LAB 9 - Transmission Line Model via Multisim
- LAB 10 - Time Domain Reflectometry
- LAB 11 – Crosstalk

### Lesson Plan

Week	Topic
1	Introduction to Analog communications Signal Analysis Introduction lab equipment
2	Decibels Amplitude Modulation (AM) Introduction
3	AM Power Distribution <i>Quiz 1</i>
4	AM examples AM transmitter
5	Multiplexing Oscillators <i>Quiz 2</i> AM receiver
6	AM receiver Image frequency Noise
7	SINAD FM modulation and examples SSB <i>Term test 1</i>
8	FM transmitter
9	PM demodulation
10	<i>Quiz 3</i> Transmission lines
11	TDR Types of transmission lines
12	Crosstalk Effect

	RF propagation
13	<i>Term test 2</i> Antennas characteristics
14	Antenna types and radiation patterns Review

Students registered with the Centre for Accessible Learning (CAL) who complete quizzes, tests, and exams with academic accommodations have booking procedures and deadlines with CAL where advanced notice is required. Deadlines can be reviewed on the [CAL exams page](http://camosun.ca/services/accessible-learning/exams.html). <http://camosun.ca/services/accessible-learning/exams.html>

## EVALUATION OF LEARNING

---

DESCRIPTION	WEIGHTING
Quizzes	10%
Labs	15%
Term Tests	40%
Final Exam	35%
	<b>TOTAL</b>
	100%

If you have a concern about a grade you have received for an evaluation, please come and see me as soon as possible. Refer to the [Grade Review and Appeals](http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf) policy for more information. <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf>

## STUDENT RESPONSIBILITY

---

Enrolment at Camosun assumes that the student will become a responsible member of the College community. As such, each student will display a positive work ethic, assist in the preservation of College property, and assume responsibility for their education by researching academic requirements and policies; demonstrating courtesy and respect toward others; and respecting expectations concerning attendance, assignments, deadlines, and appointments.

## SUPPORTS AND SERVICES FOR STUDENTS

---

Camosun College offers a number of services to help you succeed in and out of the classroom. For a detailed overview of the supports and services visit <http://camosun.ca/students/>.

Support Service	Website
Academic Advising	<a href="http://camosun.ca/advising">http://camosun.ca/advising</a>
Accessible Learning	<a href="http://camosun.ca/accessible-learning">http://camosun.ca/accessible-learning</a>
Counselling	<a href="http://camosun.ca/counselling">http://camosun.ca/counselling</a>
Career Services	<a href="http://camosun.ca/coop">http://camosun.ca/coop</a>

Support Service	Website
Financial Aid and Awards	<a href="http://camosun.ca/financialaid">http://camosun.ca/financialaid</a>
Help Centres (Math/English/Science)	<a href="http://camosun.ca/help-centres">http://camosun.ca/help-centres</a>
Indigenous Student Support	<a href="http://camosun.ca/indigenous">http://camosun.ca/indigenous</a>
International Student Support	<a href="http://camosun.ca/international/">http://camosun.ca/international/</a>
Learning Skills	<a href="http://camosun.ca/learningskills">http://camosun.ca/learningskills</a>
Library	<a href="http://camosun.ca/services/library/">http://camosun.ca/services/library/</a>
Office of Student Support	<a href="http://camosun.ca/oss">http://camosun.ca/oss</a>
Ombudsperson	<a href="http://camosun.ca/ombuds">http://camosun.ca/ombuds</a>
Registration	<a href="http://camosun.ca/registration">http://camosun.ca/registration</a>
Technology Support	<a href="http://camosun.ca/its">http://camosun.ca/its</a>
Writing Centre	<a href="http://camosun.ca/writing-centre">http://camosun.ca/writing-centre</a>

If you have a mental health concern, please contact Counselling to arrange an appointment as soon as possible. Counselling sessions are available at both campuses during business hours. If you need urgent support after-hours, please contact the Vancouver Island Crisis Line at 1-888-494-3888 or call 911.

## COLLEGE-WIDE POLICIES, PROCEDURES, REQUIREMENTS, AND STANDARDS

### Academic Accommodations for Students with Disabilities

The College is committed to providing appropriate and reasonable academic accommodations to students with disabilities (i.e. physical, depression, learning, etc). If you have a disability, the [Centre for Accessible Learning](#) (CAL) can help you document your needs, and where disability-related barriers to access in your courses exist, create an accommodation plan. By making a plan through CAL, you can ensure you have the appropriate academic accommodations you need without disclosing your diagnosis or condition to course instructors. Please visit the CAL website for contacts and to learn how to get started:

<http://camosun.ca/services/accessible-learning/>

### Academic Integrity

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.13.pdf> for policy regarding academic expectations and details for addressing and resolving matters of academic misconduct.

### Academic Progress

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.1.pdf> for further details on how Camosun College monitors students' academic progress and what steps can be taken if a student is at risk of not meeting the College's academic progress standards.

## Course Withdrawals Policy

Please visit <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.2.pdf> for further details about course withdrawals. For deadline for fees, course drop dates, and tuition refund, please visit <http://camosun.ca/learn/fees/#deadlines>.

## Grading Policy

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf> for further details about grading.

## Grade Review and Appeals

Please visit <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.14.pdf> for policy relating to requests for review and appeal of grades.

## Mandatory Attendance for First Class Meeting of Each Course

Camosun College requires mandatory attendance for the first class meeting of each course. If you do not attend, and do not provide your instructor with a reasonable reason in advance, you will be removed from the course and the space offered to the next waitlisted student. For more information, please see the “Attendance” section under “Registration Policies and Procedures” (<http://camosun.ca/learn/calendar/current/procedures.html>) and the Grading Policy at <http://camosun.ca/about/policies/education-academic/e-1-programming-and-instruction/e-1.5.pdf>.

## Medical / Compassionate Withdrawals

Students who are incapacitated and unable to complete or succeed in their studies by virtue of serious and demonstrated exceptional circumstances may be eligible for a medical/compassionate withdrawal. Please visit <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.8.pdf> to learn more about the process involved in a medical/compassionate withdrawal.

## Sexual Violence and Misconduct

Camosun is committed to creating a campus culture of safety, respect, and consent. Camosun’s Office of Student Support is responsible for offering support to students impacted by sexual violence. Regardless of when or where the sexual violence or misconduct occurred, students can access support at Camosun. The Office of Student Support will make sure students have a safe and private place to talk and will help them understand what supports are available and their options for next steps. The Office of Student Support respects a student’s right to choose what is right for them. For more information see Camosun’s Sexualized Violence and Misconduct Policy: <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.9.pdf> and [camosun.ca/sexual-violence](http://camosun.ca/sexual-violence). To contact the Office of Student Support: [oss@camosun.ca](mailto:oss@camosun.ca) or by phone: 250-370-3046 or 250-3703841

## Student Misconduct (Non-Academic)

Camosun College is committed to building the academic competency of all students, seeks to empower students to become agents of their own learning, and promotes academic belonging for everyone. Camosun also expects that all students to conduct themselves in a manner that contributes to a positive, supportive, and safe learning environment. Please review Camosun College’s Student Misconduct Policy at <http://camosun.ca/about/policies/education-academic/e-2-student-services-and-support/e-2.5.pdf> to understand the College’s expectations of academic integrity and student behavioural conduct.



**Changes to this Syllabus:** Every effort has been made to ensure that information in this syllabus is accurate at the time of publication. The College reserves the right to change courses if it becomes necessary so that course content remains relevant. In such cases, the instructor will give the students clear and timely notice of the changes.