



ECET 252 Marine Communications
Winter 2021

COURSE OUTLINE

The calendar description is available on the web @ _____

Ω Please note: This outline will not be kept indefinitely. It is recommended students keep this outline for their records, especially to assist in transfer credit to post-secondary institutions.

1. Instructor Information

- (a) **Instructor** Godfried Pimlott
(b) **Office hours** _____
(c) **Location** TEC 209
(d) **Phone** 250 370 4430 **Alternative:** _____
(e) **E-mail** pimlott@camosun.bc.ca
(f) **Website** _____

2. Intended Learning Outcomes

(If any changes are made to this part, then the Approved Course Description must also be changed and sent through the approval process.)

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

- Explain the major components of a generic radio communication system.
- Explain the operation and calculate the bandwidth of AM and FM waveforms.
- Analyze modulation schemes in the time and frequency domains.
- Describe the effects of noise and distortion on radio communications.
- Measure the characteristics of radio equipment using standard RF test equipment.
- Describe the properties, behaviour, and correct termination of transmission lines.
- Describe characteristics of antennas and analyze antenna radiation patterns.

3. Required Materials

- (a) Texts
N/A

- (b) Other

- Various on-line resources as required
- ECET 250 Intro to Analog Comms I and II – inhouse notes.
- Elex 252 Digital Communications Draft Notes

4. Course Content and Schedule

(Can include: Class hours, Lab hours, Out of Class Requirements and/or Dates for quizzes, exams, lecture, labs, seminars, practicums, etc.)

Lectures: 3 hours/Week

Labs: 2.5 hours/week

- 1. Introduction (1 hr)**
 - 1.1 Communication overview
 - 1.2 Terminology

- 2. Amplitude modulation (AM) (4 hrs)**
 - 2.1 AM waveform
 - 2.1.1 Modulation factor
 - 2.1.2 Bandwidth
 - 2.1.3 Overmodulation
 - 2.1.4 Harmonic distortion
 - 2.1.5 Power
 - 2.2 AM transmitters
 - 2.2.1 Mixers
 - 2.2.2 Filters
 - 2.2.3 Oscillators
 - 2.2.4 Low and high level modulation topologies
 - 2.3 AM receivers
 - 2.3.1 Tuned radio frequency (TRF) receiver
 - 2.3.2 Superheterodyne block diagram and operation
 - 2.3.3 Frequency conversion
 - 2.3.4 Image frequency
 - 2.3.5 Diode (peak) detector⁴
 - 2.3.6 Bandwidth

- 3. Noise (3 hrs)**
 - 3.1 Types and sources of noise
 - 3.2 Thermal noise
 - 3.3 Cascaded noise calculations
 - 3.4 Noise factor and signal-to-noise ratio
 - 3.5 Cascaded noise factor
 - 3.6 Automatic gain control (AGC) in receivers
 - 3.7 Signal-to-noise and distortion (SINAD) ratio

- 4. Frequency modulation (FM) (5 hrs)**
 - 4.1 FM waveform
 - 4.1.1 Frequency sensitivity
 - 4.1.2 Frequency deviation
 - 4.1.3 Modulation factor
 - 4.1.4 Bandwidth
 - 4.1.5 Bessel tables

- 4.1.6 Carson's rule
- 4.1.7 Narrowband and wideband FM
- 4.2 FM transmitters
 - 4.2.1 Frequency mixing and multiplying
 - 4.2.2 Phase-locked loop (PLL) modulator
 - 4.2.3 Direct and indirect transmitters
- 4.3 FM receivers
 - 4.3.1 Slope detector
 - 4.3.2 PLL detector
 - 4.3.3 Limiter
 - 4.3.4 Frequency control
 - 4.3.5 Noise and FM
 - 4.3.6 Pre-emphasis and de-emphasis

5. Single Side Band (SSB) (2 hrs)

- 5.1 SSB transmission
 - 5.1.1 Variations on AM modulation
 - 5.1.2 Power characteristics of a SSB signal
 - 5.1.3 SSB filter method
 - 5.1.4 SSB phase method
- 5.2 SSB reception
 - 5.2.1 Beat frequency oscillator (BFO)
 - 5.2.2 Double conversion and frequency inversion

6. Digital Techniques (4 hrs)

- 6.1 Digital Radio – What and Why
- 6.2 Digital Modulation
 - 6.2.1 I/Q modulation/demodulation
 - 6.2.1.1 Constellation diagrams
 - 6.2.2 FSK and PSK
 - 6.2.2.1 QPSK
 - 6.2.2.2 BPSK
 - 6.2.2.3 MSK, GMSK
 - 6.2.3 QAM
- 6.3 Synchronous/Asynchronous
- 6.4 Encoding
- 6.5 Error Handling
 - 6.5.1 Bit Error Rate (BER)
- 6.6 Digital Bandwidth
 - 6.6.1 Broadband
 - 6.6.2 Narrowband
- 6.7 Digital Noise

7. Transmission lines (6 hrs)

- 7.1 Transmission line model
 - 7.1.1 Types of transmission lines
 - 7.1.2 Distributed transmission line model
 - 7.1.3 Characteristic impedance

- 7.1.4 Velocity of propagation
- 7.1.5 Reflections and termination impedance
- 7.2 Time domain reflectometry (TDR)
- 7.3 Standing waves
 - i. 8.3.1 Incident and reflected waves
 - 8.3.2 Standing wave ratio (SWR)
 - ii. 8.3.3 Reflection coefficient
 - iii. 8.3.4 Standing wave power calculations
 - iv. 8.3.5 Input impedance of unmatched lines
 - v. 8.3.6 Importance of impedance matching
 - vi. 8.3.7 Transformer matching
 - vii. 8.3.8 Quarter-wave ($\lambda/4$) impedance transformer
 - viii. 8.3.9 Matching stub
- 7.4 Applied transmission line theory
 - 7.4.1 Balanced and unbalanced lines
 - 7.4.2 Baluns
 - 7.4.3 Impedance matching techniques
 - 7.4.4 Transmission line attenuation
- 7.5 The Smith Chart

8. RF propagation

(4 hrs)

- 8.1 Electromagnetic waves
- 8.2 Power density
- 8.3 Gain
- 8.4 Reflection, refraction and scattering
- 8.5 Line of Sight, surface wave and ionospheric propagation
- 8.6 RF Propagation at sea

9. Antennas

(4 hrs)

- 9.1 Antenna characteristics
 - 9.1.1 Radiation pattern
 - 9.1.2 Antenna gain
 - 9.1.3 Antenna impedance
 - 9.1.4 Half-wave ($\lambda/2$) dipole antenna
 - 9.1.5 Quarter-wave ($\lambda/4$) monopole antenna
 - 9.1.6 Counterpoise
 - 9.1.7 Antenna loading
 - 9.1.8 Reciprocity
- 9.2 Additional antenna types
 - 9.2.1 Folded dipole
 - 9.2.2 Long wire antenna
 - 9.2.3 Loop antennas
 - 9.2.4 Broadside and end-fired arrays
 - 9.2.5 Yagi array
 - 9.2.6 Log periodic array
 - 9.2.7 Phased array and steered beam
 - 9.2.8 Parabolic reflector
- 9.3 Antennas for Satellites

9.4 Antennas for Marine Radio

10. Satellites (1 hr)

- 10.1 Satellite types
- 10.2 Orbits
- 10.3 Voice, data, internet transmission
- 10.4 Inmarsat
- 10.5 Iridium

11. Marine Radio (2 hrs)

- 11.1 Marine Broadband Radio
 - 11.1.1 MF
 - 11.1.2 HF
 - 11.1.3 VHF
- 11.2 Frequencies and Regulations

12. DSC/GMDSS (1 hr)

- 12.1 Digital Selective Calling
- 12.2 Global Maritime Distress and Safety System

Labs (Tentative):

1. Fourier Series
2. Spectrum Analyzer (and AM Function generator)
3. Class C AM modulator
4. AM Tx/Rx in Multisim
5. Voltage Multiplier as FM modulator
6. FM modulator
7. FM PLL Demodulator
8. BPSK on Multiplier board
9. Digital PSK Multisim
10. TDR
11. Transmission Line Multisim
12. Quarter Wave line matching
13. Antenna Radiation Pattern

5. Basis of Student Assessment (Weighting)

(Should be directly linked to learning outcomes.)

(a) Assignments

10%

(b) Quizzes

10%

(c) Exams

Term Tests (2): 35%

Final Exam: 35%

(d) Other (e.g. Project, Attendance, Group Work)

Labs: 10%

6. Grading System

(If any changes are made to this part, then the Approved Course description must also be changed and sent through the approval process.)

(Mark with "X" in box below to show appropriate approved grading system – see last page of this template.)

Standard Grading System (GPA)

Competency Based Grading System

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

8. College Supports, Services and Policies



Immediate, Urgent, or Emergency Support

If you or someone you know requires immediate, urgent, or emergency support (e.g. illness, injury, thoughts of suicide, sexual assault, etc.), **SEEK HELP**. Resource contacts @

<http://camosun.ca/about/mental-health/emergency.html> or <http://camosun.ca/services/sexual-violence/get-support.html#urgent>

College Services

Camosun offers a variety of health and academic support services, including counselling, dental, disability resource centre, help centre, learning skills, sexual violence support & education, library, and writing centre. For more information on each of these services, visit the **STUDENT SERVICES** link on the College website at <http://camosun.ca/>

College Policies

Camosun strives to provide clear, transparent, and easily accessible policies that exemplify the college's commitment to life-changing learning. It is the student's responsibility to become familiar with the content of College policies. Policies are available on the College website at <http://camosun.ca/about/policies/>. Education and academic policies include, but are not limited to, Academic Progress, Admission, Course Withdrawals, Standards for Awarding Credentials, Involuntary Health and Safety Leave of Absence, Prior Learning Assessment, Medical/Compassionate Withdrawal, Sexual Violence and Misconduct, Student Ancillary Fees, Student Appeals, Student Conduct, and Student Penalties and Fines.

A. GRADING SYSTEMS <http://camosun.ca/about/policies/index.html>

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://camosun.ca/about/policies/index.html> 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.