

Western University Faculty of Engineering
Department of Electrical and Computer Engineering
ECE 3370b – COMMUNICATIONS ELECTRONICS I
Course Outline 2023-2024

Description: This course is an introduction to concepts associated with the wireless transmission and reception of analog modulated signals. It provides sufficient background in theory, devices, and circuits employed in radio communication systems, which enables the students to design, build and test basic communication circuitry. In particular, this course introduces fundamental principles of wireless RF communications, AM, FM, and PM modulation, demodulation and spectra, and frequency shifting and mixing. Practical linear and nonlinear circuits for a heterodyne radio receiver are studied, including RF/IF amplifiers, matching networks, oscillators, mixers, modulators, and demodulators.

Academic Calendar Copy: This course deals with fundamental principles of wireless RF communications, AM, FM, and PM modulation, demodulation and spectra, and frequency shifting and mixing. Practical linear and nonlinear circuits for a heterodyne radio receiver are studied, including RF/IF amplifiers, matching networks, oscillators, mixers, modulators, demodulators, and phased-locked loops

Contact Hours: 3 lecture hours/week, laboratory hours every second week, 1 tutorial hour/week, 0.5 course.

Antirequisite: N/A

Prerequisites: ECE2231 A/B, ECE2233 A/B, ECE3337 A/B

Unless you have either the requisites for this course or written special permission from your Dean to enroll in it, you will be removed from this course and it will be deleted from your record. This decision may not be appealed. You will receive no adjustment to your fees in the event that you are dropped from the course for failing to have the necessary prerequisites

CEAB Units: Science 34%, Engineering Science 66%

Suggested Textbook:

Robert Sobot, “Wireless Communication Electronics – Introduction to RF Circuits and Design Techniques”, ISBN 978-1-4614-1117-8, Springer, 2012.

Robert Sobot, “Wireless Communication Electronics by Example”, ISBN 978-3-319-02871-2, Springer, 2013.

Additional Reference:

R.L. Boylestad and L. Nashelsky, Electronic Devices and Circuit Theory, Canadian Edition. Allan.
R. Hambley, Electrical Engineering, Principles and Applications, Pearson, Prentice Hall

General Learning Objectives (CEAB Graduate Attributes)

Knowledge Base	A	Use of Engineering Tools	A	Impact on Society and the Environment	
Problem Analysis	A	Individual and Team Work		Ethics and Equity	
Investigation	D	Communication Skills	D	Economics and Project Management	
Design		Professionalism		Life-Long Learning	

Notation: I – The instructor will introduce the topic at the level required. It is not necessary for the student to have seen the material before. D – There may be a reminder or review, but the student is expected to have seen and been tested on the material before taking the course. A – It is expected that the student can apply the knowledge without prompting (e.g. no review).

Topics and Specific Learning Objectives Topics:

1. Wireless Communication Principles

- Sources and sinks of analog information, bandwidth
- Frequency Spectrum and its regulation
- Noise and its calculus
- Power budget
- Propagation of EM waves
- SuperHeterodyne receiver general principle

2. Analog Communications Electronics:

- Matching circuits and Filters
- RF Oscillators and their design
- Frequency conversion. Mixers and their design
- AM/FM/PM Modulators
- performance measures
- Automatic gain control (if time permits)

3. Modern Communications Electronics and Communications Systems

- analog/digital interface
- DSP
- Software defined radio (SDR)
- Case study: car radio receiver

Specific Learning Objectives:

At the end of the course students are expected to be able to

1. Understand physical and engineering principles behind wireless communication systems. Design and test an RF amplifier with the antenna matching network. **KB2, PA2**
2. Understand theoretical principles behind oscillations and the resonance. Design and test functionality of an RF oscillator. **KB3, ET2**
3. Understand theoretical principles behind frequency conversion. Design and test functionality of a mixer. **PA3, ET2**
4. Understand theoretical principles behind AM/FM/PM signal modulation. Design and test functionality of an AM modulator. Analyze electronic circuits for AM/FM signal demodulation. Design and test functionality of an AM demodulator. **KB3, PA3, ET2**
5. Synthesize and analyze complete wireless communication system. Design a fully functional AM receiver and test its main specifications **KB3, PA3, ET3, CS2**
6. Understand and evaluate power budget of simple links. **PA3**
7. Understand modern hardware for RF designs (**not tested**)
8. Present results of investigation, design, analysis and evaluation in the form of technical report **CS2**.

Evaluation

Course Component	Weight
Projects (3)	20%+20%+20%
Quizzes (weekly)	10%
Final Examination	30%

To obtain a passing grade in the course, a mark of 50% or more must be achieved on the final examination. A final examination mark < 50% will result in a final course grade of 48% or less.

Assignments: A number of problems will be assigned for practicing and discussed during tutorials and office hours.

Quizzes: Quizzes will be given approximately every week in the beginning of the lecture hour. The quiz schedule will be posted and updated on the course website. Missed quizzes will not be rescheduled.

Final Examination: The final examination will take place during the regular examination period. The final examination will be an open book examination and 2 hours in duration.

Late Submission Policy: No late assignments will be accepted.

Project Submission : OWL

Use of English: In accordance with Senate and Faculty Policy, students may be penalized up to 10% of the marks on all assignments, tests, and examinations for improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.

Attendance: Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the department, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

Absence Due to Illness or Other Circumstances: Students should immediately consult with the instructor or department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see the attached “Instructions for Students Unable to Write Tests or Examinations or Submit Assignments as Scheduled”). The student should seek advice from the instructor or department Chair regarding how best to deal with the problem. Failure to notify the instructor or department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

For more information concerning medical accommodations, see the relevant section of the Academic Handbook: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_medical.pdf

For more information concerning accommodations for religious holidays, see the relevant section of the Academic Handbook: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/accommodation_religious.pdf

Missed Midterm Examinations: If a student misses a midterm examination, the exam will not be rescheduled. The student must follow the Instructions for Students Unable to Write Tests and provide documentation to their department within 24 hours of the missed test. The department will decide whether to allow the reweighting of the test, where reweighting means the marks normally allotted for the midterm will be added to the final exam. If no reasonable justification for missing the test can be found, then the student will receive a mark of zero for the test.

If a student is going to miss the midterm examination for religious reasons, they must inform the instructor in writing within 48 hours of the announcement of the exam date or they will be required to write the exam.

Course Delivery with Respect to the COVID-19 Pandemic:

Although the intent is for this course to be delivered in-person, the changing COVID-19 landscape may necessitate some or all of the course to be delivered online, either synchronously (i.e., at the times indicated in the timetable) or asynchronously (e.g., posted on OWL for students to view at their convenience). The grading scheme will not change. Any assessments affected will be conducted online as determined by the course instructor.

When deemed necessary, tests and examinations in this course will be conducted using a remote proctoring service. By taking this course, you are consenting to the use of this software and acknowledge

that you will be required to provide personal information (including some biometric data) and the session will be recorded. Completion of this course will require you to have a reliable internet connection and a device that meets the technical requirements for this service. More information about this remote proctoring service, including technical requirements, is available on Western's Remote Proctoring website at: <https://remoteproctoring.uwo.ca>.

Cheating and Plagiarism: Students must write their essays and assignments in their own words. Whenever students take an idea or a passage from another author, they must acknowledge their debt both by using quotation marks where appropriate and by proper referencing such as footnotes or citations. University policy states that cheating, including plagiarism, is a scholastic offence. The commission of a scholastic offence is attended by academic penalties, which might include expulsion from the program. If you are caught cheating, there will be no second warning.

All required papers may be subject to submission for textual similarity review to commercial plagiarism-detection software under license to the University for the detection of plagiarism. All papers submitted will be included as source documents on the reference database for the purpose of detecting plagiarism of papers subsequently submitted to the system. Use of the service is subject to the licensing agreement, currently between the University of Western Ontario and Turnitin.com (<http://www.turnitin.com>).

Scholastic offences are taken seriously and students are directed to read the appropriate policy, specifically, the definition of what constitutes a Scholastic Offence, in the relevant section of the Academic Handbook: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/scholastic_discipline_undergrad.pdf

Use of Electronic Devices: Students may use laptops, tablet computers, or smart phones *only* to access the course OWL site during lectures and tutorials. Use of *nonprogrammable* calculators *only* is permitted during quizzes and examinations. No other electronic devices may be used at any time during lectures, tutorials, or examinations.

Policy on Repeating All Components of a Course: Students who are required to repeat an Engineering course must repeat all components of the course. No special permissions will be granted enabling a student to retain laboratory, assignment, or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted by the student for grading in subsequent years.

Internet and Electronic Mail: Students are responsible for regularly checking their Western e-mail and the course web site (<https://owl.uwo.ca/portal/>) and making themselves aware of any information that is posted about the course.

Accessibility: Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 519-661-2111 ext. 82147 for any specific question regarding an accommodation.

Support Services:

Office of the Registrar <http://www.registrar.uwo.ca/>
Student Development Centre, <http://www.sdc.uwo.ca/>
Engineering Undergraduate Services, <http://www.eng.uwo.ca/undergraduate/>
USC Student Support Services, <http://westernusc.ca/services/>

Students who are in emotional/mental distress should refer to Mental Health @ Western, http://www.health.uwo.ca/mental_health/, for a complete list of options about how to obtain help.

*Western University - Faculty of Engineering
2019-2020*

**INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT
ASSIGNMENTS AS SCHEDULED**

IF, ON MEDICAL OR COMPASSIONATE GROUNDS, YOU ARE UNABLE TO WRITE TERM TESTS OR FINAL EXAMINATIONS OR COMPLETE COURSE WORK BY THE DUE DATE, YOU SHOULD FOLLOW THE INSTRUCTIONS LISTED BELOW. YOU SHOULD UNDERSTAND THAT ACADEMIC RELIEF WILL NOT BE GRANTED AUTOMATICALLY ON REQUEST. YOU MUST DEMONSTRATE TO YOUR DEPARTMENT (OR THE UNDERGRADUATE SERVICES OFFICE) THAT THERE ARE COMPELLING MEDICAL OR COMPASSIONATE GROUNDS THAT CAN BE DOCUMENTED BEFORE ACADEMIC RELIEF WILL BE CONSIDERED. DIFFERENT REGULATIONS APPLY TO TERM TESTS, FINAL EXAMINATIONS AND LATE ASSIGNMENTS. PLEASE READ THE INSTRUCTIONS CAREFULLY. (SEE THE 2017 UWO ACADEMIC CALENDAR).

4. GENERAL REGULATIONS & PROCEDURES

- All first year students will report to the Undergraduate Services Office, SEB 2097, for all instances.

- If you are an upper year student and you are missing a test/assignment/lab or exam that is worth MORE THAN 10% of your final grade, you will report to the Undergraduate Services Office, SEB 2097. Otherwise, you will report to your department office to request relief.

- Check the course outline to see if the instructor has a policy for missed tests, examinations, late assignments or attendance.

- Documentation must be provided as soon as possible. If no one is available in your Department office or the Undergraduate Services Office, leave a message clearly stating your name & student number and reason for your call. The department telephone numbers are given at the end of these instructions.

- If you decide to write a test or an examination you should be prepared to accept the mark you earn. Rewriting tests or examinations or having the value of a test or examination reweighted on a retroactive basis is not permitted.

5. TERM TESTS

- If you are in first year and you are unable to write a term test, contact the Undergraduate Services Office, SEB 2097 PRIOR to the scheduled date of the test.

- If you are an upper year student and you are unable to write a term test, inform your instructor PRIOR to the scheduled date of the test. If the instructor is not available, leave a message for him/her at the department office. If the test is worth MORE THAN 10% of your final grade you will report to the Undergraduate Services Office, SEB 2097 to request relief. Otherwise, you will report to your department office to request relief.
- Be prepared to provide supporting documentation to the Department Chair and/or the Undergraduate Services Office (see next page for information on documentation).
- Discuss with the instructor if and when the test can be rescheduled. **N.B.** The approval of the Chair or the Undergraduate Services Office is required when rescheduling term tests.

6. **FINAL EXAMINATIONS**

- If you are unable to write a final examination, contact the Undergraduate Services Office PRIOR TO THE SCHEDULED EXAMINATION TIME to request permission to write a Special Final Examination. If no one is available in the Undergraduate Services Office, leave a message clearly stating your name & student number.
- Be prepared to provide the Undergraduate Services Office with supporting documentation (see next page for information on documentation) the next day, or as soon as possible (in cases where students are hospitalized). The following circumstances are not considered grounds for missing a final examination or requesting special examinations: common cold, sleeping in, misreading timetable and travel arrangements.
- In order to receive permission to write a Special Examination, you must obtain the approval of the Chair of the Department **and** the Associate Dean and in order to apply you must sign a "Recommendation for a Special Examination Form" available in the Undergraduate Services Office. The Undergraduate Services Office will then notify the course instructor(s) and reschedule the examination on your behalf.

N.B. It is the student's responsibility to check the date, time and location of the Special Examination.

7. **LATE ASSIGNMENTS**

- Advise the instructor if you are having problems completing the assignment on time (**prior** to the due date of the assignment).
- Be prepared to provide documentation if requested by the instructor (see reverse side for information on documentation).
- If you are granted an extension, establish a due date. The approval of the Chair of your Department (or the Associate Dean if you are in first year) is not required if assignments will be completed prior to the last day of classes.
- i) Extensions beyond the end of classes must have the consent of the instructor, the department Chair and the Associate Dean. Documentation is mandatory.

ii) A Recommendation of Incomplete Form must be filled out indicating the work to be completed and the date by which it is due. This form must be signed by the student, the instructor, the department Chair and the Associate Dean.

8. **SHORT ABSENCES**

If you miss a class due to a minor illness or other problem, check your course outlines for information regarding attendance requirements and make sure you are not missing a test, laboratory or assignment. Cover any readings and arrange to borrow notes from a classmate.

9. **EXTENDED ABSENCES**

If you are absent more than one week or if you get too far behind to catch up, you should consider reducing your workload by dropping one or more courses. (Note drop deadlines listed below). You may want to seek advice from the academic counsellor in your Department or Ms. Karen Murray in the Undergraduate Services Office, if you are in first year.

10. **DOCUMENTATION**

If you consulted an off-campus doctor or Student Health Services regarding your illness or personal problem, **you must provide the doctor with a Student Medical Certificate** to complete at the time of your visit and then bring it to the Department (or the Undergraduate Services Office). **This note must contain the following information: severity of illness, effect on academic studies and duration of absence. Regular doctor's notes will not be accepted; only the Student Medical Certificate will be accepted.**

In Case of Serious Illness of a Family Member: Provide a Student Medical Certificate to your family member's physician to complete and bring it to the Department (or the Undergraduate Services Office if you are in first year).

In Case of a Death: Obtain a copy of the death certificate or the notice provided by the funeral director's office. You must include your relationship to the deceased and bring it to the Department (or the Undergraduate Services Office if you are in first year).

For Other Extenuating Circumstances: If you are not sure what documentation to provide, ask the Departmental Office (or the Undergraduate Services Office if you are in first year) for direction.
Note: Forged notes and certificates will be dealt with severely. To submit a forged document is a scholastic offence (see below).

11. **ACADEMIC CONCERNS**

- You need to know if your instructors have a policy on late penalties, missed tests, etc. This information may be included on the course outlines. If not, ask your instructor(s).
- **You should also be aware of attendance requirements in some courses. You can be debarred from writing the final examination if your attendance is not satisfactory.**
- If you are in academic difficulty, check out the minimum requirements for progression in the calendar. If in doubt, see your academic counsellor.

Calendar References: Check these regulations in your 2017 Western Academic Calendar available at www.westerncalendar.uwo.ca.

Absences Due to Illness: <http://westerncalendar.uwo.ca/2017/pg117.html>

Academic Accommodations for Students with Disabilities: <http://westerncalendar.uwo.ca/2017/pg118.html>

Academic Accommodations for Religious or Holy Days: <http://westerncalendar.uwo.ca/2017/pg119.html> Course

Withdrawals: <http://westerncalendar.uwo.ca/2017/pg157.html>

Examinations: <http://westerncalendar.uwo.ca/2017/pg129.html> Scheduling of Term Assignments: <http://westerncalendar.uwo.ca/2017/pg135.html>

Scholastic Offences: <http://www.westerncalendar.uwo.ca/2017/pg111.html>

Student Medical Certificate: http://www.uwo.ca/univsec/pdf/academic_policies/appeals/medicalform.pdf

Engineering Academic Regulations: <http://www.westerncalendar.uwo.ca/2017/pg1442.html>

Note: These instructions apply to all students registered in the Faculty of Engineering regardless of whether the courses are offered by the Faculty of Engineering or other faculties in the University

Drop Deadlines

First term half course (i.e. "A" or "F"):	November 5, 2023
Full courses and full-year half courses (i.e. "E", "Y" or no suffix):	November 30, 2023
Second term half or second term full course (i.e. "B" or "G"):	March 7, 2024

Contact Information:

Undergraduate Services Office: SEB 2097 Telephone: (519) 661-2130 E-mail: engugrad@uwo.ca

Dept. of Chemical and Biochemical Engineering & Green Process Engineering: TEB 477 Telephone: (519) 661-2131

E-mail: cbeugrad@uwo.ca

Dept. of Civil and Environmental Engineering: SEB 3005 Telephone: (519) 661-2139 E-mail: civil@uwo.ca

Dept. of Electrical and Computer Engineering, Software Engineering & Mechatronics Engineering: TEB 279 Telephone: (519) 661-3758 E-mail: eceugrad@uwo.ca

Dept. of Mechanical and Materials Engineering: SEB 3002 Telephone: (519) 661-4122 E-mail:

mmeundergraduate@uwo.ca