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Western University
Faculty of Engineering
Department of Electrical and Computer Engineering

ECE 9031: Advanced Digital Signal Processing
Course Outline 2017-18

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Description: Digital Signal Processing (DSP) is at the heart of many applications in a wide array of fields: speech and audio processing, system monitoring and fault detection, biomedical signal analysis, mobile and internet communications, radar and sonar, vibration measurement and analysis, seismograph analysis, image/video coding and decoding etc. The objective of this course is to strengthen the students' knowledge of DSP fundamentals, and to familiarize them with the practical aspects of DSP algorithm development and implementation.

Instructor: Dr. Vijay Parsa, P.Eng.
EC 2262E/TEB 241, 519-661-2111 ext. 88947/81252, vparsa@uwo.ca
Consultation hours: Thursdays between 9 AM – 12:30 PM in TEB 241.

Academic Calendar Copy: Digital Signal Processing (DSP) is widely used in speech and audio processing, biomedical engineering, and telecommunication applications. The objectives of this course are to strengthen the students' knowledge of DSP fundamentals, to introduce them to advanced DSP topics, and to familiarize them with the practical aspects of DSP algorithm implementation.

Contact Hours: 2 lecture hours, 3 laboratory hours every other week, 0.5 course.

Mondays: 8:30 AM – 10:30 AM or 6:30 PM – 8:30 PM in UCC-66 (Lecture)
Alternate Wednesdays: 3:30 PM – 6:30 PM in SEB-1004 and SEB-1011 (Lab). Lab schedule will be posted to course OWL site.

Prerequisite: ECE 3331A/B or equivalent

Anti-requisite: ECE 4429

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 a course for failing to have the necessary prerequisites.

Required Textbook: Tan, L., & Jiang, J. (2013). Digital Signal Processing: Fundamentals and Applications. Boston, USA: Academic Press.

Reference Textbook: Orfanidis, S. J. (2010). Introduction to signal processing. Prentice-Hall, Inc. http://www.ece.rutgers.edu/~orfanidi/intro2sp/orfanidis-i2sp.pdf

Topics and Specific Learning Objectives

1. **Sampling and quantization**

   At the end of this section, students will be able to:

   a. Understand the theory behind sampling and quantization processes.

   b. State the sampling, quantization and signal conditioning requirements for a given DSP application.

2. **Discrete Fourier Transform (DFT) and its applications**

   At the end of this section, students will be able to:

   a. Understand the theory behind DFT and Fast Fourier Transform (FFT)

   b. Apply FFT for spectrum analysis, convolution, and correlation.

   c. Apply FFT for filtering applications using overlap-add and overlap-save methods.

3. **Z-transform and its applications**

   At the end of this section, students will be able to:

   a. Understand Z-transform and related topics such as transfer function, frequency response, and pole-zero analysis.

   b. Design digital filters based on pole-zero placement.

4. **Design of FIR filters**

   At the end of this section, students will be able to:

   a. Understand the importance of linear phase and the different types of FIR filters.

   b. Design lowpass, highpass, bandpass, and bandstop FIR filters using the Kaiser window, frequency sampling and optimal design methods.

   c. Design FIR filters with arbitrary frequency response using frequency sampling method.

5. **Design of IIR filters**

   At the end of this section, students will be able to:

   a. Understand IIR filters and the structures for their implementation.

b. Design lowpass, highpass, bandpass, and bandstop IIR filters using Butterworth and Chebyshev prototypes.

6. Multirate Signal Processing

At the end of this section, students will be able to:

a. Understand the theory behind interpolators, decimators, and sampling rate converters.

b. Design and application of filterbanks.

Evaluation

Course Component	Weight
In-class problem sets	15%
Midterm	25%
Laboratory	25%
Final Examination	35%

To obtain a passing grade in the course, a mark of 60% or more must be achieved on the final examination, midterm, in-class problem sets and on the laboratory reports. A final examination, quiz, in-class problem set or laboratory mark < 60% will result in a final course grade of 58% or less.

In-class problem sets: Students are expected to work on a set of topic-specific problems during the lecture hours and submit the work at the end of the lecture period.

Midterm: The midterm will take place on November 1, 2017 between XXX p.m. – XXX p.m. in XX XXX. The midterm is limited open book. Use of calculators is limited to an acceptable make and model without large memory programming capability.

Laboratory: The laboratory portion of this course will consist of MATLAB-based experiments. Labs will be held every other week in SEB 1004/1011. Students are required to successfully complete the experiments and submit their MATLAB session (code & data) to OWL course site at the end of the laboratory time.

Final Examination: The final examination will take place during the regular examination period. The final examination is limited open book, with a duration of 3 hours. Use of calculators is limited to an acceptable make and model without large memory programming capability.

Late Submission Policy: Problem sets and laboratory results will be penalized by 50% of the available marks per day for late submission.

Submission Locker for late problem sets: Locker 206 located on the second floor of TEB.

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: All classes, laboratories, and tutorials are mandatory unless otherwise stated. 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 Examination: If a student misses the midterm, 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 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.

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.