University of Manitoba

Department of Electrical & Computer Engineering
Graduate Course Outline

WINTER 2023

ECE 7440 – Multidimensional Signal Processing

COURSE DESCRIPTION:

Signal Processing is an area of applied mathematics to perform useful operations on those signals. e.g., signal analysis and information extraction. This course covers topics that relate to multilinear processing of multidimensional (more than two) signals.

COURSE OBJECTIVE:

The objective of this course is to understand fundamental multilinear representations and algorithms for analyzing and extracting information from multidimensional (more than two) signals.

PRE-REQUISITES:

Undergraduate courses on Linear Algebra & Digital Signal Processing.

CONTACT HOURS:

3-hours per week

COURSE CONTENT:

The following topics will be discussed:

- Review of linear signal spaces
- Basic operations on multidimensional arrays (tensors)
- Multilinear operators on tensors
- CPD and Tucker tensor decompositions
- Hierarchical Tucker decompositions and Tensor Networks
- Multilinear Signal Spaces

Additional advanced research topics as determined by the instructor.

HOMEWORK:

Homework will consist of analytical or computer-based assignments.

TEXTBOOKS:

1. Tensor Networks for Dimensionality Reduction and Large-scale Optimization (Part 1, Low-Rank Tensor Decompositions) by Andrzej Cichocki (Now Publishers, 2016)

2. Tensor Spaces and Numerical Tensor Calculus by Wolfgang Hackbusch, (Springer 2012)

GRADE ANNOUNCEMENTS:

Grades for this course will be announced by May 2023

EVALUATION:

Your final course grade is determined by your performance in the components list below in the Evaluation Table (seminar, assignments, project, mid-term, and a final examination. Students must receive a minimum of 50% on the final examination and must complete and pass all components in the course in order to be eligible to receive a passing grade.

Each component is weighted as follows:

COMPONENT	NO	VALUE %	TOTAL VALUE	DETAILS / ADDITIONAL INFO
Seminars	0	0%	0	
Assignments	5	2%	10	
Project	1	10%	10	
Mid-Term Exam	1	30%	30	
Final Examination	1	50%	50	
TOTAL			100	

GRADE SCALE:

LETTER	MARK	LETTER	MARK	LETTER	MARK	LETTER	MARK
A+	95-100	B+	80-84	C+	65-69	D	45-54
A	85-94	B	70-79	C	55-64	F	<45

INSTRUCTOR INFO:

Name:..... Sherif S. Sherif
Office:..... E3-557 EITC
Tel:..... (204) 474-6893
Email:..... Sherif.Sherif@umanitoba.ca

Office Hours: ..... By appointment

VOLUNTARY WITHDRAW:

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REQUIREMENTS/REGULATIONS

Student Responsibilities: It is the responsibility of each student to contact the instructor if he/she is uncertain about his/her standing in the course and his/her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with, among others, incomplete term work, deferred examinations, attendance and withdrawal, etc..

Lectures: Attendance at lectures is essential for successful completion of this course. Students must satisfy each evaluation component in the course.

ACADEMIC INTEGRITY

Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism* or any other form of cheating is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university) regardless of media

- examinations
- assignments
- laboratory reports
- term exams

A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty

Please refer any questions regarding Academic Integrity to your course instructor.

***Plagiarism:** to steal and pass off (the ideas or words of another) as one's own; use (another's production) without crediting the source