EXPANDED COURSE DESCRIPTION
EARTH, SPACE SCIENCE AND ENGINEERING
Lassonde School of Engineering
Earth and Space Science and Engineering
LE / ESSE 4020 3.0 SECTION A
TIME SERIES AND SPECTRAL ANALYSIS
FALL 2017 / WINTER 2018

Last Modified Date: 08/18/2017

COURSE CALENDAR DESCRIPTION

Treatment of discrete sampled data involving correlation, convolution, spectral density estimation, frequency, domain filtering, and Fast Fourier Transforms. Three lecture hours. One term. Three credits. Prerequisites: LE/EECS 1011 3.00 or equivalent programming experience; SC/MATH 2015 3.00; SC/MATH 2271 3.00. Prior to Summer 2014: Prerequisites: LE/SC/CSE 1540 3.00 or equivalent programming experience; SC/MATH 2015 3.00; SC/MATH 2271 3.00. Course credit exclusions: LE/SC/CSE 3451 4.00, LE/SC/CSE 3451 3.00, SC/MATH 4130B 3.00, SC/MATH 4930C 3.00.

Course Listed Courses: PHYS 4060 , MATH 4060

INSTRUCTOR(S)

<table>
<thead>
<tr>
<th>Name</th>
<th>Section / Format / Term</th>
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ADDITIONAL INFORMATION

Course material will be online at http://www.yorku.ca/pat/ESSE4020/

Classes are in Bergeron 217 (TR 0830-10.00, starting Sept 07). Elise Shaw (Petrie 102 - elise.shaw@lassonde.yorku.ca) can grant permissions if you have had problems enrolling.

TOPICS COVERED

- Objectives and examples of time series analysis
- Auto- and cross covariance/correlation
- Fourier analysis
- Fourier transform
- FFT
- Power spectrum
- Wiener-Khintchine theorem
- Convolution and deconvolution
- Frequency domain filtering
- Impulse response and transfer function
- Windowing
- Aliasing
- Practical computations

COURSE LEARNING OUTCOMES

- Understand representation of time series (“data”) in the time and frequency domain
- Assess differences between continuous and discrete (“digital”) data
- Evaluate the properties of auto- and cross-covariance functions and convolution
- Develop relationships between operations in the Time Domain and Fourier Analysis and Power Spectrum analysis.
• Understand the Wiener-Khintchine and Convolution Theorems
• Apply knowledge to implementation of digital filters
• Learn to use matlab to implement theoretical foundations taught in class and analyze time series in the
time and frequency domain
• Use matlab to graphically represent data and results of their analysis

TEXTBOOK


• You can usually find this text free on the web, if you Google "Introduction to Time Series and
Forecasting, Brockwell".
• Both B&D versions come with software, ITSM2000 - student version. The library has CDs with
ITSM2000 or you can download; http://extras.springer.com and enter ISBN, 978-3-319-29852-8.
• There is also parallel material in "Introduction to Time Series and Forecasting“ by Douglas C.
Montgomery, Cheryl L. Jennings and Murat Kulahci available on line through the library.

Additional Texts:
• Time Series Analysis and Its Applications: With R Examples: H. Shumway and D.S. Stoffer (3rd
• Introductory time series with R: Cowpertwait, P. S. P. and Metcalfe, A. V. (CM2009). Available at

Please note: Both of these texts use R - which I strongly encourage you to learn and use, but you could use
MATLAB or OCTAVE as well.

“R”

R is widely used, free, statistics software, easy to install, easy to use and with good documentation,
including on time series. Start at https://www.r-project.org/ or R Quick Syntax Reference - library e-book or,
for time series go to https://a-little-book-of-r-for-time-series.readthedocs.io/en/latest/. There are also
additional libraries associated with SS2011/7.

The course will cover material that is in Chapters 1-4 of B&D, 1-6, 9 of CM2009 and 1-4 of SS2011 in some
depth plus additional material on Fourier and related spectral analyses, and selected topics from other
Chapters and Appendices.

ACADEMIC INTEGRITY LINKS

• Senate Policy on Academic Honesty -
  http://secretariat-policies.info.yorku.ca/policies/academic-honesty-senate-policy-on/
• Academic Integrity - http://lassonde.yorku.ca/academic-integrity

STUDENT LINKS

• Student Rights and Responsibilities - http://oscr.students.uit.yorku.ca/student-conduct
• Religious Observance - https://w2prod.sis.yorku.ca/Apps/WebObjects/cdm.woa/wa/regobs
• Academic Accommodation for Students with Disabilities -
  http://secretariat-policies.info.yorku.ca/policies/academic-accommodation-for-students-with-disabilities-policy/
• Counselling and Disability Services - http://cds.info.yorku.ca/

Yogi Berra or Niels Bohr?— 'It's tough to make predictions, especially about the future.' - we will also look
at the, all important, practical, forecasting aspects of time series.

Many courses utilize Moodle, York University's course website system. If your course is using Moodle,
click here to access it.

Moodle @ York University