

PROBABILITY AND STOCHASTIC SIGNALS MTH 5425, Aug 19 to Dec 11, Fall of **2019**

Instructor: *Eugene (aka Jewgeni) Dshalalow*, Dr. rer. nat., Professor of Mathematical Sciences

Meets MW from 7:00 to 8:15 pm at Skurla 106

Observed days: (1) Mon, Oct 14 (*Columbus Day*), (2) Mon-Tu, Oct 14-15 (*Fall Break*), (3) Mon, Nov 11 (*Veterans Day*), (4) Wed, Nov 27 to Fri, Nov 29 (*Thanksgiving*).

Main academic events: (1) Wed noon, Aug 28, last day to drop a class with the full tuition refund and without receiving a grade of W; (2) Fri, Oct 25, last day to withdraw from a class with a final grade of W; (3) Fri, Dec 6, last day of classes; (4) Final Exam, Wed, Dec 11, from 6:00 to 8:00 pm

Contacts: Office Phone: 8579, Department: 8091, Office Location: S308C (Crawford Science Tower)

<https://www.fit.edu/faculty-profiles/3/jewgeni-dshalalow/>

e-mails: edshalalow@scienceatlantic.net or eugene@fit.edu

PRIMARY TEXT: **LECTURE NOTES**, by Eugene Dshalalow

OTHER SUGGESTED TEXT: *Stationary Stochastic Processes for Scientists and Engineers*, by G. Lindgren et al., CRC Press, 2014, ISBN 13: 978-1-4665-8618-5.

Course Information. This course presents an introduction to probability theory, statistics of random processes, linear stochastic systems, and spectral theory of stochastic processes, with applications to *physics, electrical and computer engineering*. The course is based on instructor's lecture notes that are self-contained and complete. However, some students may want to consult the book by Lindgren et al. that can complement the lecture notes.

Course Description and Schedule

Weeks1-3. Combinatorial Analysis. Set theoretic preliminaries. Probability axioms and basic theorems. Conditional probability, Bayes theorem, independence. Discrete random variables. Moments. Transforms: probability and moment generating functions.

MIDTERM TEST 1, 75 minutes

Weeks4-6. Continuous univariate distributions: Exponential, Poisson, Binomial, Gaussian, Uniform, Erlang. Moment generating functions. Random vectors, independent random variables, sums and transforms of sums of independent random variables. Correlation.

MIDTERM TEST 2, 75 minutes

Weeks7-8. Statistics of Stochastic processes: mean, subcovariance, autocovariance, complex-valued random variables and stochastic processes, wide-sense stationary processes. Voltage process and its statistics. White noise, Poisson process. Random telegraph signal process. Estimators of mean and autocovariance. Wiener process. Systems with stochastic inputs. The Dirac delta function as an impulse function. Fourier transform. Fourier transform of the Dirac delta function. Linear, time-invariant, operators or filters (LTIO). System response under LTIO. Impulse response of a linear system. Examples with LRC circuits.

MIDTERM TEST 3, 75 minutes

Weeks9-10 Mean and autocorrelation of the system response with a wide-sense stationary input. Cross-correlation measurement system. The transfer function, unit sinusoid. The transfer function of a linear system. Examples of LR circuits. Spectral analysis, spectral density function. An illustration with the random telegraph process. White noise and an example with a voltage process. Spectral density response. Power transfer function. Example with an LR circuit.

FINAL EXAM, on September 18, from 5:00 to 7:00 pm.

Grading Policy. The overall score will be computed using 20% of each midterm test, and 40% of the final exam. The final course grade will be based on the following grading scale:

90-100% **A**
67-79.99% **C**

80-89.99% **B**
56-66.99% **D**

Please note that even if your overall score is 90% or more, to earn an A grade, your **final exam's score** must be at least **85%**. Furthermore, to pass the course you need to score at least **50% in the final exam**.

You are strongly encouraged to attend classes on a regular basis. You are responsible for all lecture materials and assignments. During lectures, I will also discuss various problems, pertinent to those in the exams.

All examinations will be **closed book and closed notes**. You are allowed to use any **non-smart calculator**. Note that the use of a mobile phone or a smart calculator (such as *N-Spire* manufactured by TI) during the exams is **prohibited**, because mobile phones as well as smart calculators can download course materials. Consequently, an underlying exam will be cancelled if any such devices are used.