NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

# MATH 477: Stochastic Processes
## *Spring 2021 Course Syllabus*

**NJIT Academic Integrity Code**: All Students should be aware that the Department of Mathematical Sciences takes the University Code on Academic Integrity at NJIT very seriously and enforces it strictly. The NJIT Academic Integrity Code applies to all activities associated with this course, including but not limited to homeworks, quizzes, projects, and examinations. As an example, when you submit a homework assignment, you are certifying that your paper contains only your work and is not copied from other people or sources. Any violation of the Academic Integrity Code by cheating, plagiarizing, or using online software or websites inappropriately will result in disciplinary action.

## COURSE INFORMATION

**Course Description**: This course introduces the theory and applications of random processes needed in various disciplines such as mathematical biology, finance, and engineering. Topics include discrete and continuous Markov chains, Poisson processes, as well as topics selected from Brownian motion, renewal theory, and simulation. Effective From: Spring 2009.

**Number of Credits**: 3

**Prerequisites**: Introductory Probability (Math 244 or Math 333), Linear Algebra (Math 337), and familiarity with basic ordinary differential equations.

**Course-Section and Instructors**

| Course-Section | Instructor |
|---|---|
| Math 477-102 | Professor D. Horntrop |

**Office Hours for All Math Instructors**: Spring 2021 Office Hours and Emails

**Required Textbook**:

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|---|---|
| **Title** | *Introduction to Probability Models* |
| **Author** | Ross |
| **Edition** | 11th |
| **Publisher** | Academic Pressv |
| **ISBN #** | 978-0124079489 |
| **Additional References** | S. Karlin and H. Taylor, *A First Course in Stochastic Processes*, contains a more theoretical treatment of many of the topics of this course.<br><br>P. Hoel, S. Port, and C. Stone, *Introduction to Stochastic Processes*, is a classical intro- duction to stochastic processes. |

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| | H. Taylor and S. Karlin, *An Introduction to Stochastic Modeling*, is similar in breadth and depth as our textbook. |

**University-wide Withdrawal Date**: The last day to withdraw with a **W** is **Monday, April 5, 2021**. It will be strictly enforced.

## COURSE GOALS

**Course Objectives and Description**: Instruction will gear toward concepts and methods of stochastic processes such as discrete- and continuous-time Markov chains, homogeneous and nonhomogeneous Poisson processes, and Brownian motion and related topics.

**Course Outcomes**

- Conditioning in probability and statistics
- Homogeneous and non-homogeneous Poisson processes
- Discrete and continuous Markov chains
- Brownian motion
- Simulate Poisson process event times, Metropolis—Hastings algorithm, Gibbs sampling
- Problem solving skills involving stochastic calculations

**Course Assessment**: Will be based on regular homework, one midterm exam, and one final exam.

## POLICIES

**DMS Course Policies**: All DMS students must familiarize themselves with, and adhere to, the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. DMS takes these policies very seriously and enforces them strictly.

**Grading Policy**: The final grade in this course will be determined as follows:

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| **Homework and Quizzes** | 30% |
| **Midterm Exam** | 35% |
| **Final Exam** | 35% |

**Attendance Policy**: Attendance at and participation in all lectures is expected. If you know in advance that you will be absent from class for a legitimate reason, please tell me prior to your absence so that appropriate arrangements (if any) can be made.

**Homework Requirements**:Homework assignments/projects will be given frequently. Each assignment must be turned in at the beginning of class through an upload to Canvas. Late assignments are NOT accepted. Your work must be shown in order to receive credit. You should read the relevant sections of the textbook prior to class.

**Quizzes**: From time to time, quizzes may be given. Make up quizzes are NOT given. Quizzes will be online and follow the same format as described above for examinations.

**Attendance:**Attendance at and participation in all lectures is expected. If you know in advance that you will be absent from class for a legitimate reason, please tell me prior to your absence so that appropriate arrangements (if any) can be made. Tardiness to class is very disruptive of the classroom environment and should be avoided.

**Exams**: There will be a midterm examination and a final examination. The midterm examination will occur before the “drop” deadline. The final examination date, time, and location will be determined by the university. Exams will given online and will be proctored using both the Respondus LockDown Browser/Monitor andWebex. Students will be required to join a Webex meeting from their cell phone with their cameras on, and

to access the exam through LockDown Browser on a computer with a webcam. Students must follow all instructions related to environment checks and camera positioning.

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| Midterm Exam | TBA |
| Final Exam Period | May 7 - 13, 2021 |

The final exam will test your knowledge of all the course material taught in the entire course. Make sure you read and fully understand the Math Department's Examination Policy. This policy will be strictly enforced.

**Makeup Exam Policy**: There will be **NO MAKE-UP QUIZZES OR EXAMS** during the semester. In the event an exam is not taken under rare circumstances where the student has a legitimate reason for missing the exam, the student should contact the Dean of Students office and present written verifiable proof of the reason for missing the exam, e.g., a doctor's note, police report, court notice, etc. clearly stating the date AND time of the mitigating problem. The student must also notify the Math Department Office/Instructor that the exam will be missed.

**Cellular Phones**: All cellular phones and other electronic devices must be switched off during all class times.

## ADDITIONAL RESOURCES

**Math Tutoring Center**: Located in the Central King Building, Lower Level, Rm. G11 (See: Spring 2021 Hours)

**Further Assistance**: For further questions, students should contact their instructor. All instructors have regular office hours during the week. These office hours are listed on the Math Department's webpage for Instructor Office Hours and Emails.

All students must familiarize themselves with and adhere to the Department of Mathematical Sciences Course Policies, in addition to official university-wide policies. The Department of Mathematical Sciences takes these policies very seriously and enforces them strictly.

**Accommodation of Disabilities**: The Office of Accessibility Resources and Services (OARS) offers long term and temporary accommodations for undergraduate, graduate and visiting students at NJIT.

If you are in need of accommodations due to a disability please contact Chantonette Lyles, Associate Director of the Office of Accessibility Resources and Services at 973-596-5417 or via email at lyles@njit.edu. The office is located in Kupfrian Hall, Room 201. A Letter of Accommodation Eligibility from the Office of Accessibilty Resources and Services authorizing your accommodations will be required.

For further information regarding self identification, the submission of medical documentation and additional support services provided please visit the Office of Accessibility Resources and Services (OARS) website at:

- https://www.njit.edu/studentsuccess/accessibility/

**Important Dates** (See: Spring 2021 Academic Calendar, Registrar)

| Date | Day | Event |
|---|---|---|
| January 19, 2021 | T | First Day of Classes |
| January 23, 2021 | S | Saturday Classes Begin |
| January 25, 2021 | M | Last Day to Add/Drop Classes |
| March 14 - March 21, 2021 | Su - Su | Spring Recess - No Classes |
| April, 2, 2021 | F | Good Friday - No Classes |
| April 5, 2021 | M | Last Day to Witdraw |
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| May 4, 2021 | T | Friday Classes Meet |
| May 4, 2021 | T | Last Day of Classes |
| May 5 & May 6, 2021 | W & R | Reading Days |
| May 7 - May 13, 2021 | F - R | Final Exam Period |

# Course Outline

| Course Topics |
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| Review of basic probability, common discrete and continuous distributions, moment gen- erating functions, conditional probability. |
| Discrete-time Markov chains, Chapman–Kolmogorov equations, classification of states, limiting probabilities, mean time in transient states, applications. |
| Exponential distribution, Poisson processes. |
| Continuous-time Markov chains, birth and death processes, transition probabilities, time reversibility. |
| Stationary processes, Brownian motion, Gaussian processes, white noise, pricing stock options. |

*Updated by Professor D. Horntrop- 1/15/2021*
*Department of Mathematical Sciences Course Syllabus, Spring 2021*