NJIT New Jersey's Science & Technology University

THE COLLEGE OF SCIENCE AND LIBERAL ARTS

THE DEPARTMENT OF MATHEMATICAL SCIENCES

MATH 477: Stochastic Processes
Spring 2019 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. This means that there must not be any forms of plagiarism, i.e., copying of homework, class projects, or lab assignments, or any form of cheating in quizzes and exams. Under the University Code on Academic Integrity, students are obligated to report any such activities to the Instructor.

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: Math 244 with a grade of C or better or Math 333 with a grade of C or better and Math 337 with a grade of C or better.

Course-Section and Instructors

Course-Section	Instructor
Math 477-002	Professor S. Subramanian

Office Hours for All Math Instructors: Spring 2019 Office Hours and Emails

Required Textbook:

Title	*Introduction to Probability Models*
Author	Ross
Edition	11th
Publisher	Pearson
ISBN #	978-0124079489
Notes	(Notes)

University-wide Withdrawal Date: The last day to withdraw with a **W** is **Monday, April 8, 2019**. 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:

Homework and Quizzes	20%
Midterm Exam	40%
Final Exam	40%

Your final letter grade will be based on the following tentative curve.

A	90 - 100	**C**	68 - 74
B+	85 - 89	**D**	50 - 67
B	80 - 84	**F**	0 - 49
C+	75 - 79		

Attendance Policy: Attendance at all classes will be recorded and is **mandatory**. Please make sure you read and fully understand the Math Department's Attendance Policy. This policy will be strictly enforced.

Homework Requirements: Homework assignments are due within a week unless announced otherwise by instructor. Late homework will not be accepted.

Exams: There will be one midterm exam held in class during the semester and one comprehensive final exam. Exams are held on the following days, which are subject to change:

Midterm Exam	March 15, 2019
Final Exam Period	May 10 - 16, 2019

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 2019 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: Disability Support Services (DSS) 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 Disability Support Services at 973-596-5417 or via email at lyles@njit.edu. The office is located in Fenster Hall Room 260. A Letter of Accommodation Eligibility from the Disability Support Services office 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 Disability Support Services (DSS) website at:

- http://www5.njit.edu/studentsuccess/disability-support-services/

Important Dates (See: Spring 2019 Academic Calendar, Registrar)

Date	Day	Event
January 22, 2019	T	First Day of Classes
February 1, 2019	F	Last Day to Add/Drop Classes
March 17 - 24, 2019	Su - Su	Spring Recess - No Classes, NJIT Open
April 8, 2019	M	Last Day to Withdraw
April 19, 2019	F	Good Friday - No Classes, NJIT Closed
May 7, 2019	T	Friday Classes Meet/ Last Day of Classes
May 8 & 9, 2019	W & R	Reading Days
May 10 - 16, 2019	F - R	Final Exam Period

Course Outline

Lecture	Sections	Topic
Week of 1/21	3.1-3.4	Conditional probability and conditional expectation
Week of 1/28	5.1-5.3	**POISSON PROCESSES - I** Definition of a Poisson process, properties

Week of 2/4	5.3	**POISSON PROCESSES - II** Interarrival and waiting time distributions; Conditional distribution of arrival times
Week of 2/11	5.4	**POISSON PROCESSES - III** Nonhomogeneous Poisson processes; applications to simulation
Week of 2/18	4.1-4.3	**DISCRETE-TIME MARKOV CHAINS - I** Introductory examples, definitions; Matrix of transition probabilities; Chapman-Kolmogorov equations; Classification of states
Week of 2/25	4.4-4.5	**DISCRETE-TIME MARKOV CHAINS - II** Long run behavior, stationary distribution; Applications
Week of 3/4	4.6-4.7	**DISCRETE-TIME MARKOV CHAINS - III** Recurrence and Transience; branching processes
Week of 3/11		**REVIEW AND MIDTERM EXAM**
Week of 3/25	6.1-6.2	**CONTINUOUS TIME MARKOV CHAINS - I** Definitions, Motivating examples, Application: Poisson process; Applications
Week of 4/1	6.3	**CONTINUOUS TIME MARKOV CHAINS - II** Birth and Death Processes
Week of 4/8	6.4-6.5	**CONTINUOUS TIME MARKOV CHAINS - III** The transition probability function; Backward and forward Kolmogorov differential equations; Limiting probabilities
Week of 4/15	10.1-10.2	**BROWNIAN MOTION - I** Hitting times; Maximum variable and the Gambler's Ruin problem
Week of 4/22	10.3	**BROWNIAN MOTION - II** Brownian motion with drift; Geometric Brownian motion
Week of 4/29	10.5-10.7	**BROWNIAN MOTION - III** Maximum of Brownian motion with drift; White Noise; Gaussian Processes
Week of 5/6		**BROWNIAN MOTION - III (CONTINUED)**