ENG EC534
Spring 2025

Catalog Data:

Discrete Stochastic Models Prereq: ENG EC 381 or ENG EK 500. Markov chains, Chapman-Kolmogorov equation. Classification of states, limiting probabilities, branching processes, time-reversible processes. Poisson process and its generalization, continuous-time Markov chains, birth and death processes, embedded Markov chains, applications to queuing systems, renewal processes. 4 cr.

Class/Lab Schedule:
Lecture: 4 hours/week

Textbooks and other required materials:
Ross, S.M., "Introduction to Probability Models," 12th edition, Elsevier Books, 2019. (Actually, any previous edition is good).

References:
1. Wolfe, R.W., "Stochastic Modeling and the Theory of Queues," Prentice Hall, 1989.
2. Taylor, H.M. and S. Karlin, "An Introduction to Stochastic Modeling," Academic Press, 1984.
3. Asmussen, S., "Applied Probability and Queues," J. Wiley & Sons, 1987.

Coordinator:

Prerequisites by topic:
EK300 or EK500, Probability Theory

Goals:
Presentation of discrete-time Markov chains, Poisson and related processes, continuous-time Markov chains, renewal processes, and their applications to queuing systems.

Course Outcomes:
As an outcome of completing this course, students should be able to:

1. *Understand and be able to use* discrete-time Markov chains, Poisson and related processes, continuous-time Markov chains, and renewal processes.
2. *Apply* probabilistic models to various problem of engineering and bioengineering practice.
3. *Be able to design* mathematical models for queuing systems, reliability, communication, etc. using the probabilistic processes.
4. *Communicate* in written and orally, using mathematical concepts and models learned.
5. *Know, understand, and appreciate* the importance of mathematical literacy and mathematical rigor in research and engineering practice.

Course Outcomes mapped to Program Outcomes:

	Educational Breadth	Understanding	Communication	Collaboration	Laboratory	Integrated View	Design	Discovery
Program Outcomes	**h, f**	**a, e**	**g**	**d**	**b**	**m**	**c**	**i**
Course Outcomes	**1-5**	**1-5**	**4**			**1-5**	**2, 3**	**3**
Emphasis (1-5)	**5**	**5**	**4**			**3**	**5**	**4**

1=not at all; 5=a great deal;
H: Educational Breadth- (technology and society)**, J**: Educational Breadth- (contemporary issues),
F: Educational Breadth- (professional and ethical responsibility), **A**: Understanding- (laws and principles),
E: Understanding-(problem solving), **G**: Communication, **D**: Collaboration,
B: Laboratory – design & conduct experiments**, K**: Laboratory – tool use, **M**: Integrated View**,**
C: Design, **I**: Discovery

Topics in Project Assignments:
1) Markov Chains, Chapman-Kolmogorov Equation. 2) Classification of States, Limiting Probabilities. 3) Branching Processes. 4) The Poisson Process and its Generalization. 5) Continuous-Time Markov Chains. 6) Birth and Death Processes. 7) Queuing Systems; Exponential Models. 8) The Systems M/M/s, M/G/1, G/M/1, and its Variations. 9) Renewal Processes.

Contribution of Course to Meeting the Professional Component:

Engineering topics: 30%
Math & Basic Science: 65%
General Education: 5%

Prepared by:
Lev B. Levitin

Percent in Final Grades:

Homeworks	30%
Mid-Term Exam	30%
Final Exam	40%