ECE 313 – COURSE SYLLABUS

1. Course number and name:

   ECE 313: Probability with Engineering Applications

   Spring 2026 Website: Link

2. Credits and contact hours

   Credit hours: 3

Days	Meeting time	Location
Tuesdays, and Thursdays	14:00 – 15:20	ECEB 1015

3. Instructor's or course coordinator's name, office hours

   - Prof. Ravishankar K. Iyer, rkiyer@illinois.edu

4. Textbook

   Sheldon M. Ross, *A First Course in Probability*, 9th edition, Pearson, 2012 (available online)

   Other resources:

   ECE 313 Course Notes: Probability with Engineering Applications (August 2021 edition) by Prof. Bruce Hajek (https://hajek.ece.illinois.edu/ECE313Notes.html)

   Sheldon M. Ross, *Introduction to Probability Models*, 11th edition, Academic Press, 2014 (available online)

5. Course information specific to Section A

   Probability theory with applications to engineering problems such as the reliability of circuits and systems to statistical methods for hypothesis testing, decision making under uncertainty, and parameter estimation.

   Prerequisite: MATH 286 or MATH 415

   Required for Computer Engineering and Electrical Engineering curricula.

   In addition to regular homework assignments, this section (Section A), will have two projects running throughout the semester, providing hands-on experience by applying probability concepts learned to-date on analyzing and providing insights using real systems data. Those projects are in-place of the second midterm.

6. Course goals

At the end of this course, the student will be able to apply the knowledge of probability and statistics gained in this course to several different types of problems in engineering.

1. Given a network of hosts that communicate with each other over links that are prone to failure, the student will be able to compute the probability that there exists a viable communication path between any two nodes in the network. (1) The student will also be able to model failure modes for systems composed of several subsystems as a network problem, and to solve such problems. (1)
2. The student will be able to formulate engineering decision-making problems as hypothesis testing schemes that compare likelihood ratios to thresholds. (1, 2) The student will be able to calculate the thresholds required to meet design specifications such as maximum false-alarm probabilities or detection probabilities. (1,3) The student will be able use Bayesian methods for the inference problems and for minimizing the average probability of error. (1,2)
3. The student will be able to specify maximum-likelihood estimates for system parameters. (1,2,3) The student will be able to estimate confidence intervals for parameters for any specified confidence level. (1)
4. The student will be able to compute probability distributions for the parameters of various systems, to estimate average values and variances of these parameters, and to estimate the probabilities that various design specifications are met. (1,3)

The course will allow the student to attain the following outcomes

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics.

2. an ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental factors.

3. ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions.

7. Brief list of topics to be covered

- Probability spaces
- Conditional probability and independence
- Basic probability distributions and how they arise
- Bayes’ rule and decision making under uncertainty
- Reliability of systems

- Random variables
- Functions of random variables
- Many random variables (joint distributions, covariance, prediction, etc.)
- Applications
- Limit theorems

8. Lecture Schedule (draft – dates are subject to update and change by TAs)

Date	Lecture No.	Concepts	Suggested Chapters	Class Notes	Homework/ Project	In-class Activity
Jan 20 (Tue)	Lecture 1	Probability theory fundamentals; Algebra of events; Probability axioms	Ch. 1–2 (Overview)		HW0 Assigned	
Jan 22 (Thu)	Lecture 2	Steps to problem solving; Combinatorial problems	Ch. 2.1–2.3			
Jan 27 (Tue)	Lecture 3	Conditional probability; Bayes' formula	Ch. 3.1–3.2			
Jan 29 (Thu)	Lecture 4	Total probability; Independence and mutual exclusivity	Ch. 3.3–3.4		HW1 Assigned (Jan 31st) [LINK]	
Feb 3 (Tue)	Lecture 5	Reliability evaluation applications: Series systems	Supplementary notes			
Feb 5 (Thu)	Lecture 6	Reliability evaluation applications: Parallel redundancy	Supplementary notes		HW1 Due (Feb 7th): SOLUTION / HW2 Assigned [LINK]	In-Class Activity 1: SOLUTION
Feb 10 (Tue)	Lecture 7	Bernoulli trials; TMR	Ch. 4.6 (Binomial)	Notes 1		
Feb 12 (Thu)	Lecture 8	More reliability application examples	Supplementary notes		HW2 Due: SOLUTION / HW3 Assigned [LINK]	
Feb 17 (Tue)	Lecture 9	Intro to random variables (discrete & continuous);	Ch. 4.1–4.5			

		PMF, CDF, PDF				
Feb 19 (Thu)	Lecture 10	Important discrete RVs (Bernoulli, Binomial, Poisson, Geometric)	Ch. 4.6–4.8		HW3 Due: SOLUTION / HW4 Assigned [LINK]	In-Class Activity 2: SOLUTION
Feb 24 (Tue)	Lecture 11	Important continuous RVs (Gaussian, exponential)	Ch. 5.1–5.4			
Feb 26 (Thu)	Lecture 12	Memoryless property; Relationship to Poisson	Ch. 5.5		HW4 Due: SOLUTION / HW5 Assigned [LINK]	
Mar 3 (Tue)	Lecture 13	Hypo-exponentials; TMR vs. TMR/simplex	Ch. 5.5–5.6 (supplement)			
Mar 5 (Thu)	Lecture 14	Hyper-exponentials	Ch. 5.6 (supplement)		HW5 Due: SOLUTION / HW6 Assigned [LINK]	
Mar 10 (Tue)	Midterm Solutions	MIDTERM EXAM				
Mar 12 (Thu)	Lecture 15	Project 1 Introduction / Expectation	Ch. 6.1–6.2		HW6 Due: SOLUTION/ PROJECT 1 Release	
Spring Break: March 14–22 (No classes Tue 3/17 & Thu 3/19)						
Mar 24 (Tue)	Lecture 16	Reliability evaluation apps: MTTF, failure rates, hazard functions	Supplementary notes			
Mar 26 (Thu)	Lecture 17	Moments; Mean & variance; Functions of RVs	Ch. 6.3–6.5		HW7 Assigned [LINK]	
Mar 31 (Tue)	Lecture 18	Joint distribution functions; Independence of RVs	Ch. 7.1–7.3			In-Class Activity 3: SOLUTION
Apr 2 (Thu)	Lecture 19	Covariance & correlation	Ch. 7.4–7.5		HW7 Due: SOLUTION / HW8 Assigned	

					[LINK]	
Apr 7 (Tue)	Lecture 20	Joint probability distributions	Ch. 7.6			
Apr 9 (Thu)	Lecture 21	Binary hypothesis testing	Supplementary notes		HW8 Due: SOLUTION / HW9 Assigned [LINK]	
Apr 14 (Tue)	Lecture 22	Project 2 Introduction / Types of errors; ROC curve	Supplementary notes			
Apr 16 (Thu)	Lecture 23	Max likelihood & MAP decision rules	Supplementary notes		HW9 Due: SOLUTION / HW10 Assigned [LINK] / PROJECT 2 Release	
Apr 21 (Tue)	Lecture 24	Limit theorems; Central limit theorem	Ch. 8.1–8.3			In-Class Activity 4: SOLUTION
Apr 23 (Thu)	Lecture 25	Markov inequality	Ch. 8.4		HW10 Due: SOLUTION	
Apr 28 (Tue)	Lecture 26	Wrap up	Review materials			
Apr 30 (Thu)	Lecture 27	Review for Final Exam	Review materials			
May 4 (Tue)	Lecture 28	TBD				

9. Exam Schedule

Exam	Date
Midterm	During the week before spring-break.
Final	Per campus exam calendar.

The midterm exams will be scheduled for 50 mins. Specific exam time TBA (will be arranged as the semester progresses). If you have an unavoidable medical or personal emergency, you must notify the instructor immediately. DRES students, please contact the instructor with DRES accommodation letter in the first 2 weeks.

10. Grading Policy

Final grades for ECE 313 will be weighted as shown below to determine your total score, which in turn, will determine your grade.

Components	**Proportion**
Homework	15%
In-class activity, quizzes, participation and attendance	10%
Project 1 Project 2	10% 15%
Midterm exam	20%
Final exam	30%

Furthermore:

- No late homework will be accepted.
- There are no make-ups for missed in-class activities or pop-up quizzes
- The lowest homework, in-class activity and quiz score will be dropped when determining the final grade.

11. Academic Integrity

Academic integrity is essential for maintaining the quality of scholarship in the Institute and for protecting those who depend on the results of research work performed by faculty and students in the Institute. The faculty of the University of Illinois Urbana-Champaign Institute expect all students to always maintain academic integrity in the classroom and the research laboratory and to conduct their academic work in accordance with the highest ethical standards of the engineering profession. Students are expected to maintain academic integrity by refraining from academic dishonesty, and by refraining from conduct which aids others in academic dishonesty, or which leads to suspicion of academic dishonesty. Violations of academic integrity will result in disciplinary actions ranging from failing grades on assignments and courses to probation, suspension or dismissal.