**EE 351K Probability, Statistics, and Random Processes** **Spring 2022 Unique ID: [17580]**
**Instructor: Sanjay Shakkottai**

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**Overview:** This course is an introduction to probability, statistics and random processes for engineers. It will focus on the fundamentals and applications of probability models and associated computations in computer and communication systems, statistical machine learning, algorithms, logistics, etc.

**Pre-requisites:** Math 427J or 427K with a grade of C- or higher.

**Textbook:** *Introduction to Probability,* Dimitri Bertsekas and John Tsitsiklis, Athena Scientific, 2nd edition, 2008. Homeworks may be derived from the text and the associated material (e.g. instructor manual).

**Optional References:** *Video Lectures:* John Tsitsiklis. 6.041SC Probabilistic Systems Analysis and Applied Probability. Fall 2013. Massachusetts Institute of Technology: MIT OpenCourseWare, `https://ocw.mit.edu`. License: Creative Commons BY-NC-SA. The links to these lectures are available on Canvas. These are provided as an optional reference.

**Class Hours:** Tuesday and Thursday, 2:00 PM - 3:30 PM in ETC 2.136. Office hours will be posted on Canvas.

**Class Structure:** The topics for each lecture has been provided at the end of this syllabus (also available on Canvas). You are required to read the associated material from the textbook (see the Detailed Course Schedule for sections to read for each lecture), and you will be tested twice a week (details below).

**Biweekly Quizzes:** We will hold an online quiz following each class. The quiz will be administered through Canvas. Each quiz will consist of two multiple choice questions.

The quiz will focus on the material covered in the assigned reading and the material covered in the lecture for that class. You will need to log into Canvas and answer two multiple choice questions. The quiz will open immediately after class (you will need a code to access the quiz that will be provided during the lecture), and is due before midnight of the next day. Specifically, the quiz will open immediately following the class on Tuesday (2 - 3:30 pm), and will be due before midnight on Wednesday. Similarly, the quiz will open immediately following the class on Thursday (2 - 3:30 pm), and will be due before midnight on Friday.

**Class Recordings:** As the semester progresses, we expect that the lectures will be delivered in-class. Due to COVID spread, some of the lectures might be delivered in an online mode (on Zoom), in which case the class recordings will be available on Canvas (e.g., the first two weeks of class). Class recordings are reserved only for students in this class for educational purposes and are protected under FERPA. The recordings should not be shared outside the class in any form. Violation of this restriction by a student could lead to Student Misconduct proceedings.

**Online Platforms:** Homework and related class material will be posted on Canvas – UT's course management platform. This is available at: `http://canvas.utexas.edu`. We will be using *Piazza* – an online discussion platform – for posting and answering questions regarding class and homework and using *Gradescope* for electronic submission and grading of homework. The details for signing into these platforms will be posted on Canvas.

**Teaching Assistant:** The course TA is Ramakrishna Annaluru. Details on contact information, meeting times and links are available on Canvas.

**Course Policy – General:** Attendance is required. You are responsible for material covered in the reading assignments (even if not covered in class) as well as material covered in class that is not in the book.

University disciplinary procedures will be invoked if any form of cheating is detected.

**Homework:** Homework will be assigned weekly. You will need to scan your homework and submit it electronically via Gradescope before 12 midnight on the due dates (see Detailed Course Schedule below). Late homework will not be accepted.

Groups of students (typically three, but a few groups could have either two or four members) will be assigned at the beginning of class. Each group is responsible for submitting a single homework, and typically the same homework score will be assigned to all students in a group. All students within each group are required to contribute equally to the solutions. We will be polling students within groups to ensure contributions from all (unequal contributions can potentially result in reduced grades for individual students). We also expect that homework solutions are written **neatly and clearly.** We hope that this group will also serve as your informal study group. One member from the group will upload the homework on Gradescope on behalf of the group.

**Mid-Term Exams:** There will be two mid-term exams.

(i) Exam 1 – *Thursday, March 3*

(ii) Exam 2 – *Thursday, April 14*

These exams are closed book, however you are allowed to bring one cheat-sheet (8.5 x 11 inch paper). You can write on both sides. The material on the cheat sheet needs to be handwritten, and you need to turn these in along with your exam.

If you think you might miss an exam, you need to let the instructor know prior to the exam. The instructor will determine if the absence is excused on a case-by-case basis (e.g. medical condition with doctor's note, required participation in an official University event). If you have an excused absence for an exam, your exam score will be calculated as the weighted average of the other mid-term exam and final scores based on their relative weights. Unexcused absence will result in zero points for the exam.

**Grading:**

(i) Quiz: 10%

(ii) Homework: 10%

(iii) Exam 1: 25%

(iv) Exam 2: 25%

(v) Final Exam: 30% (tentative – Wednesday, May 11, 9 am to noon)

There will be 24 daily quizes and 12 homework sets. The two (2) lowest scoring homeworks will be dropped when computing your overall grade. Further, the four (4) lowest scoring daily quizes will also be dropped for determining the overall grade. Note that extra credit quizes might be assigned, in which case the top twenty (20) highest scoring quizes will be taken for determining the overall grade.

The overall course grade will be based on a curve. We expect roughly 25% of the students to get an A, 25% a B, 50% a C or below. However we reserve the right to move these based on the degree to which we feel students have mastered the material and the quality of their work. Further, we might give $+/-$ grades for students on the curve decision boundaries.

**Notices from the University:** If you have any questions regarding the notices below, please contact appropriate offices as detailed below.

"*Privacy in Canvas:* Information in Canvas is protected by your UTEID login. Please be aware that I will use a merged Canvas site for all sections of the course that I am teaching this semester. This will allow students in other sections to see that you are enrolled in the course and send you email from within Canvas. However, they will not actually learn your email address and no other personal data will be revealed through Canvas. If you have any concerns, please contact the ITS Help Desk at 475-9400 for help removing your name from view of other students."

"*Academic adjustment:* The University of Texas at Austin provides, upon request, appropriate academic adjustments for qualified students with disabilities. For more information, contact the Office of the Dean of Students at 471-6259, 471-4241 TDD or the College of Engineering Director of Students with Disabilities at 471-4321."

# EE 351K Detailed Course Schedule – Spring 2022

| Date | Topic | Required Reading | HW-due |
|---|---|---|---|
| Tu 1/18 | Introduction and Set Theory | 1.1 | |
| Th 1/20 | Probability Models | 1.1-1.2 | |
| Tu 1/25 | Conditioning, Bayes Rule and Total Probability | 1.3-1.4 | 1 |
| Th 1/27 | Independence | 1.5 | |
| Tu 2/1 | Counting | 1.6 | 2 |
| Th 2/3 | Discrete RVs, PMFs, Expectation | 2.1-2.4 | |
| Tu 2/8 | Joint PMFs | 2.4-2.6 | 3 |
| Th 2/10 | Conditioning and Independence (with multiple RVs) | 2.6-2.7 | |
| Tu 2/15 | Continuous RVs, PDFs and Normal RV | 3.1-3.3 | 4 |
| Th 2/17 | Joint PDFs and Conditioning | 3.4-3.5 | |
| Tu 2/22 | Continuous Bayes Rule, Derived Distributions | 3.6-4.1 | 5 |
| Th 2/24 | Covariance and correlation | 4.1-4.2 | |
| Tu 3/1 | Review Class | | 6 |
| Th 3/3 | **Midterm 1, covers 1/19 – 2/25** | | |
| Tu 3/8 | Conditional Expectation and random sums of RVs | 4.3, 4.5 | |
| Tu 3/10 | Markov and Chebyshev Inequalities, Weak Law of Large Numbers | 5.1-5.3 | |
| Tu 3/15 | **Spring Break** | | |
| Th 3/17 | | | |
| Tu 3/22 | Central Limit Theorem | 5.4 | 7 |
| Th 3/24 | Bayesian Inference, Hypothesis Testing, MAP Rule | 8.1-8.2 | |
| Tu 3/29 | LMS, LLMS | 8.3-8.4 | 8 |
| Th 3/31 | Parameter Estimation | 9.1 | |
| Tu 4/5 | Linear regression | 9.1-9.2 | 9 |
| Th 4/7 | Hypothesis Testing | 9.3-9.4 | |
| Tu 4/12 | Review Class | | 10 |
| Th 4/14 | **Midterm 2, covers 1/19 – 4/8** | | |
| Th 4/19 | Discrete Time Markov Chain (DTMC) | 7.1-7.2 | |
| Tu 4/21 | Steady-State Behavior of DTMC | 7.3 | |
| Th 4/26 | Absorption of DTMC | 7.4 | 11 |
| Th 4/28 | Poisson process (definition and construction) | 6.2 | |
| Tu 5/3 | Poisson process (properties) | 6.2 | |
| Th 5/5 | Review Class | | 12 |
| | **Final Exam – Wednesday, May 11, 9 am to noon (tentative)** | | |