Description: Engineers and scientists deal with systems, devices, and environments that contain unavoidable elements of randomness. Probability theory is a mathematical tool that allows logical ways to reason about knowledge and uncertainty. This course introduces 3rd- and 4th-year electrical and computer engineering students to basic concepts in probability theory.

ECE302 2020 Learning Outcomes

- Understand the basic concepts of probability, random variables, probability distribution, and joint probability distribution.
- Acquire basic knowledge of discrete and continuous, univariate, and multi-variate probability distribution functions.
- Have an appreciation for probabilistic analysis techniques.

Textbook: A. Leon-Garcia**, *Probability and Random Processes for Electrical Engineering*, Third Edition, Addison Wesley, ISBN-13: 978-0-13-147122-1.

Instructor: Konstantinos N (Kostas) Plataniotis; Email: kostas (AT) ece.utoronto.ca
    (http://www.comm.utoronto.ca/~kostas)

Course Website: The course will be administered via Quercus. Communications with the instructor and Teaching Assistants, announcements, on-line course notes, detailed course notes, assigned homework, homework solutions, evaluations (midterms and finals), and grades, and will be posted here. Please ensure that you always have to the Quercus based ECE302 page. **There is only one ECE302 web page**. Tutorial section-based web pages will also be introduced.

Evaluation: There will be three midterms and a final examination. The composition of the final ECE302 mark is as follows:

Composition of final mark

Off-line Time limited Final Examination	40%
Off-line Time limited Midterm Test 1	20%
Off-line Time limited Midterm Test 2	20%
Off-line Time limited Midterm Test 3	20%
Total	100%

Note:
1. Petitions related to any evaluation must be submitted online through the Term-Work Petition system: http://uoft.me/termworkpetition
2. Midterm tests will be 60 minutes long. They will be following **UofT's offline time limited examination** paradigm (i.e. https://crowdmark.com/).
3. **The final examination will be 2 ½ hours long (150 minutes) minutes long and it will be a "crowdmark based" offline time limited examination.**

Coverage

Week	First Nominal Lecture	Second Nominal Lecture	Third Nominal Lecture
WK 0			**Start: FRIDAY, September 11, 2020** Course Introduction, Random Experiments, Relative Frequency (ch 1.3, 2.1)
WK1 14/09-18/09	Events, Axiomatic Definition of Probability, Properties of Probability (ch 2.2)	Properties of Probability, Specifying Probability: Discrete and Continuous (ch 2.2)	Computing Probability by Counting (ch 2.3)
WK2 21/09-25/09	Conditional Probability (ch 2.4)	Total Probability, Bayes' Rule (ch 2.4)	Independence of Events (ch 2.5)
WK3 28/09-02/10	Sequential Experiments, Independent Bernoulli Trials, Binomial, Geometric Probability Laws (ch 2.6)	Random Variables, Discrete RVs, PMF (ch 3.1, 3.2)	Expected Value: Discrete, Expected Value of g(X) (ch 3.3)
Midterm 1 - Coverage: Chapter 2; Sections: 2.1, 2.2., 2.3, 2.4, 2.5, 2.6 **Off-line Time Limited Examination** **Tuesday, October 6, 2020**			
WK4 05/10-09/10	Variance, Conditional PMF and Expectation (ch 3.3, 3.4)	Important Discrete RVs: Uniform, Bernoulli, Binomial (ch 3.5)	Important Discrete RVs: Geometric, Poisson (ch 3.5)
WK5 13/10 - 16/10	**12/10 Thanksgiving holiday**	Cumulative distribution Function CDF (ch 4.1)	Types of RVs, PDF, (ch 4.1, 4.2)
Midterm 2 – Coverage: Chapter 2; Sections: 2.1, 2.2., 2.3, 2.4, 2.5, 2.6 **&** **Chapter 3; Sections: 3.1, 3.2, 3.4, 3.5; Chapter 4; Section 4:1** **Off-line Time Limited Examination** **Tuesday, October 20, 2020**			
WK6 19/10-23/10	Conditional CDF and PDF (ch 4.2)	Expected Values (ch 4.3)	Important Continuous RVs: Uniform, Exponential, Gaussian (ch 4.4)
Wk7 26/10-30/10	Gaussian, Gamma, Cauchy (ch 4.4), Function of RV (ch 4.5)	Function of RV (ch 4.5)	Function of RV, Markov and Chebyshev Inequalities (ch 4.5, 4.6)

	Midterm 3 – Coverage: Chapter 3; Sections: 3.1, 3.2, 3.4, 3.5 & Chapter 4; Sections: 4.1, 4.2, 4.3, 4.4, 4.5, 4.6 Off-line Time Limited Examination Tuesday, November 3, 2020		
WK8 02/11-06/11	Characteristic Function (ch 4.7)	Two RVs, Joint PMF (ch 5.1, 5.2)	Marginal PMF, Joint CDF, Marginal CDF (ch 5.3)
	Fall Semester Break 09/11-13/11		
WK9 16/11 - 20/11	Joint PDF, Marginal PDF (ch 5.4)	Joint CDF/PDF, Two Mixed RVs (ch 5.3, 5.4)	Independence of Two RVs (ch 5.5)
WK10 23/11-27/11	Expected Value of a Function of Two RVs, Correlation, Covariance (ch 5.6)	Conditional Probability and Density with Two RVs (ch 5.7)	Total Probability, Conditional Expectation (ch 5.7)
WK11 30/11-04/12	One Function of Two RVs (ch 5.8)	Transformation of Two RVs (ch 5.8)	Two Jointly Gaussian RVs (ch 5.9)
WK12 07/12-09/12	Sum of RVs, Sample Mean, Law of Large Numbers (ch 7.1, 7.2)	Central Limit Theorem (ch 7.3)	**END: Wednesday, December 9, 2020**
	Final Examination – Coverage: Chapter 2,3,4,5, 7 ALL pertinent Sections Off-line Time Limited Examination		

Note: The lecturing schedule is provided for information purposes only. All specific details are subject to change (with notice).

Special Note: ECE302 - 2020 FALL Organizational structure

The course is organized into three main components. **The lectures, the tutorials, and the homework readings**. In Fall 2020 each of these contribute uniquely to deepen understanding and enrich your (online) learning. Please note the following:

A. Lectures

ECE302 – 2020Fall makes use of four types of lecturing material.

1. Per lecture hour notes in PDF format following the lecturing schedule included in this syllabus.
2. Per week summary notes in PDF format offering a succinct summary of the material covered

within a week. **Please note that there will be ten (10) summaries posted on your web page**.
3. Per week summary - audio recordings of (2) above.
4. **Video 'lecturettes". Each week will be one or two lectures on the most important topics to be covered that week.**

o Lectures will be delivered in asynchronous mode.

The approach presents two challenges, namely a) it does not allow for interaction, and b) it isolates concepts that need to be understood in interaction with other.

Timetable: Nominal Lecturing Schedule

Activity	Day and Time	Instructor	Location	Class Size	Current Enrolment
Lec 0101	FRIDAY 10:00-11:00 TUESDAY 10:00-11:00 WEDNESDAY 10:00-11:00	K Plataniotis	Online asynchronous	100	100
Lec 0102	WEDNESDAY 10:00-11:00 FRIDAY 10:00-11:00 TUESDAY 10:00-11:00		Online asynchronous	100	91
Lec 0103	WEDNESDAY 10:00-11:00 TUESDAY 10:00-11:00 FRIDAY 10:00-11:00		Online asynchronous	100	87

B. Tutorials

There are five tutorial groups. Normally, in typical delivery mode, tutorials are two hours long and are held weekly. Teaching assistants typically cover homework exercise problems, take questions from students, and present extended examples or applications of probability theory. However, in 2020Fall, we are dividing you into smaller seminar groups for better on-line discussion, and to accommodate participation from different time zones. To that end, we plan to utilize normal tutorial slots and lecture slots. The tutorial facilitators (Teaching Assistants) will be provided to students prior to the start of the first tutorial. Tutorial sessions will be running as follows:

Revised Tutorial Schedule

Tutorial Activity	Day and Time	Facilitator	Current Enrolment
Tut 0101	THURSDAY 10:00-11:00 FRIDAY 10:00 – 11:00		55
Tut 0102	WEDNESDAY 10:00 – 11:00 FRIDAY 16:00-17:00		59
Tut 0103	WEDNESDAY 10;00 – 11:00 FRIDAY 13:00-14:00		57
Tut 0104	FRIDAY 10:00 – 11:00 FRIDAY 16:00-17:00		59
Tut 0105	FRIDAY 10:00 – 11:00 FRIDAY 16:00-17:00		47

Tutorial sessions provide students with a relax setting for discussing important topics and engaging in critical thinking. Learning relies on you to exchange perspectives, information, and contributions towards solutions. Students can prepare for the on-line tutorial sessions by viewing the pre-recorded material, studying posted notes, and solving the assigned problems (homework readings). As part of the tutorial sessions problems will be presented and solved each week, and students are encouraged to formulate their own questions to bring to the tutorial session each week. In certain occasions, during the on-line session students may be asked to complete short (on-line) tasks.

- o **Tutorials will not start until the second Full week of the semester (week of Monday, September 14, 2020.**
- o **Tutorials will be delivered in synchronous mode.**
- o **Visual input (cameras) may be used during the tutorial sessions to facilitate interaction.**
- o **All tutorial sessions will be recorded, and material will be posted on the pertinent web page.**

C. Homework Problems / Readings

While ECE302 is one of the most interesting and useful courses in electrical and computer engineering, it is also a challenging upper-year course. **To do well in this course you must *keep up to date with the on-line class schedule***. The best way to accomplish this is to *practice*, through the assigned homework and other exercise problems. **In Fall 2020 homework problems have been pre-announced, and their solutions have been posted**. Thus, homework solutions will not be collected, but you are required to work out the problems when the pertinent material is covered and before you consult the solutions.

ECE302 Fall 2020 Homework Assignments
Assignment #1:
1.1, 1.2, 1.5, 2.2, 2.4, 2.5, 2.9, 2.23, 2.24
Assignment #2:
2.36, 2.38, 2.49, 2.54, 2.63, 2.73, 2.74, 2.75, 2.76, 2.77
Assignment #3:
2.82, 2.85, 2.92, 2.95, 2.97, 2.99, 2.101, 2.104, 2.126, 2.128
Assignment #4:
3.8, 3.10, 3.12. ab, 3.13, 3.17, 3.25.b, 3.27, 3.31, 3.36.ab, 3.41, 3.43
Assignment #5:
3.44, 3.49, 3.52, 3.53, 3.56, 3.57, 3.63, 3.65, 3.66, 4.5, 4.6, 4.7
Assignment #6:
4.12, 4.16, 4.17, 4.19, 4.27.ab, 4.35, 4.38, 4.39, 4.41, 4.48, 4.54, 4.56
Assignment #7:
4.62, 4.63, 4.64, 4.67, 4.68, 4.69
Assignment #8:
4.77, 4.79, 4.82, 4.85, 4.88, 4.91, 4.99, 4.100, 4.102, 4.104, 4.105, 4.106
Assignment #9:
5.8 (a - e), 5.9, 5.11, 5.14, 5.17, 5.26, 5.31, 5.33
Assignment #10:
5.40, 5.41, 5.42, 5.45, 5.48, 5.56, 5.57, 5.58, 5.63 5.64, 5.68, 5.76, 5.79, 5.80
Assignment #11: (optional – will not be discussed in a tutorial session)
5.81(a, b), 5.84, 5.86, 5.88, 5.93, 5.95, 5.96, 5.98, 5.99, 5.102, 5.105, 5.111, 5.113.
Assignment #12: (optional – will not be discussed in a tutorial session)
7.1, 7.5, 7.8, 7.9, 7.16, 7.17, 7.23, 7.26, 7.29

D. Learning Schedule

The following schedule provides you with a weekly outline for your workflow.

- **Tuesday-Wednesday-Friday:** 3 sets of lecturing notes and a weekly summary (all in PDF) have been posted on the course web page for each week. **Students must complete readings prior to your tutorial session on the same subject matter.**
- **Tuesday:** Video lecturettes will be posted to the course web page by Tuesday at the latest. Please watch pertinent recorded material prior to your synchronous tutorial sessions.
- **Wednesday-Friday:** Synchronous tutorial seminar. Please attend your assigned tutorial session day/time. The synchronous tutorial sessions, facilitated by your teaching assistant, **will begin promptly at 10 minutes after the hour.**

ECE302 Fall 2020 Statements

1. **Academic Integrity Policies**

http://www.academicintegrity.utoronto.ca/
https://governingcouncil.utoronto.ca/secretariat/policies/code-behaviour-academic-matters-july-1-2019

2. **Land Acknowledgement**

We wish to acknowledge this land on which the University of Toronto operates. For thousands of years it has been the traditional land of the Huron-Wendat, the Seneca, and most recently, the Mississaugas of the Credit River. Today, this meeting place is still the home to many Indigenous people from across Turtle Island and we are grateful to have the opportunity to work on this land.

3. **Inclusivity, Accommodations & Mental Health Support**

Inclusivity Statement:
You belong here. The University of Toronto commits to all students, faculty and staff that you can learn, work and create in a welcoming, respectful and inclusive environment. In this class, we embrace the broadest range of people and encourage their diverse perspectives. This team environment is how we will innovate and improve our collective academic success. You can read the evidence for this approach here.

We expect each of us to take responsibility for the impact that our language, actions and interactions have on others. Engineering denounces discrimination, harassment and unwelcoming behaviour in all its forms. You have rights under the Ontario Human Rights Code. If you experience or witness any form of harassment or discrimination, including but not limited to, acts of racism, sexism, Islamophobia, anti-Semitism, homophobia, transphobia, ableism and ageism, please tell someone so we can intervene. Engineering takes these reports extremely seriously. You can talk to anyone you feel comfortable approaching, including your professor or TA, an academic advisor, our Assistant Dean, Diversity, Inclusion and Professionalism, the Engineering Equity Diversity & Inclusion Action Group, any staff member or a U of T Equity Office.

You are not alone. Here you can find a list of clubs and groups that support people who identify in many diverse ways. Working together, we can all achieve our full potential.

4. **Statement on Accommodations**
The University of Toronto supports accommodations for students with diverse learning needs, which may be associated with mental health conditions, learning disabilities, autism spectrum, ADHD, mobility impairments, functional/fine motor impairments, concussion or head injury, blindness and low vision, chronic health conditions, addictions, deafness and hearing loss, communication disorders and/or temporary disabilities, such as fractures and severe sprains, or recovery from an operation.
If you have a learning need requiring an accommodation the University of Toronto recommends that students register as soon as possible with Accessibility Services

at https://studentlife.utoronto.ca/service/accessibility-services-registration-and-documentation-requirements/.