Course Outline
ECSE 205

Course Title:	**Probability and Statistics for Engineers**
Credits:	**3**
Contact Hours:	**(3-2-4)**
Course Prerequisite(s):	**N/A**
Course Corequisite(s):	**N/A**
Course Description:	**Probability: basic probability model, conditional probability, Bayes' rule, random variables and vectors, distribution and density functions, common distributions in engineering, expectation, moments, independence, laws of large numbers, central limit theorem. Statistics: descriptive measures of engineering data, sampling distributions, estimation of mean and variance, confidence intervals, hypothesis testing, linear regression.**

Canadian Engineering Accreditation Board (CEAB) Curriculum Content

CEAB curriculum category content	Number of AU's	Description
Math	**52**	Mathematics include appropriate elements of linear algebra, differential and integral calculus, differential equations, probability, statistics, numerical analysis, and discrete mathematics.
Natural science	**0**	Natural science includes elements of physics and chemistry, as well as life sciences and earth sciences. The subjects are intended to impart an understanding of natural phenomena and relationships through the use of analytical and/or experimental techniques.
Complementary studies	**0**	Complementary studies include the following areas of study to complement the technical content of the curriculum: engineering economics and project management; the impact of technology on society; subject matter that deals with the arts, humanities and social sciences; management; oral and written communications; health and safety; professionalism, ethics, equity and law; and sustainable development and environmental stewardship.
Engineering science	**0**	Engineering science involves the application of mathematics and natural science to practical problems. They may involve the development of mathematical or numerical techniques, modeling, simulation, and experimental procedures. Such subjects include, among others, applied aspects of strength of materials, fluid mechanics, thermodynamics, electrical and electronic circuits, soil mechanics, automatic control, aerodynamics, transport phenomena, elements of materials science, geoscience, computer science, and environmental science.
Engineering design	**0**	Engineering design integrates mathematics, natural sciences, engineering sciences, and complementary studies in order to develop elements, systems, and processes to meet specific needs. It is a creative, iterative, and open-ended process, subject to constraints which may be governed by standards or legislation to varying degrees depending upon the discipline. These constraints may also relate to economic, health, safety, environmental, societal or other interdisciplinary factors.

Accreditation units (AU's) are defined on an hourly basis for an activity which is granted academic credit and for which the associated number of hours corresponds to the actual contact time: one hour of lecture (corresponding to 50 minutes of activity) = 1 AU; one hour of laboratory or scheduled tutorial = 0.5 AU. Classes of other than the nominal 50-minute duration are treated proportionally. In assessing the time assigned to determine the AU's of various components of the curriculum, the actual instruction time exclusive of final examinations is used.

Graduate Attributes

This course contributes to the acquisition of graduate attributes as follows:

Graduate attribute	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
Level descriptor	I	I			I							

I = Introduced;   D = Developed;   A = Applied

KB - *Knowledge Base for Engineering: Demonstrated competence in university level mathematics, natural sciences, engineering fundamentals, and specialized engineering knowledge appropriate to the program.*

PA - *Problem Analysis: An ability to use appropriate knowledge and skills to identify, formulate, analyze, and solve complex engineering problems in order to reach substantiated conclusions.*

IN - *Investigation: An ability to conduct investigations of complex problems by methods that include appropriate experiments, analysis and interpretation of data, and synthesis of information in order to reach valid conclusions.*

DE - *Design: An ability to design solutions for complex, open-ended engineering problems and to design systems, components or processes that meet specified needs with appropriate attention to health and safety risks, applicable standards, economic, environmental, cultural and societal considerations.*

ET - *Use of Engineering Tools: An ability to create, select, adapt, and extend appropriate techniques, resources, and modern engineering tools to a range of engineering activities, from simple to complex, with an understanding of the associated limitations.*

IT - *Individual and Team Work: An ability to work effectively as a member and leader in teams, preferably in a multi-disciplinary setting.*

CS - *Communication Skills: An ability to communicate complex engineering concepts within the profession and with society at large. Such abilities include reading, writing, speaking and listening, and the ability to comprehend and write effective reports and design documentation, and to give and effectively respond to clear instructions.*

PR - *Professionalism: An understanding of the roles and responsibilities of the professional engineer in society, especially the primary role of protection of the public and the public interest.*

IE - *Impact of Engineering on Society and the Environment: An ability to analyse social and environmental aspects of engineering activities. Such abilities include an understanding of the interactions that engineering has with the economic, social, health, safety, legal, and cultural aspects of society; the uncertainties in the prediction of such interactions; and the concepts of sustainable design and development and environmental stewardship.*

EE - *Ethics and Equity: An ability to apply professional ethics, accountability, and equity.*

EP - *Economics and Project Management: An ability to appropriately incorporate economics and business practices including project, risk and change management into the practice of engineering, and to understand their limitations.*

LL - *Life-Long Learning: An ability to identify and to address their own educational needs in a changing world, sufficiently to maintain their competence and contribute to the advancement of knowledge.*

Policies

Academic Integrity

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the Code of Student Conduct and Disciplinary Procedures.
(see *www.mcgill.ca/students/srr/honest/* for more information).
(approved by Senate on 29 January 2003)

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded.
(approved by Senate on 21 January 2009)

Grading Policy

In the Faculty of Engineering, letter grades are assigned according to the grading scheme adopted by the professor in charge of a particular course. This may not correspond to practices in other Faculty and Schools in the University.

In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.

ECSE-205A PROBABILITY AND STATISTICS FOR ENGINEERS

Fall 2020

Additional Information

Instructor:	Prof. H. Leib, Tel. 398-8938, (Room 757 ENGMC, due to coronavirus restrictions will not be present in office) Email: harry.leib@mcgill.ca Office hours: please email your questions
Course delivery:	Lectures and tutorials will be delivered remotely through Zoom. All the information will be provided through the course web page on MyCourses.
Text book:	Jay L. Devore, *Probability and Statistics for Engineering and the Sciences, 9th ed.,* Cengage Learning (in Canada Nelson Education, Ltd.), 2016
Problem sets:	A number of problems will be assigned every 1-2 weeks for training. Problem sets will not be marked, however the solutions will be distributed.
Final mark composition:	Based on two midterm tests, and final exam. The midterm tests and the final exam will follow the on-line take home format, will be open book and notes, and will take place over a time slot of 50 hours. The midterm tests and final exam will be conducted through the course web page on MyCourses. More detailed instructions will be provided before each midterm test and the final exam. The final mark will be calculated as follows: Final_mark= 0.25*Test1 +0.25*Test2+ 0.5*Final_exam
Marking policy:	There will not be make-ups for students who miss a midterm test. Students who miss a midterm test due to a health condition should notify the instructor within a week of the test, and provide an adequate medical certificate stating the date and nature of the condition. In case the certificate is accepted, the mark of the missed test will be computed from that obtained in the final exam. Students who miss a midterm test for unjustified reasons will get a mark of zero.
	Any request for re-evaluation of a midterm test must be made in writing to the instructor, within a week of its return, by clearly stating the reasons for the need of re-evaluation.
First class:	Wednesday, Sept. 2, 2020.
Term test dates:	To be determined
Recommended references:	Roland E. Walpole, Raymond H. Myers, Sharon L. Myers, Keying Ye, *Probability & Statistics for Engineers & Scientists, 9th ed.,* Prentice Hall, 2012.
	H. Hsu, *Schaum's Outline: Probability, Random Variables, and Random Processes,* 2nd ed., McGraw-Hill, 2010 (coverage of theory is concise, however it contains many solved problems).
Online resources:	The Probability Web: http://probweb.berkeley.edu/probweb.html
	Virtual Lab in Probability and Statistics: http://www.math.uah.edu/stat/

Course Outline

Many engineering systems exhibit a behavior that is affected by randomness. Hence suitable tools have to be employed for the analysis and design of such systems. The mathematical disciplines that provides tools to cope with random phenomena, analytically or through computer simulations, is probability theory and statistics. Hence probability theory and statistics are indispensable subjects in modern engineering.

This is an introductory course in probability theory and statistics. Its objectives are to provide a solid foundation in this mathematical area, especially for students in electrical, computer and software engineering. This course will cover the following subjects:

1. Fundamental concepts

1.1) Determinism and randomness.

1.2) Main interpretations of probability.

1.3) Basic concepts of set theory.

1.4) Axiomatic probability model.

1.5) Conditional probability and statistical independence.

1.6) Combinatorial techniques in probability theory

2. Scalar random variables

2.1) The concept of a random variable, and the Cumulative Distribution Function (CDF).

2.2) Discrete random variables, the Probability Mass Function (PMF), and moments.

2.3) Commonly used models for discrete random variables.

2.4) Continuous random variables, the Probability Density Function (PDF), and moments.

2.5) Commonly used models for continuous random variables.

2.6) Transformations of a random variable.

2.7) The Moment Generating Function (MGF), and the Characteristic Function (CF).

3. Multivariate random variables

3.1) Multiple random variables, Joint CDF, and statistical independence.

3.2) Joint PMF and Joint PDF

3.3) Conditional CDF, Conditional PMF and conditional PDF.

3.4) Joint moments and conditional expectation.

3.5) Multivariate Gaussian random variables.

3.6) Joint MGF and Joint CF.

3.7) Convergence of random variable sequences, and limit theorems.

4. Statistics

4.1) Application of statistics in science and engineering, and representation of data.

4.2) Random samples, statistics and sampling distribution.

4.3) Point estimation

4.4) Hypotheses testing

4.5) Linear regression , the least-square principle, and some applications in Machine Learning

4.6) Correlation analysis