Carleton University  
Department of Systems and Computer Engineering  
SYSC-2510 Probability, Statistics and Random Processes for Engineers Winter 2020  
Course Outline

Instructor: Dr. Jean-Daniel Medjo Me Biomo  
Office Hour: Fridays 3-4 pm @ ME-4239  
Email: jemeda@sce.carleton.ca

TA Information: TBD

Calendar Description
http://calendar.carleton.ca/undergrad/courses/SYSC/

Prerequisites:
MATH 1004 and MATH 1104, and second-year status in Engineering.

Students who have not satisfied the prerequisites for this course must either withdraw from the course or obtain a prerequisite waiver by visiting the Engineering Undergraduate Academic Support Office.

Assumed Knowledge:
Upon entry into this course, students are expected to have knowledge of: Integrals; Techniques of integration and their applications to areas and volumes; Systems of linear equations; and Linear transformations.

Course Objectives:
This course will cover topics in probability theory and random processes with applications in Communications Engineering. In particular, the course covers probability model, counting methods, discrete and continuous random variables (R.V.), computer generation of R.V.’s, conditional distribution, multiple R.V.’s, functions of several R.V.’s, expected value of functions of R.V.’s (moments, correlation, and covariance), laws of large numbers, central limit theorem, and introduction to random processes.

Learning Outcomes (LOs):
By the end of the course, students will be able to:
1. Distinguish between deterministic and probabilistic models.
2. Analyze continuous and discrete-time random processes.
3. Understand the fundamentals of probability, conditional probability and independence of events.
4. Deal with cumulative distribution function, probability density function, conditional distribution and expected values for one or multiple random variables.
5. Apply the fundamentals of probability theory and random processes for solving practical engineering problems in communication and information systems.
6. Understand Markov processes and queueing theory.

Graduate Attributes (GA’s)
The Canadian Engineering Accreditation Board requires graduates of engineering programs to possess 12 attributes at the time of graduation. Activities related to the learning outcomes listed above are measured throughout the course and are part of the department’s continual improvement process. Graduate attribute measurements will not be taken into consideration in determining a student’s grade in the course. For more information, please visit: https://engineerscanada.ca/.

Activities related to the learning outcomes listed above are intended to develop students' competence in 3 of these attributes. The mapping is shown in the table below:

<table>
<thead>
<tr>
<th>Graduate Attribute</th>
<th>Learning Outcome (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1: Knowledge Base: Mathematical skills</td>
<td>1, 3, 6</td>
</tr>
<tr>
<td>2.1: Problem Analysis: Problem definition</td>
<td>2, 4, 5</td>
</tr>
<tr>
<td>2.2: Problem Analysis: Approach to the Problem</td>
<td>2, 4, 5</td>
</tr>
<tr>
<td>2.4: Problem Analysis: Interpreting the Solution - validity of results</td>
<td>2, 4, 5</td>
</tr>
<tr>
<td>3.5: Investigation: Interpretation of data and discussion</td>
<td>5</td>
</tr>
</tbody>
</table>

**Textbook:**

**Tutorial Sessions:**
A 3-hour weekly tutorial period has been scheduled. These sessions are for the students to get help with their assignment problems. Supplementary lectures or the quiz/midterm exam may be scheduled for some of the tutorial periods on an as-required basis; these will be announced in class.

**Assignments and Exams:**
Students will be evaluated by means of 5 assignments, a quiz, a midterm exam, and a final exam. There will be a total of 5 assignments. Doing the assignments is the best way to learn the course material, so students are encouraged not to “write off” any particular assignment just because of its relative low weight in the overall grading scheme. In addition, completing a subset of the assignments will be a pre-requisite for being allowed to write the final exam. Late assignments will not normally be accepted, and will receive a mark of 0; however, students who cannot submit an assignment by the due date for valid medical or compassionate reasons should contact the instructor immediately and prior to the due date to arrange for appropriate accommodations (e.g., an extension of the due date). Arrangements must be made in a timely manner, otherwise the assignment will be considered late and not accepted. Note that assignments will be submitted using cuLearn, using the cuLearn server cutoff time. However, all assignments can be submitted multiple times, so I encourage you to submit an early version.

Students are encouraged to discuss design issues when working on assignments; however, you are expected to write your own assignments. There is a fine line between cooperating with your classmates (discussing problems and ideas) and copying an assignment (plagiarism). Not only is plagiarism an
instructional offense (see the current Undergraduate Calendar, Academic Regulations of the University), but doing the assigned work by yourself is by far the best way to prepare for the exams. Note that it is not only an instructional offence to submit someone else’s work as your own. It is also an instructional offence to knowingly allow someone else to hand in your work as his/her work.

The quiz and midterm exams will be held in-class. Quiz and midterm exam papers will be returned to the students. Re-evaluations may be considered based on specific requests by you, but will be performed without your presence. Students who are unable to write the exam because of illness or other circumstances beyond their control must provide evidence. In the case of illness, this requires a medical certificate dated no later than one working day after the exam. The certificate must specify the date of the onset of the illness, the (expected) date of recovery, and the extent to which the student was/is incapacitated during the time of the examination. If this information is provided to the instructor no later than three working days after the exam, the marks for the quiz will be transferred to the midterm; a deferred midterm may be offered to the student. Otherwise, the mark for the missed exam will be zero.

Final Exam:
The final examination is for evaluation purposes only and will not be returned to students. You will be able to make arrangements with the instructor or with the department office to see your marked final examination after the final grades have been made available.

The final exam will be held during the University’s April examination period. For SYSC 2510, only students who completed at least 4 out of 5 assignments are eligible to write the final examination or, where circumstances warrant, apply to the Registrar’s Office for deferral of the final exam. Completed means any assignment mark greater than 0 (note that in case of confirmed cases of plagiarism, the usual penalty is to be awarded zero on an assignment). In case of deferral, the following rule will apply:

Students who miss the final exam may be granted permission to write a deferred examination (see the Undergraduate Calendar for regulations on deferred exams). These students have additional months to study and a less crowded examination schedule compared to their colleagues who write the final exam in April. As such, it is only fair to expect substantially better performance from these students on the deferred examination than on the April final exam.

Grading Scheme and Schedule:
To pass the course, a student must pass the final examination (D- or better). For these students, the marks will be calculated as follows:

Assignments: 25%
Quiz: 5%
Midterm exam: 20%
Final exam: 50%

The complete schedule of assignments, exams, and their weights are listed in the following table (assignments are due at 23h59 on their deadline day – but you are welcome to submit them earlier):

<table>
<thead>
<tr>
<th></th>
<th>Assign. 1</th>
<th>Assign. 2</th>
<th>Assign. 3</th>
<th>Assign. 4</th>
<th>Assign. 5</th>
<th>Quiz</th>
<th>Midterm</th>
<th>Final Exam</th>
</tr>
</thead>
</table>

---

Page 3
Please note that the quiz, the midterm, and final exams will be closed book.

Week-by-Week breakdown (may change):

**Week 1:** Introduction, random experiment, statistical regularity, relative frequency, sample space.

**Week 2:** Set theory, axioms of probability, computing probabilities using counting methods.

**Week 3:** Conditional probability, independence of events, sequential experiments.

**Week 4:** Discrete and continuous random variables, probability mass function.

**Week 5:** Cumulative distribution function (cdf), probability density function (pdf), conditional cdf’s and pdf’s, expected value.

**Week 6:** Some important continuous random variables, functions of a random variable, Markov and Chebyshev inequalities

**Week 7:** Transform methods, computer generation of random variables, pairs of random variables.

**Week 8:** Independence of two random variables, conditional probability and conditional expectation, vector random variables.

**Week 9:** Functions of several random variables, expected values of vector random variables, Jointly Gaussian random vectors.

**Week 10:** Sums of random variables, the laws of large numbers, central limit theorem. Introduction to statistics.

**Week 11:** Random processes; mean, autocorrelation, and auto-covariance functions, stationary random processes.

**Week 12:** Power spectral density, Markov processes, introduction to queueing theory.

### General Regulations

**Attendance:** Students are expected to attend all lectures and lab periods. The University requires students to have a conflict-free timetable. For more information, see the current Undergraduate Calendar, Academic Regulations of the University, Section 2.1.3, Course Selection and Registration and Section 2.1.7, Deregistration.

**Health and Safety:** Every student should have a copy of our Health and Safety Manual. A PDF copy of this manual is available online: [http://sce.carleton.ca/courses/health-and-safety.pdf](http://sce.carleton.ca/courses/health-and-safety.pdf)

**Deferred Term Work:** Students who claim illness, injury or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases this must occur no later than three (3.0) working days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. For more information, see the current Undergraduate Calendar, Academic Regulations of the University, Section 4.4, Deferred Term Work.
Appeal of Grades: The processes for dealing with questions or concerns regarding grades assigned during the term and final grades is described in the Undergraduate Calendar, Academic Regulations of the University, Section 3.3.4, Informal Appeal of Grade and Section 3.3.5 Formal Appeal of Grade.

Academic Integrity: Students should be aware of their obligations with regards to academic integrity. Please review the information about academic integrity at: https://carleton.ca/registrar/academic-integrity/. This site also contains a link to the complete Academic Integrity Policy that was approved by the University's Senate.

Plagiarism: Plagiarism (copying and handing in for credit someone else's work) is a serious instructional offense that will not be tolerated.

Academic Accommodation: You may need special arrangements to meet your academic obligations during the term. You can visit the Equity Services website to view the policies and to obtain more detailed information on academic accommodation at http://www.carleton.ca/equity/ For an accommodation request, the processes are as follows:

- Pregnancy or Religious obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details see https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf
- Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at 613-520-6608 or pmc@carleton.ca for a formal evaluation. If you are already registered with the PMC, contact your PMC coordinator to send me your Letter of Accommodation at the beginning of the term, and no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). Requests made within two weeks will be reviewed on a case-by-case basis. After requesting accommodation from PMC, meet with me to ensure accommodation arrangements are made. Please consult the PMC website (www.carleton.ca/pmc) for the deadline to request accommodations for the formally-scheduled exam (if applicable).
- Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton’s Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: https://carleton.ca/sexual-violence-support/.
- Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact
your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf

Copyright on Course Materials: The materials created for this course (including the course outline and any slides, posted notes, labs, project, assignments, quizzes, exams and solutions) are intended for personal use and may not be reproduced or redistributed or posted on any web site without prior written permission from the author(s).