MASTER OF SCIENCE SYSTEMS SCIENCE

Summary
- Degree offered: Master of Science (MSc)
- Registration status options: Full-time; Part-time
- Language of instruction:
  - French
  - English
- Program option (expected duration of the program):
  - with thesis (6 full-time terms; 24 consecutive months)

Program Description
The Systems Science program provides qualified students with the opportunity for master's-level study in a broad range of areas that emphasize transdisciplinary work in the context of general systems analysis. The emphasis in Systems Science is on the development of analytical and integration skills for use in the resolution of complex applied problems that require a broad-based perspective.

Many professors in Information Technology and Engineering, Mathematics and Statistics, Administration, Economics, and other disciplines are active in the Systems Science program as instructors, student advisers and thesis directors. Others are interested in ongoing Systems Science activities including the seminar series, and Systems Science applications days.

The graduate program in System Science is an interdisciplinary program specially designed for those who are interested in the analysis and modelling (mathematical and computer) of natural and man-made systems. It provides the professional with skills and knowledge required to understand, control, predict and optimize behaviour in a variety of fields from engineering and computer science to management and applied economics. The program is supervised by a Committee composed of representatives from the Department of Economics, the School of Information Technology and Engineering, the Telfer School of Management, and the Department of Mathematics and Statistics.

To accommodate part-time students, the core courses are usually offered in the late afternoon or evening.

Main Areas of Research
Their areas of research, both theoretical and applied, span a wide variety of fields:
- Operations research
- Deterministic and probabilistic modelling
- Optimization
- Computer science
- Information systems
- Control

Other Programs Offered Within the Same Discipline or in a Related Area
- Graduate Diploma Systems Science
- Master of Systems Science (MSysSc)
- Master of Science Systems Science Specialization in Environmental Sustainability (MSc)

Fees and Funding
- Program fees:
  The estimated amount for university fees (https://www.uottawa.ca/university-fees) associated with this program are available under the section Finance your studies (http://www.uottawa.ca/graduate-studies/programs-admission/finance-studies).

International students enrolled in a French-language program of study may be eligible for a differential tuition fee exemption (https://www.uottawa.ca/university-fees/differential-tuition-fee-exemption).

- To learn about possibilities for financing your graduate studies, consult the Awards and financial support (https://www.uottawa.ca/graduate-studies/students/awards) section.

Notes
- Programs are governed by the general regulations (http://www.uottawa.ca/graduate-studies/students/general-regulations) in effect for graduate studies.
- In accordance with the University of Ottawa regulation, students have the right to complete their assignments, examinations, research papers, and theses in French or in English. Research activities can be conducted either in English, French or both, depending on the language used by the professor and the members of his or her research group.
Program Contact Information
Graduate Studies Office,
Faculty of Engineering (http://engineering.uottawa.ca/about/programs/graduate)
161 Louis-Pasteur, Colonel By Hall, room B111
Ottawa, Ontario, Canada
K1N 6N5

Tel.: 613-562-5800 x6189
Email: engineering.grad@uottawa.ca

Twitter|Faculty of Engineering (https://twitter.com/uOttawaGenie?lang=en)
Facebook|Faculty of Engineering (https://www.facebook.com/uottawa.engineering)

Admission Requirements
For the most accurate and up to date information on application deadlines, language tests and other admission requirements, please visit the specific requirements (http://www.uottawa.ca/graduate-studies/programs-admission/apply/specific-requirements) webpage.

To be eligible, candidates must:
- Have a bachelor’s degree in Computer Science, Economics, Engineering, Mathematics, Operations Research, Science or a related area with a minimum average of B (70%).
Note: International candidates must check the admission equivalencies (https://www.uottawa.ca/graduate-studies/international/study-uottawa/admission-equivalencies) for the diploma they received in their country of origin.
- Undergraduate courses in probability, linear algebra, differential equations and computer programming are prerequisites for the core courses of the Program. Details regarding the level and content of prerequisite courses are included in the information package which is sent to all applicants. If a student lacks any of these courses, he will normally be required to complete them as a condition of admission. Entering students who lack the required undergraduate preparation may be permitted to enter a qualifying program.
- Pay the $100 (CDN non-refundable) application fee.
- Identify at least one professor who is willing to supervise your research and thesis. We recommend that you contact potential thesis supervisors as soon as possible.

Language Requirements
Applicants must be able to understand and fluently speak the language of instruction (French or English) in the program to which they are applying. Proof of linguistic proficiency may be required.

Applicants whose first language is neither French nor English must provide proof of proficiency in the language of instruction.

Language tests recognized by the University of Ottawa:
- TOEFL: 550 Paper-based or 79-80 Internet-based; or
- IELTS: Overall 6.5 – Individual 5.0 (Paper-based or Internet-based); or
- An equivalent language test (http://www.uottawa.ca/graduate-studies/programs-admission/apply/required-documents).

Note: Candidates are responsible for any fees associated with the language tests.

Notes
- The admission requirements listed above are minimum requirements and do not guarantee admission to the program.
- Admissions are governed by the general regulations (http://www.uottawa.ca/graduate-studies/students/general-regulations) in effect for graduate studies.
- No equivalencies or advanced standing are granted. A student who has already successfully completed some of the compulsory units, may be allowed to replace those units with elective units. For details, see the general regulations in effect for graduate studies, section B 2.7 c).

Documents Required for Admission
In addition to the documents required (http://www.uottawa.ca/graduate-studies/programs-admission/apply/required-documents) for graduate and postdoctoral studies, candidates must submit the following documents:
- A resume
- A letter of intent or motivation or statement of purpose
  Letter of 350 words outlining your proposed research.
- Two confidential letters of recommendation from professors who have known the applicant and are familiar with the student work.
  You are strongly encouraged to contact your referee(s) prior to submitting your application in order to confirm their email address and their availability to complete your letter of recommendation.
- Transcripts from all universities attended:
  • You must submit official transcripts from all the universities you have attended.
  This applies to all courses and programs at any university you attended, including regular programs (completed or not), exchanges, letters of permission, online or correspondence courses, courses taken as a special student or visiting student, etc.
If the transcript and degree certificate are not in English or French, a certified translation (signed and stamped/sealed) must be submitted.

Note: Documents that are not required for admission will not be consulted, conserved or returned to the student. These documents will be destroyed according to our administrative procedures.

Information about how to apply to this program is available under the Apply Now (http://www.uottawa.ca/graduate-studies/programs-admission/apply/#apply-now) section.

Students should complete and submit their online application with supporting documentation (if applicable) by the deadline indicated above.

Program Requirements

Master’s with Thesis

Students must meet the following requirements:

Compulsory Courses:\(^1\)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>SYS 5160</td>
<td>Systems Integration</td>
<td>3 Units</td>
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12 course units from the following: 12 Units

- SYS 5100 Systems Engineering
- SYS 5110 Foundation of Modelling and Simulation
- SYS 5120 Applied Probability
- SYS 5130 Systems Optimization and Management
- SYS 5140 Economic System Design

3 elective course units at the graduate level \(^2\) 3 Units

Thesis Proposal:

<table>
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<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYS 7990</td>
<td>Master Thesis Proposal (^3)</td>
<td>0 Unit</td>
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</tbody>
</table>

Thesis:

<table>
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<tr>
<th>Course</th>
<th>Title</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>SYS 7999</td>
<td>Master's (^4)</td>
<td>0 Unit</td>
</tr>
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</table>

Note(s)

1. Students enrolled in the Master’s who have successfully completed the core courses (15 units) and who are not continuing in the program, may be awarded the Graduate Diploma in Systems Science.

2. Consult the department for the list of elective courses and for the regulations governing the selection of these courses.

3. Candidates enrolled for the MSc degree must submit to the program committee, by the middle of their third term of enrollment in the MSc program, a clearly defined research proposal that has been approved by their thesis director. Approval of the proposal must normally be obtained by the end of the term. A student must enroll in the Master’s Thesis (SYS 7999) in the term immediately following the approval of the proposal. A student whose proposal is not approved on the first attempt may be permitted to submit a second proposal. Failure to obtain approval following the second submission will lead to withdrawal from the MSc program. Students required to withdraw from the MSc but who have successfully completed all the core courses are eligible to receive the graduate diploma.

4. Students are responsible for ensuring they have met all of the thesis requirements (http://www.uottawa.ca/graduate-studies/students/theses). Upon submission, the completed thesis will be examined by a committee of at least two professors.

Minimum Requirements

The passing grade in all courses is C+. Students who fail two courses (equivalent to 6 units) must withdraw from the program.

Research

Research Fields & Facilities

Located in the heart of Canada’s capital, a few steps away from Parliament Hill, the University of Ottawa is among Canada’s top 10 research universities.

uOttawa focuses research strengths and efforts in four Strategic Areas of Development in Research (SADRs):

- Canada and the World
- Health
- e-Society
- Molecular and Environmental Sciences

With cutting-edge research, our graduate students, researchers and educators strongly influence national and international priorities.

Research at the Faculty of Engineering

Areas of research:

- Chemical and Biological Engineering
- Civil Engineering
- Electrical Engineering and Computer Science
- Mechanical Engineering

For more information, refer to the list of faculty members and their research fields on Uniweb. IMPORTANT: Candidates and students looking for professors to supervise their thesis or research project can also consult the website of the faculty or department (https://www.uottawa.ca/graduate-studies/students/academic-unit-contact-information) of their program of choice. Uniweb does not list all professors authorized to supervise research projects at the University of Ottawa.

Courses

SYS 5010 Foundations of Simulation (2 crédits / 2 units)

Volet / Course Component: Cours magistral / Lecture

SYS 5100 Systems Engineering (3 units)

Controllability and observability, Euler-Lagrange equations, Pontryagin maximum principle, dynamic programming, linear quadratic regulator problem, matrix Ricatti differential equations and properties of their solution, design of optimal regulator based on steady state solution of the Ricatti differential equation, time optimal control, LaSalle bang-bang principle, applications to motor speed control, satellite attitude control, etc.

Course Component: Lecture

Prerequisites: CSI 1100 and MAT 2341 and (MAT 2324 or MAT 2331) and MAT 2371 and MAT 2375.
SYS 5110 Foundation of Modelling and Simulation (3 units)
Course Component: Lecture
Prerequisites: CSI 1100 and MAT 2341 and (MAT 2324 or MAT 2331) and MAT 2371 and MAT 2375.

SYS 5120 Applied Probability (3 units)
An introduction to stochastic processes, with emphasis on regenerative phenomena. Review of limit theorems and conditioning. The Poisson process. Renewal theory and limit theorems for regenerative processes; Discrete-time and continuous-time Markov processes with countable state space. Applications to queueing.
Course Component: Lecture
Prerequisites: MAT 2341 and MAT 2371 and MAT 2375.

SYS 5130 Systems Optimization and Management (3 units)
Analysis of user requirements and model design. Data mining. Use of optimization software. Systems thinking and its application to economic systems and hierarchical systems. Applications to economic systems simulation, modeling, optimization and management.
Course Component: Lecture
Prerequisites: CSI 1100 and MAT 2341 and (MAT 2324 or MAT 2331).

SYS 5140 Economic System Design (3 units)
Introduction to the epistemology of systems thinking and its application to economic systems. Basic concepts of complex systems thinking including hierarchical systems and economic systems simulation and behaviour. Soft systems thinking. Examples from other fields of application will be reviewed from an interdisciplinary perspective.
Course Component: Lecture
Prerequisites: CSI 1100 and MAT 2341 and (MAT 2324 or MAT 2331) and MAT 2371 and MAT 2375.

SYS 5160 Systems Integration (3 units)
Course Component: Lecture
Prerequisites: Two of the following: SYS 5100, SYS 5110, SYS 5120, SYS 5130, SYS 5140.

SYS 5180 Topics in Systems Science (3 units)
Course Component: Research

SYS 5190 Directed Readings in Systems Science (3 units)
Course Component: Tutorial

SYS 5580 Thèmes en science des systèmes / Topics in Systems Science (3 crédits / 3 units)
Volet / Course Component: Recherche / Research

SYS 7990 Proposition de thèse de maîtrise / Master Thesis Proposal
Volet / Course Component: Recherche / Research

SYS 7999 Thèse de maîtrise / Master's
Volet / Course Component: Recherche / Research
Préalable : SYS 7990. / Prerequisite: SYS 7990.