This course presents methods and tools for a systems approach to civil and environmental engineering planning, design and management. It includes simulation, optimisation and multi-objective analysis. The general objectives are for the student to become able to:

• Use systems approach in addressing civil and environmental engineering problems by understanding: system definition; system structure; links and interrelationships between different elements of the structure; feedback; and behaviour of systems over time.
• Understand and use the mathematical model as a device for formalization, standardization and treatment of civil and environmental engineering planning, design and management problems.
• Develop an awareness of utility of systems approach to practice of civil and environmental engineering.
• Recognize the need for life-long learning, interdisciplinarity and use of systems approach in civil and environmental engineering as one of the cognitive paradigms for understanding complexity.

Calendar Copy:
Use of systems approach in civil and environmental engineering planning, design and management. Course topics include: systems thinking; simulation; optimization; and multi-objective analysis. Exposure to, and use of computer-based simulation and optimization tools in solving civil and environmental engineering problems. (0.5 course)

Contact Hours:
3 lecture hours/week; 2 tutorial hours; (recommended additional personal study - 5 hours). Attendance at the tutorial/laboratory session is mandatory

Prequisites: CEE2219a/b
Corequisites: None
Antirequisite: The former CEE2218a/b

Note: It is the student's responsibility to ensure that all Prerequisite and Corequisite conditions are met or that special permission to waive these requirements has been granted by the Faculty. It is also the student's responsibility to ensure that they have not taken a course listed as an Antirequisite. The student may be dropped from the course or not given credit for the course towards their degree if they violate the Prerequisite, Corequisite or Antirequisite conditions.

Instructor:
Dr. Slobodan P. Simonovic, Ph.D., P.Eng., ESB 3115, email: simonovic@uwo.ca. Administrative support: Room 3005.
**Textbook:**

**Other References:**

**Computing:**
Assignments will require the use of VENSIM system dynamics simulation tool, LINPRO linear programming optimization tool, and COMPRO multi-objective analysis tool (available on the CD Rom attached to the course textbook).

**Units:**
SI units will be used in lectures and examinations

**Specific Learning Objectives:**
1. Systems approach. At the end of this section, the student should be able to:
   a) Make the difference between linear and systems thinking
   b) Understand definitions of system, systems approach, systems engineering
   c) Use the concept of mathematical modelling and differentiate between simulation and optimization

2. System dynamics simulation. At the end of this section, the student should be able to:
   a) Apply system dynamics simulation approach to formulation and analysis of an engineering problem
   b) Use Vensim system dynamics simulation tool

3. Linear programming. At the end of this section, the student should be able to:
   a) Formulate an engineering problem as a linear programming problem
   b) Understand graphical solution to the linear programming problem
   c) Understand Simplex method
   d) Use the Simplex method and computer based linear programming tool

4. Multi-objective analysis. At the end of this section, the student should be able to:
   a) Understand the difference between single objective optimization and multi-objective analysis
   b) Comprehend the concept of non-dominated solution
   c) Use basic methods for solving multi-objective problems and computer based programming tool

Instructor may expand on material presented in the course as appropriate.
General Learning Objectives

E=Evaluate, T=Teach, I=Introduce

<table>
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<tr>
<th>Problem Analysis</th>
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<th>Team Work</th>
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<tr>
<td>Investigation</td>
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<td>Engineering Tools</td>
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Evaluation:
The final course mark will be determined as follows:

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<tbody>
<tr>
<td>Weekly assignments</td>
<td>15%</td>
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<tr>
<td>Midterm exam</td>
<td>35%</td>
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<tr>
<td>Final exam</td>
<td>50%</td>
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<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
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Note:  
(a) **Students must pass the final examination to pass this course.** Students who fail the final examination will be assigned the aggregate mark, as determined above, or 48%, whichever is less.  
(b) **Students who have failed this course previously must repeat all components of the course.** No special permissions will be granted enabling a student to retain laboratory, assignment or test marks from previous years. Previously completed assignments and laboratories cannot be resubmitted.  
(c) Should the exam conflicts with a religious holiday that a student wishes to observe, the student must inform the instructor of the conflict no later than two weeks before the scheduled test.  
(For further information on Accommodations for Religious Holidays see 
http://www.uwo.ca/univsec/handbook/appeals/accommodation_religious.pdf)

1. Quizzes and Examinations:  
The midterm and final examinations will be **CLOSED BOOK:** no programmable calculators or other external sources of information, including books, notes or crib sheets, are permitted. A list of acceptable calculators for closed book exams will be posted on the bulletin board across from the Department of Civil and Environmental Engineering Office: please be sure your calculator is on it!  

2. Weekly Assignments  
Due date for all assignments will be minimum one week after the distribution of assignments. Nine assignments will be assigned during the course.  

3. Use of English  
In accordance with Senate and Faculty Policy, students may be penalised up to 10% of the marks on all assignments, tests, and examinations for the improper use of English. Additionally, poorly written work with the exception of the final examination may be returned without grading. If resubmission of the work is permitted, it may be graded with marks deducted for poor English and/or late submission.
**Plagiarism Checking:**
The University of Western Ontario uses software for plagiarism checking. Students are required to submit their Laboratory Reports in electronic form to Turnitin.com for plagiarism checking.

**Cheating:**
University policy states that cheating is a scholastic offence. The commission of a scholastic offence is attended by academic penalties that might include expulsion from the program. If you are caught cheating, there will be no second warning.

For more information on scholastic offenses, please see:  
http://www.uwo.ca/univsec/handbook/appeals/scholastic_discipline_undergrad.pdf

**Attendance:**
Any student who, in the opinion of the instructor, is absent too frequently from class, laboratory, or tutorial periods will be reported to the Dean (after due warning has been given). On the recommendation of the Department concerned, and with the permission of the Dean, the student will be debarred from taking the regular final examination in the course.

**Accessibility:**
Please contact the course instructor if you require material in an alternate format or if any other arrangements can make this course more accessible to you. You may also wish to contact Services for Students with Disabilities (SSD) at 661-2111 x 82147 for any specific question regarding an accommodation.

**Conduct:**
Students are expected to arrive at lectures on time, and to conduct themselves during class in a professional and respectful manner that is not disruptive to others. Late comers may be asked to wait outside the classroom until being invited in by the Instructor. Please turn off your cell phone before coming to a class, tutorial, quiz or exam.

On the premises of the University or at a University-sponsored program, students must abide by the Student Code of Conduct:  
http://www.uwo.ca/univsec/board/code.pdf

**Sickness and Other Problems:**
Students should immediately consult with the Instructor or Department Chair if they have any problems that could affect their performance in the course. Where appropriate, the problems should be documented (see attached). The student should seek advice from the Instructor or Department Chair regarding how best to deal with the problem. Failure to notify the Instructor or Department Chair immediately (or as soon as possible thereafter) will have a negative effect on any appeal.

Students that are in emotional/mental distress should refer to Mental Health@Western  
http://www.uwo.ca/uwocom/mentalhealth/ for a complete list of options about how to obtain help

For more information concerning medical accommodations, please see:  
http://www.uwo.ca/univsec/handbook/appeals/accommodation_medical.pdf
Notice:
Students are responsible for regularly checking their email, course website (https://owl.uwo.ca) and notices posted outside the Civil and Environmental Engineering Department Office

Consultation:
Students are encouraged to discuss problems with their teaching assistant and/or instructor in tutorial sessions. Office hours will be arranged for the students to see the instructor and teaching assistants. Other individual consultation can be arranged by appointment with the appropriate instructor.

Course breakdown:
Engineering Science = 90% ; Mathematics = 10%.

The document “INSTRUCTIONS FOR STUDENTS UNABLE TO WRITE TESTS OR EXAMINATIONS OR SUBMIT ASSIGNMENTS AS SCHEDULED” is part of this course outline.