1 INSTRUCTOR

Instructor: Fantahun Defersha, PhD, EIT.
Office: THRN 2403, ext. 56512
Email: fdefersh@uoguelph.ca
Office hours: After Class (Tuesday at 5:30 pm) and by appointment

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*6060 Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources

2. Simulation with Arena, 5/E; by Nancy Swets, Randall Sadowski, W. Kelton

2.3 Recommended Resources

NA

2.4 Additional Resources

Lecture Information: All the lecture notes are posted on coucelink.
3 ASSESSMENT

3.1 Dates and Distribution

Labs/Assignments: 20%

4. Assignment 4: Nov. 12, 2013

Quiz No.1: 25%

   Oct 15, 17:30-18:30, Room THRN1126

Quiz No.2: 25%

   Nov, 19, 17:30-18:30, Room THRN1126

Project: 30%

2. Project Presentation/Submission: Nov. 26, 2013

3.2 Course Grading Policies

When You Cannot Meet a Course Requirement: When you find yourself unable to meet an in-course requirement because of illness or compassionate reasons, please advise the course in writing, with your name, id#, and e-mail contact. See the graduate calendar for information on regulations and procedures for Academic Consideration:

http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1400.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:

http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing grade: Students must obtain a grade of 50% or higher to pass the course.

Missed Quiz: If you miss a quiz due to grounds for granting academic consideration or religious accommodation, you have to inform the instructor to arrange a make-up quiz within a week from the date of the missed quiz.

Lab Work: The laboratory work is intended to introduce students the computer implementation of discrete-event systems simulation using a general purpose programming language such as C++ and the state-of-art simulation package called ARENA. You are strongly advised to attend and complete all laboratories. No lab-report is to be submitted.
Late Lab Reports: NA.

4 AIMS & OBJECTIVES

4.1 Calendar Description
NA

4.2 Course Aims
Many complex engineering, operations, and business systems can be modeled as discrete-event systems. These include multi-teller banks; computer networks; automated manufacturing systems; hospital emergency rooms; call center; airport terminals; traffic control systems and so on. In order to efficiently manage and operate these systems, it is often necessary to apply simulation to study their performance since no closed-form analytical solutions exist for such problems. This course deals with this category of systems. On completion of this course, successful students should be able to demonstrate an understanding of principles and methodologies, of discrete event simulation. Also, they will be able to develop simulation models using a general purpose programming language (such as C++) and ARENA Simulation Environment.

4.3 Learning Objectives
At the successful completion of this course, the student will have demonstrated the ability to:

1. Describe the role of important elements of simulation and modeling paradigm.
2. Analyze discrete-event systems and design simulation models.
3. Develop and apply appropriate random number and random variable generation techniques;
4. Analyze, model, and select appropriate input distributions of discrete-event systems
5. Apply appropriate simulation statistical output techniques.
6. Use general purposed pogromming language and simulation package for discrete-event systems simulation modelling and analysis.

4.4 Instructor’s Role and Responsibility to Students
The instructor’s role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink/D2L but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and project.

4.5 Students’ Learning Responsibilities
Students are expected to take advantage of the learning opportunities provided during lectures and laboratory sections. Students, especially those having difficulty with the course content, should also make
use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

**E-mail Communication:** As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

**Recording of Materials:** Presentations which are made in relation to course work—including lectures—cannot be recorded in any electronic media without the permission of the presenter, whether the instructor, a classmate or guest lecturer.

### 4.6 Relationships with other Courses

**Previous Courses:** NA

**Follow-on Courses:** NA

Basic knowledge of probability and statistics is required in this course. Students are also expected to have some basic knowledge in computer programming using a general purpose programming language.

### 5 Teaching and Learning Activities

#### 5.1 Timetable

**Lectures:**
Tuesday from 2:30 to 5:20 pm, Room THRN 1126

**Laboratory:**
Tuesday from 5:30 to 7:20 pm, Room THRN 1009

#### 5.2 Course Topics and Schedule

<table>
<thead>
<tr>
<th>Topic</th>
<th>Contents</th>
<th>Nominal Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Principles</td>
<td>Concepts in Discrete-Event Simulation; The Event Scheduling/Time Advance Algorithm; World Views; Manual Simulation Using Event Scheduling; List Processing; Lists: Basic Properties and Operations;</td>
<td>1-3</td>
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<tr>
<td>Statistical Models in Simulation</td>
<td>Review of Terminology and Concepts; Useful Statistical Models; Discrete Distributions; Continuous Distributions; Poisson Process; Properties of a Poisson Process; Non-stationary Poisson Process; Empirical Distributions</td>
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### Queuing Models

- Characteristics of Queuing Systems; The Calling Population; System Capacity; The Arrival Process; Queue Behavior and Queue Discipline; Service Times and the Service Mechanism; Queuing Notation; Long-Run Measures of Performance of Queuing Systems; Steady-State Behavior of Infinite-Population Markovian Models; Single-Server Queues with Poisson Arrivals and Unlimited Capacity; M/G/1; Multiserver Queue: M/M/c/∞/∞; Multiserver Queues with Poisson Arrivals and Limited Capacity: M/M/c/N/∞; Steady-State Behavior of Finite-Population Models (M/M/c/K/K); Networks of Queues

### Random Number Generation

- Properties of Random Numbers; Generation of Pseudo-Random Numbers; Techniques for Generating Random Numbers; Linear Congruential Method; Combined Linear Congruential Generators; Random-Number Streams; Tests for Random Numbers; Frequency Tests; Tests for Autocorrelation.

### Random-Variate Generation

- Inverse-Transform Technique; Exponential Distribution; Uniform Distribution; Weibull Distribution; Triangular Distribution; Empirical Continuous Distributions; Continuous Distributions without a Closed-Form Inverse; Discrete Distributions; Acceptance—Rejection Technique; Poisson Distribution; Nonstationary Poisson Process; Gamma Distribution; Special Properties; Direct Transformation for the Normal and Lognormal Distributions; Convolution Method.

### Input Modeling

- Data Collection; Identifying the Distribution with Data; Histograms; Selecting the Family of Distributions; Quantile-Quantile Plot; Parameter Estimation; Preliminary Statistics: Sample Mean and Sample Variance; Suggested Estimators; Goodness-of-Fit Tests; Chi-Square Test; Chi-Square Test with Equal Probabilities; Kolmogorov—Smirnov Goodness-of-Fit Test; $p$-Values and “Best Fits”; Fitting a Nonstationary Poisson Process; Selecting Input Models without Data; Multivariate and Time-Series Input Models; Covariance and Correlation; Multivariate Input Models; Time-Series Input Models; The Normal-to-Anything Transformation

### Output Analysis

- Types of Simulations with Respect to Output Analysis; Stochastic Nature of Output Data; Measures of Performance and Their Estimation; Point Estimation; Confidence-Interval Estimation; Output Analysis for Terminating Simulations

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<tr>
<th>5.3 Lab Schedule (no lab report)</th>
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<tr>
<td><strong>Week</strong></td>
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<td>3</td>
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5.4 Other Important Dates

**Drop Date:** The last date to drop one-semester courses, without academic penalty, is October 31, 2013. Two-semester courses must be dropped by the last day of the add period in the second semester. Refer to the Graduate Calendar for the schedule of dates:

http://www.uoguelph.ca/registrar/calendars/graduate/current/sched/sched-dates-f10.shtml

6 LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community – faculty, staff, and students – to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection. The Academic Misconduct Policy is detailed in the Graduate Calendar:

http://www.uoguelph.ca/registrar/calendars/graduate/current/genreg/sec_d0e1687.shtml

7.1 Resources

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:

http://www.academicintegrity.uoguelph.ca/
The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

The Graduate Calendar is the source of information about the University of Guelph’s procedures, policies and regulations which apply to graduate programs:
http://www.uoguelph.ca/registrar/calendars/graduate/current/