MECH ENG 4H03 **MECHATRONICS** **2019 Winter**

INSTRUCTOR: Dr. Gary Bone, JHE-326F (ext. 27591)
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TEACHING ASSISTANTS: To be announced on Avenue to Learn.

COURSE MATERIALS: Course notes will be made available on Avenue to Learn.

Additional examples (and cool videos!) will be presented during the lectures.

TUTORIALS: See note #2 on page 2.

COURSE OUTLINE

1. INTRODUCTION
- What is Mechatronics?
- The Role of Computer Simulations in Mechatronic Engineering
- Examples of Mechatronic Systems

2. SENSORS
- Sensor Performance Specifications
- Standard Industrial Sensors
- Sensor Interfacing
- Sensor Selection

3. ACTUATORS
- Mechanisms
- Electrical Actuators
- Pneumatic and Hydraulic Actuators

4. MATHEMATICAL MODELLING OF DYNAMIC SYSTEMS
- Building Block Approach
- Introduction to the State Space Method
- Discrete Time Models
- Introduction to the System Identification Method

5. PROGRAMMABLE LOGIC CONTROLLERS
- Operation of PLCs
- Ladder Logic Programming

6. DIGITAL CONTROL OF DYNAMIC SYSTEMS
- ON-OFF Control
- PID Control
- Model-Based Direct Digital Design

7. INTRODUCTION TO DESIGNING FOR SAFETY
- Risk Assessment and Risk Reduction
- System Faults and Fault Management
- Fault Detection and Fault Tolerance Techniques
- Issues related to System Architectures, Human Factors, and Reliability

8. DEMONSTRATIONS

McMaster Policy Reminders:

The Faculty of Engineering is concerned with ensuring an environment that is free of all adverse discrimination. If there is a problem, that cannot be resolved by discussion among the persons involved, individual are reminded that they should contact the Department Chair, the Sexual Harassment Office or the Human Rights Consultant, as soon as possible

Academic dishonesty consists of misrepresentation by deception or by other fraudulent means and can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various kinds of academic dishonesty please refer to the Academic Integrity Policy, specifically Appendix 3, located at http://www.mcmaster.ca/senate/academic/ac_integrity.htm

The following illustrates only three forms of academic dishonesty:
1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations.

The instructor and university reserve the right to modify elements of a course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course website weekly during the term and to note any changes.

COURSE EVALUATION

In-class quizzes	5%
Test 1 (50 min)*	10%
Test 2 (50 min)*	15%
Test 3 (50 min)*	15%
Final Exam (2.5 hrs)*	55%

*Student ID required, Closed Book, McMaster Standard Calculator (Casio fx-991 MS or Casio fx-991 MS Plus).

The dates and times for tests 1, 2, and 3 will be as follows:
Test 1: February 1, 11:30-12:20
Test 2: March 1, 11:30-12:20 and
Test 3: March 26, 11:30-12:20
The rooms for these tests will be announced on Avenue to Learn.

Notes: #1. Practice problems and solutions will be provided to help you to learn the course material.

#2. The only tutorial sessions will be on PLC programming. These will be held on March 14, 18 and 19. The time and location of your tutorial is available on Mosaic.

Learning Outcomes

Upon successful completion of the course the student will be expected to have demonstrated the ability to:
1. List several types of sensors and actuators, and describe their properties.
2. Analyse a measurement system operating under static and dynamic conditions.
3. Design electro-mechanical, hydraulic and pneumatics actuators.
4. Derive mechanistic models for dynamic systems.
5. Design a model-based digital control system.
6. Design a functional PLC programs and write it using standard symbols.
7. Describe methods for improving the safety of mechatronic systems.