MIE 1809H Advanced Mechatronics (January 2021)

1. Instructors:

Professor Ridha Ben Mrad
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Office hour reserved for MIE1809H:
Wednesday 3-4 (additional times can be arranged through appointments)

Dr. Eswar Prasad
Founder, Sensor Technology Limited
Chairman, Piemades, Inc.
Adjunct Professor, University of Toronto
Email: eprasad@mie.utoronto.ca

Guest lecturer: Dr. Sailu Nemana, VP R&D, Sensor Technology Ltd.

2. Marking Scheme:

Project:	80%
Final Exam:	20%
Total:	100%

In this course, there will be no graded assignments or tests returned before the last date to drop courses. Students should be aware of this in making any decision whether or not to remain in the course past the drop date. No requests for late withdrawal will be supported on the grounds that insufficient feedback was available before the drop date.

3. Lectures:

2-4 pm (eastern time zone) Wednesday Zoom/Teams link: xxxxxxx

4. Final exam:

You are allowed one 8.5"x11" aid sheet into the final exam. Calculators are allowed. No additional material is allowed.

5. Project description and requirements:

- The project is selected by the students from the projects listed in Sessions 11 and 12. Projects are developed in groups of 2 to 3 students. Other projects can also be selected in one of the following areas:
  - Development of precision sensors
  - Development of precision actuators
  - Implementation of precision systems and issues addressed.
- The project report is submitted at the beginning of Session 12 in technical paper format. The report should not exceed 10 pages using single line spacing. Powerpoint presentations are also submitted at the beginning of the presentation session. Each presentation is 20 minutes long and up to 10 minutes for questions.
- The project presentation and report are marked based on: presentation (written and oral), complexity of the work done, and technical correctness.

- The syllabus shows a list of suggested projects. Other projects are also possible.
- The project reports and presentations need to present a summary of state of the art on the technology, describe the concepts and basic forms of the technology and provide some ideas for future development.

Tentative Schedule

February 10	Presentation of project outlines
February 17	Reading week – no lecture
March 24	Final exam (up to 90 minutes)
March 31	Presentation of projects
April 7	Presentation of projects/Project reports due

Tentative Course Outline (Major Headings)

Session 1: Course introduction and rules, Smart materials and their characteristics. (R. Ben Mrad and E. Prasad – January 13)

Session 2: Piezoelectric devices and their applications – Part I (E. Prasad – January 20)

Session 3: Introduction to piezoelectrics. (R. Ben Mrad – January 27)

Session 4: Piezoceramic materials and their processing (S. Nemana – February 3)

Session 5: Brief student presentations of their projects outline (up to 5 minutes per project); Piezoelectric devices and their applications – Part II (E. Prasad – February 10).

Session 6: Modeling of non-linearities in piezoceramics and real-time compensation of the nonlinearities for high precision applications (R Ben Mrad – February 24)

Session 7: Precision piezoceramic sensors – case study (E. Prasad – March 3)

Session 8: Energy harvesting using piezoelectrics (R. Ben Mrad – March 10)

Session 9: Piezoelectric precision linear and rotary motors (R. Ben Mrad – March 17)

Session 10 (March 24**):** Final exam

Session 11 (March 31**)**: Student presentations for suggested projects
Group 1 presentation – Piezoceramics for energy harvesting
Group 2 presentation - Other energy harvesting technology
Group 3 presentation - Piezo ultrasonic motors
Group 4 presentation – Power requirements of piezo actuators

Session 12 (April 7**)**: Student presentations for suggested projects, final reports due for all projects
Group 5 presentation – Multi-axis accelerometers, their capabilities, and their applications
Group 6 presentation - MEMS gyros, their capabilities, and their applications
Group 7 presentation - A survey of piezoelectric sensors and their characteristics
Group 8 presentation - Thin film piezoceramics