

MIE 1809H Advanced Mechatronics (January 2019)

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

2. Marking Scheme:

Project:	80%
Final Exam:	<u>20%</u>
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:

1-3 Wednesday

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 6	Presentation of project outlines
February 20	Reading week – no lecture
March 20	Final exam (up to 90 minutes)
April 4	Presentation of projects
April 11	Presentation of projects/Project reports due

Tentative Course Outline (Major Headings)

Session 1: Course introduction and rules, Smart Materials and their characteristics. (E. Prasad – January 9)

Session 2: Piezoelectric devices and their applications - Part I (E. Prasad – January 16)

Session 3: Design based on system requirements; Introduction to piezoelectrics. (R. Ben Mrad – January 23)

Session 4: Piezoceramic materials and their processing (S. Nemana – January 30)

Session 5: Brief student presentations of their projects outline (up to 5 minutes per project); Application of piezoelectric devices – Part II (R. Ben Mrad – February 6).

Session 6: Modeling of non-linearities in piezoceramics and real-time compensation of the nonlinearities for high precision applications (R Ben Mrad – February 13)

Session 8: Piezoelectric precision linear and rotary motors (R. Ben Mrad – February 27)

Session 7: Precision piezoceramic sensors – case study (E. Prasad – March 6)

Session 9: Energy harvesting using piezoelectrics (E. Prasad and R. Ben Mrad – March 13)

Session 10 (March 20): Final exam

Session 11 (March 27): 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 3): 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