Fall 2019

ME 632-101: Mechanical Engineering Measurements

Chao Zhu
ME 632    Mechanical Engineering Measurements

Instructors:  Dr. Chao Zhu; 1-973 642-7624; e-mail: chao.zhu@njit.edu
Dr. Zhiming Ji; 1-973-596-3341; e-mail: zhiming.ji@njit.edu
TA: Tony Guo; 1-973-596-3358; MEC343; e-mail: gg239@njit.edu
Office hours: Mondays: 3:00 – 5:00 pm; Wednesdays: 1:00-2:30 pm

Lecture Notes: from http://www-ec.njit.edu/~me/; under ME618; password: me618f08


1. Lab and Project Arrangement

<table>
<thead>
<tr>
<th></th>
<th>Lab Title</th>
<th>Lab requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group 1</strong></td>
<td>Pipe Flows: Flow and Heat Transfer Characteristics</td>
<td>Measurement &amp; analysis</td>
</tr>
<tr>
<td>(thermodynamics &amp; thermo fluids)</td>
<td>Power Generation of Gasoline Engine (demo)</td>
<td>Design &amp; exp. methods</td>
</tr>
<tr>
<td></td>
<td>Air Conditioning by Vapor-compression Cycle (demo)</td>
<td>Design &amp; exp. methods</td>
</tr>
<tr>
<td><strong>Group 2</strong></td>
<td>Dynamic Stresses and Deformation in Collision</td>
<td>Measurement &amp; analysis</td>
</tr>
<tr>
<td>(stress &amp; control)</td>
<td>PLC Pneumatic Actuator Control (demo)</td>
<td>Design &amp; exp. methods</td>
</tr>
<tr>
<td>Project Design (one project per one/two students)</td>
<td>Using a published research paper or thesis, present &amp; defend an experiment-based project</td>
<td>Design, exp. methods, data analysis, &amp; presentation</td>
</tr>
</tbody>
</table>

2. Lecture Arrangement

1) Introduction to ME Measurement
   -- Course structure & requirement
   -- Understand predesigned labs vs design new labs
   -- Calibration vs theoretical (or CFD) comparison
   -- Lab report & lab group constitute

2) Basic Data Analysis
   Curve fitting; data uncertainty; system uncertainty

3) Basic Measurements
   Flow, temperature, force, motion, signal conditioning

4) Predesigned Group-1 Labs
   -- Flow Measurements in Pipe Flows
   -- Heat Transfer Measurements in Tubular Heat Exchangers
   -- Power Generation and Cooling by Thermodynamic Cycles

5) Predesigned Group-2 Labs
   -- Static and Dynamic Load Measurements
   -- PLC Logic Control
6) Project Design (based on published paper or thesis)
   - Project objectives & background
   -- System design with theoretical basis
   -- Measurement methods and equipment characteristics
   -- Sample experimental results
   -- (Bonus) calibration or uncertainty analysis
   -- (Bonus) theoretical comparison

3. Weekly Arrangement

<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Content</th>
<th>Assignments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-3</td>
<td>9/9; 9/16; 9/23</td>
<td>Introduction; Data Analysis; Basic Measurements; Lectures of Group 1</td>
<td>HW#1 - 3</td>
</tr>
<tr>
<td>4-5</td>
<td>9/30; 10/7</td>
<td>Lab of Group-1</td>
<td>Lab Reports #1-3</td>
</tr>
<tr>
<td>6</td>
<td>10/14</td>
<td>Review of Group-1; Lecture of Group-3 (Stresses)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>10/21</td>
<td>Midterm</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>10/28</td>
<td>MT Solution; Lecture of Group-3 (Stresses)</td>
<td>HW#4</td>
</tr>
<tr>
<td>9</td>
<td>11/4</td>
<td>Lab of Group-3 (Dynamic Stresses)</td>
<td>Lab Report #4</td>
</tr>
<tr>
<td>10-11</td>
<td>11/12; 11/19</td>
<td>Lecture &amp; Lab on Group 3 (PLC)</td>
<td>HW#5; LR#5</td>
</tr>
<tr>
<td>12-13</td>
<td>11/25; 12/2</td>
<td>Presentation of Design Projects</td>
<td>Project Report</td>
</tr>
<tr>
<td>14</td>
<td>12/9</td>
<td>Review for Final</td>
<td></td>
</tr>
</tbody>
</table>
**Grading Policy**

(1) **Grade Calculations**

- 35% Lab abstracts (5; 5% each) and Project Report (1: 10%)
  - Lab attendance is a must for each lab experiment! More than 1-hour delay is considered as absence.
  - Makeup may be allowed, with TA’s supervision ($20/hour for TA’s supervision as personal tutorship unless the absence is officially excused: jury duty, sick or military service, all with Dean’s approval).
- 25% Homework (5; 5% each; each problem has the equal weight factor)
- 20% Mid-term Examination
- 20% Final Examination

Final Grade is based on the total grade. Up to 10% bonus points may be assigned in HW and tests.
In general, above 90% guarantees an “A” grade and below 60% will result in an “F” grade.

(2) **Lab Report Requirement**

- All reports should be individually completed and submitted in time. Group discussion is encouraged but not for “Group Report”. For identical reports or very similar reports, the grade is divided by the number of students involved. Resubmitted Lab report is accepted (final grade will be averaged with the original grade). **No online submission.**

(3) **Homework Requirement**

- (a) Five Assignments will be given, with 5 (+1) problems per assignment, no late or resubmission.
- (b) Homework grade is based on “completeness”, not necessarily on “correctness”.
- (c) Solution discussions will be given in class in the next class after the week of due.
- (d) No online submission unless pre-approved by instructor.

(4) **Mid-term/Final Exam Requirement**

- (a) A 2-hour mid-term exam will be given, mainly covering topics on Data Analysis and Methods in Group 1 Labs.
- (b) A 2.5-hour final exam will be given, mainly covering topics of Methods in Group 2 & lab designs.
**Project Requirement and Grading Policy**
(one project per one/two students; total **10 points**)

1. The project consists of two parts: (a) oral ppt presentation (10 min.) and oral defense (5 min); and (b) written report (hard copy of presentation + supporting materials). **5 points each part.**

2. For a team of two students, one is for presentation and the other is for defense, without any assistance between the two during the presentation and defense. Individual grading for this part (Part (a)). The grade of report (Part (b)) will be the same for each student.

3. Project must be experiment-based and related to Mechanical Engineering, from a published resource (such as research paper or thesis that can be publicly cited). No on-going research projects can be used without the written permission of project principal investigator (PI).

4. The project should contain the following:
   (a) **What**: what is the purpose of the experiment or what needs to be determined from the measurements?
   (b) **Why**: Why can the measurements be linked to your experiment objectives. *Quantitative relationship between the two must be provided.*
   (c) **How**: How is the experiment designed? *(Schematic diagram of experiment set-up must be provided)*; and how are the measurements obtained (with what types of measurement devices used and why to select a particular one against other options, if any)?
   (d) **So What**: Conclude the significance of the results from experiment. For example, how to validate your measurements (such as against available theory or definition)? Or by conducting an error/analysis of the measurements.

5. The project presentation start next Monday (Nov. 25) after the homework explanation session. It is expected to host 4-6 presentations, with the rest continued the following Monday (Dec. 2).

6. Any volunteers to present first will be allow to do so. Otherwise, the order to present will be based on the alphabetic order of the last names of students (whichever comes first of the two students in a team).

7. Those completing the presentation on Nov. 25 will not be required to attend the class on Dec. 2.

8. The last class is on Dec. 9, for a review preparation for final. **All lab resubmissions are due on Dec. 9.**