MCT 3010 Instrumentation

Course Description:
Theory and use of measuring instruments and techniques; standards and dimensional units; experimental procedures and data analysis; sensors and transducers for parameters such as displacement, stress, strain, force, torque, temperature, motion, sound.

Credit Hours:
3 (Lct: 2; Lab:2).

Prerequisites – Co requisites:
Prerequisites: PHY 2140 General Physics, EET 2000 Electrical Principles

Text(s) Required:

Computer Program(s):
As needed

Course Contents:
1. Units, Data Acquisition, Statistical Analysis
2. Sensors and Transducers
3. Frequency and Period
4. Displacement and Dimensions
5. Stress and Strain
6. Force and Torque
7. Temperature
8. Linear and angular motion
9. Sound

Laboratory:
1. Strain Gage
2. Permanent Magnet D.C. Tachometer
3. Slotted Opto Transducer
4. Counter Timer
5. Photo Transistor
6. D.C. Permanent Magnet Motor
7. Platinum RTD (Temperature)
8. LN035 IC (Temperature)
9. Wheatstone Bridge and Null balance

Student Learning Objectives:
Upon successful completion of this course, students will be able to:
1. Perform and explain laboratory tests based on specified procedures of engineering systems [SO-a,c].
2. Achieve familiarity with methods of experimental evaluations. [SO-c].
3. Correlate results from experiments with predicted values.[SO-c].
4. Analyze and interpret test data and write technical reports. [SO-c,g].
5. Work in teams and do oral presentation. [SO-e,g].
6. Design and develop experiments and instrumentation using measurement techniques. [SO-a,d].
Assessment:
Assignments 10%
Class Participation 10%
3 Tests 35%
Labs 25%
Project 15%
Presentation 5%
Total 100%

Instructor's Grading Criteria:
Grading Scale:

95 - 100 = A 90 - 94 = A-
87 - 89 = B+ 84 - 86 = B 80 - 83 = B-
77 - 79 = C+ 74 - 76 = C 70 - 73 = C-
67 - 69 = D+ 64 - 66 = D 60 - 63 = D-
0 - 59 = F

Remarks:
1. Assigned homework will be collected at the beginning of the class on due date.
2. Late homework will be graded with a penalty of 20% per day late.
3. Make up exams/tests would be given only under extenuating personal circumstances; must be taken within a week of missing one.
4. Regular attendance and class participation are highly advised.
5. Collaboration during studying is encouraged.
6. Cheating is reported for disciplinary action.
7. If you have a documented disability that requires accommodations, you will need to register with Student Disability Services for coordination of your academic accommodations. The Student Disability Services (SDS) office is located at 1600 David Adamany Undergraduate Library in the Student Academic Success Services department. SDS telephone number is 313-577-1851 or 313-577-3365 (TDD only). Once you have your accommodations in place, I will be glad to meet with you privately during my office hours to discuss your special needs. Student Disability Services' mission is to assist the university in creating an accessible community where students with disabilities have an equal opportunity to fully participate in their educational experience at Wayne State University.

University / Department Policies:
Academic Misconduct
http://www.et.eng.wayne.edu/et/academicmisconduct/academicmisconduct.html
Withdrawal from Engineering Tech class
http://www.et.eng.wayne.edu/et/withdrawal/withdrawal.html
Deferred Grades
http://www.et.eng.wayne.edu/et/deferredgrade/deferredgrade.html

Code of Ethics for Engineers:
http://cems.alfred.edu/courses/ces120/ethics/abet.html
http://cems.alfred.edu/courses/ces120/ethics/ieee.html
http://onlineethics.org/codes/
http://www.iit.edu/departments/csep/codes/coe/abet-a.html

Prepared by:
M S Rathod
**MCT 3010 Contributions to Student Outcomes:**

<table>
<thead>
<tr>
<th>General Criteria Student Outcomes</th>
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</thead>
<tbody>
<tr>
<td>2. a. an ability to select and apply the knowledge, techniques, skills, and modern tools of their disciplines to broadly-defined engineering technology activities,</td>
</tr>
<tr>
<td>b. an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies,</td>
</tr>
<tr>
<td>3. c. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes,</td>
</tr>
<tr>
<td>2. d. an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives,</td>
</tr>
<tr>
<td>3. e. an ability to function effectively as a member or leader on a technical team,</td>
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<tr>
<td>f. an ability to identify, analyze, and solve broadly-defined engineering technology problems,</td>
</tr>
<tr>
<td>3. g. an ability to communicate effectively regarding broadly-defined engineering technology activities,</td>
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<tr>
<td>h. an understanding of the need for and an ability to engage in self-directed continuing professional development,</td>
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<tr>
<td>i. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity,</td>
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<tr>
<td>j. a knowledge of the impact of engineering technology solutions in a societal and global context, and</td>
</tr>
<tr>
<td>k. a commitment to quality, timeliness, and continuous improvement.</td>
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</table>

**EET Program Specific Student Outcomes**

| E1 - the ability to analyze, design, and implement control systems, instrumentation systems, communications systems, computer systems, or power systems. |
| E2 - the ability to apply project management techniques to electrical/electronic(s) systems. |
| E3 - the ability to utilize statistics/probability, transform methods, discrete mathematics, or applied differential equations in support of electrical/electronic(s) systems. |

**MCT Program Specific Student Outcomes**

| M1 – MCT Design Track: Students in this track will demonstrate the ability to apply principles of materials and mechanics to the design and analysis of mechanical components and mechanisms. |
| M2 – MCT Energy Track: Students in this track will demonstrate the ability to apply principles of thermo-fluid sciences to the design and analysis of energy systems. |
| M3 – MCT Manufacturing Track: Students in this track will demonstrate the ability to apply principles of materials and production techniques to the planning, implementation, and control of manufacturing processes. |
# MCT 3010 Instrumentation

**Time:** Sa 8:30 am -12:10 pm  
**Class:** 1036 ETB  
**Term:** Fall 2010  
**Faculty:** Mulchand S Rathod, PhD, PE  
**Office:** 1159 ETB  
**Phone:** 313 577 0800  
**Email:** mrathod@wayne.edu  
**Hours:** MF 3:15-5:00 pm  
**Fax:** 313 578 5865  
**Sa 12:10-1:00 pm online**

## MCT 3010 Instrumentation Course Tentative Schedule

<table>
<thead>
<tr>
<th>Session</th>
<th>Date</th>
<th>Topic</th>
<th>Reading/Assignment</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>9/4</td>
<td>Course overview, syllabus, report writing format and procedures.</td>
<td></td>
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</table>
| 2       | 9/11  | Process of Measurement  
Standards and Dimensional Units of Measurement | Ch 1 (13)  
Ch 2 (16) |
| 3       | 9/18  | Assessing & Presenting Experimental Data.  
Project & Lab Preparation | Ch 3 (43)  
Review Lab Write up |
| 4       | 9/25  | Sensors                                                              | Ch 6 (40)  
Project Proposals Due |
| 5       | 10/2  | Test 1                                                               | (50)  
Lab 2 |
| 6       | 10/9  | Measurement of Count, Events per Unit Time, Time Interval, and Frequency | Ch 10 (19) |
| 7       | 10/16 | Displacement and Dimensional Measurement                             | Ch 11 (24) |
| 8       | 10/23 | Strain and Stress Measurement                                        | Ch 12 (36) |
| 9       | 10/30 | Test 2                                                               | (40)  
Lab 4 |
| 10      | 11/6  | Measurement of Force and Torque                                      | Ch 13 (31) |
| 11      | 11/13 | Temperature Measurements                                             | Ch 16 (55) |
| 12      | 11/20 | Measurement of Motion                                                | Ch 17 (21) |
| 13      | 12/4  | Acoustical Measurements                                              | Ch 18 (25) |
| 14      | 12/11 | Project Presentations                                                | Make up Lab |
| 15      | 12/14 | Study Day                                                            |                    |
| 16      | 12/18 | Test 3                                                              | (40) |

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*Note: Dates and topics are subject to change.*
List of Attachments

1. Writing a Project Report
2. Cover Page
3. Signature Page
4. Copyright Page
5. Summary Page
6. An Example of Table of Contents
7. Another Example of Table of Contents
8. Oral Presentation - Important Elements
10. Understanding Group Dynamics
Attachment 1. Writing a Project Report

The following information was adopted from the ASME Manual MS-4:

**Description of a Report.** A project report should be clear, concise, complete with assumptions plainly identified and data presented, including their uncertainty, with precise logic, with relevance to practice described, and with actual accomplishments of the work plainly stated and honestly appraised.

**Length.** The length of a project report depends on the complexity of the project and the amount of material to be included. Usually, the senior project reports have 20 to 50 type written pages for the main text.

**Contents of the Report.** The order of the contents of a project report is recommended as follows:

- Title Page
- Copyright Page
- Summary
- Acknowledgments
- Table of Contents
- Nomenclature (if more than 15 symbols)
- List of Figures (if more than 10)
- List of Tables (if more than 10)
- Body of Paper (including
  - Introduction
  - Literature Review
  - Design
  - Results
  - Discussion
  - Conclusions
  - Recommendations etc.)
- Appendices
- References

**Summary.** A short summary (100 to 200 words) should head the report. Its purposes are (1) to give a clear indication of the objective, scope, and results of the project so that readers may determine whether the full text will be of particular interest to them, and (2) to provide key words and phrases for indexing, abstracting, and retrieval purposes. The summary should attempt to condense the whole subject matter into a few words of quick reading.

**Acknowledgments.** Acknowledgments may be made to individuals or institutions not mentioned elsewhere in the paper who have made an important contribution.

**Nomenclature.** Nomenclature abbreviations follow customary usage (see American National Standards Institute recommendations). The nomenclature list should be in alphabetical order, followed by any Greek symbols. Subscripts and superscripts should be listed last and be identified with headings. Symbols that cannot be typed may be carefully handwritten.

**Body of the Paper.** The text should be organized into logical parts or sections. The purpose of the paper, or the author's aim, should be stated at the beginning so that the reader will have a clear conception of the objective. This should be followed by a description of the problem, the means of solution, and other information necessary to qualify properly the results presented and the conclusions drawn. Finally, the results should be presented in orderly for followed by the conclusions of the author.

**Headings.** Headings and subheadings should appear throughout the text to divide the subject matter into logical parts and to emphasize the major elements and considerations. They assist the reader in following the trend of thought and in forming a mental picture of the points of chief importance. Parts or sections of the paper may be numbered, if desired, but the paragraphs should not be numbered.

**Tables.** Where several considerations, conditions, requirements, or other qualifying items are involved in a presentation, it is often advantageous to put them in tabular form, one after the other, rather than to string them out in the text. This arrangement, in addition to emphasizing the items, creates a graphic impression that aids the reader in forming an overall
picture. It is customary to identify the individual items tabulated as 1, 2, 3, etc. or (a), (b), (c), etc. Tabulations of this kind help to make the text more lively. Care should be taken, however, not to use scheme too frequently, as it may make the reading choppy and be wasteful of space.

All tables should be numbered consecutively and have a caption consisting of the table number and a brief title on top of the table. Use the table number when referring to a table. Tables may be typed as part of the text, but they should be located so that they do not run over onto a second page.

Table 1. Title of the table

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Mathematics. Equations should be numbered consecutively from equation (1) to the end of the paper including any Appendices. Use the equation number when referring to equations. Formulas and equations should be carefully typed or lettered. A list of all symbols used in the paper should appear at the beginning of the text as Nomenclature. The distinction between capital and small letters should be clear. Care should be taken to avoid confusion between the small letter "l" (el) and the numeral one, or between zero and the letter "o". All subscript and superscript letters and figures should be clearly shown. In all mathematical expressions and analyses, explain what the symbols stand for and the unit in which each is measured. In a highly mathematical paper, it may be advisable to develop equations and formulas in appendixes, rather than in the body of the paper.

Figures. All figures should be numbered consecutively and have a caption consisting of the figure number and a brief title at the bottom of the figure. Use the figure number when referring to a figure.

Figure 1. Title of the figure

Photographs should be clear and sharp with a glossy finish, with scales included as needed; photostatic prints and halftones from printed reproductions do not reproduce satisfactorily. Graph, charts, line drawings, sketches, and diagrams should be high-contrast black-on-white glossy prints.

For good legibility, lettering in figures must be at least 2 mm (1/16 in.) high after reproduction, and lines must be of sufficient weight. No one figure should be larger than one journal page; folded pages are not acceptable.

Outline. The advantages of preparing an adequate outline before writing the text cannot be overemphasized. In the process of making the outline, the author classifies ideas and order thoughts into logical sequence so that, by the time information is ready to be transformed into complete sentences, a good overall mental picture is formed. In outline form, the sequence of the various items and the progression of thought can easily be adjusted and readjusted until the desired order is obtained. Much time and rewriting are thus saved. A proper outline is the framework upon which a good paper is readily written.

Style. It is well to remember that the chief purpose of a paper is to convey information to others, many of whom will be far less familiar with the general subject than is the author. Care should be taken, therefore, to use simple terms and expression and to make statements as concise as possible. If highly technical or unusual terms of phraseology are necessary, they should be adequately explained and defined. The use of the first person and reference to individuals always should be made in such a manner as to avoid personal bias. Company names should be mentioned only in acknowledgments.
All reports should be concise regardless of length. Long quotations should be avoided by referring to sources. Illustrations and tables, where they help to clarify the meaning or are necessary to demonstrate results properly, are desirable, but they must be kept to a practicable minimum. Detailed drawings, lengthy test data and calculations, and photographs that may be interesting, but which are not necessarily important to the understanding of the subject, should be omitted. Equations should be kept to a reasonable minimum, and built-up fractions should be avoid whenever possible. Reports that fail to conform to these requirements will probably be returned for revision and condensation.

**Accuracy.** It is of the greatest importance that formulas, equations, mathematics, and all technical and scientific data be checked with great care. A slight error in a mathematical sign or symbol, in a table of data, or in a graph may result in serious error on the part of anyone who may later use the information.

**Appendices.** In a highly mathematical paper it may be advisable to develop equations and formulas in an appendix. Appendixes may also be used for detailed descriptions of apparatus, sample calculations, computer printouts, long data tables, and other related material not essential to the general presentation of the subject. Each appendix must be referred in the main text and in each appendix text is needed that leads into the information contained therein.

**References.** Number the references consecutively and include a list of citations at the end of the paper. Extreme care must be taken with references. A single error, e.g., volume or page number, causes waste of time in locating the reference and waste of money if a reader orders copies of an article by mail. Each reference must be cited in the text as [1] and the following is an example of how references should be listed:


**Typing**

**Mechanics:** The senior project must be typewritten. Standard font types should be used and the same font type and size must be used consistently for all text. Suggested font types are Courier 10 cpi or Times Roman 12. This includes the title page, all headings and subheadings, and page numbering.

**Paper:** White paper must be used throughout and should be letter size 8.5" x 11."

**Margins:** The following margins must be maintained: Left - 1.5," Top, bottom, right - 1."

**Spacing:** All preliminary pages and the body of text must be double spaced, even between paragraphs. Indent to show paragraph. Quotations exceeding four lines are single-spaced. Captions for tables and figures are single-spaced. The reference material is single-spaced within each reference and double-spaced between references.

**Pagination:** All preliminary pages (i.e. acknowledgments, summary, table of contents, list of figures, list of tables) are numbered consecutively in lower case Roman numerals at the bottom center of each. Use Arabic numbers beginning with “1” on the first page of the text and continue throughout the text.
A COMPUTER MODEL

OF

HEATING, VENTILATION, AND AIR CONDITIONING SYSTEM

by

Group A

LARRY BROWN
SALVATORE CHIARELLI
MICHELLE DOWNE

MCT 3010 Instrumentation

Division of Engineering Technology
Wayne State University
Detroit, Michigan

December 2010
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Detroit, Michigan

December 2010

Approved by:

__________________________
M S Rathod, Faculty,   Date
SUMMARY

A COMPUTER MODEL OF HEATING, VENTILATION, AND AIR CONDITIONING SYSTEM

by

Group A

LARRY BROWN
SALVATORE CHIARELLI
MICHELLE DOWNE

December 2010 (Month and year)

Body of the summary/abstract (double spaced throughout, must not exceed 350 words, approximately 1.5 pages; must be factual with the following important components: explain problem, methodologies to solve the problem, results/conclusions/recommendations).
# Table of Contents

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<td>III. Preliminary Designs and Tests</td>
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<td>Experimental Setup No. 1</td>
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<td>Experimental Setup No. 2</td>
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## Attachment 7. Another Example of Table of Contents

### Table of Contents

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</tr>
<tr>
<td>Table of Contents</td>
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<td>Nomenclature</td>
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<td>List of Figures</td>
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<tr>
<td>I. Introduction</td>
<td>1</td>
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<td>II. Literature Review</td>
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<td>III. Model Preparation</td>
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<td>Machining</td>
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<td>IV. Experimental Equipment</td>
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<td>Loading System</td>
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<td>VIII. References</td>
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Attachment 8. Oral Presentation - Important Elements

Design consideration - content, concepts, fonts, color

Content - Summarize presentation (Agenda)
- Select 3 or 4 main issues
- Use ideas/examples to support issues
- One idea or concept per screen/page

Concepts - 5 to 7 words per line
- 5 to 7 lines per page
- Major figures/diagrams/flowcharts helps
- Keep it simple
- Clutter creates confusion

Text - Keep text lines short
- One font per slide (up to 3 is ok)
- Use styles (bold, italics) rarely
- Uppercase letters are difficult to read
- Arial or San serif fonts are easier to read
- White space improves audience attention

Colors - Cool colors tend to diminish
- Warm colors tend to emphasize
- Avoid red and green next to one another
- Use color to highlight data: + blue, - red

Last Slide - Summarize project
- Conclusions/recommendations
- Acknowledgments

1. Summary vague, not factual.

2. Report not written in third person and not written in the past tense.

3. Figures not numbered sequentially, not referred in the text, and not located immediately following the citation.

4. Tables not numbered sequentially, not referred in the text, and not located immediately following the citation.

4. References not cited in the text, references not listed according to the required format.

5. One page long chapter(s).

6. One page long paragraph(s).
10. Understanding Group Dynamics

a. Understand purpose of the team
b. Develop group structure, designate leader(s)
c. Discuss expectations of each member
d. Establish patterns of how to get work done
e. Remain true to roles and responsibilities
f. Build trust within team
g. Regularly exchange information, keep everyone involved/informed.
h. Maintain polite discourse, decrease emotionality, increase cooperation
i. Respect ideas/opinions, minimize conflict
j. Focus on goals and outcomes
k. Revisit various stages if team dynamics warrants.

References:
i. Understanding Group Dynamics, Best Practices, Sun Devil Involvement Center, Arizona State University.
iii. Understanding Group Dynamics - Stages of Team Growth, Ezine@articles.com