CRN 2805

IST 260 Instrumentation Section 101

**Course Syllabus – Fall 2014, MWF 10:00-10:50 am ML 119**

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| Instructor: **E. David Cartwright**  Office: **ML 112**, **TTE TLC** | E-mail: **david.cartwright@marshall.edu** |
| Telephone: **(304) 417-5227** (cell) | Office Hours: **MTWRF 8-9:15 am.** **TTE TLC** **MTW, ML RF** Other times by appointment. |

**Course Description:** The course introduces students to modern data gathering methods, laboratory instrumentation, and programming. Focuses range from transportation, engineering, to environmental issues. The student will develop an understanding of the basic ideas of an instrumentation package: the sensor, its input and output signals, data analysis of the sensor output, displaying and interpreting data, calibration, and the errors that are inherit in data collection.

**Required Text, Additional Reading, and Other Materials:** Materials will be provided by instructor.

**Course Student Learning Outcomes and Assessment Measures:**

|  |  |  |
| --- | --- | --- |
| Course Student Learning Outcome | How Practiced in this Class | How Assessed in this Course |
| Describe in general terms how a sensor system operates. | Class lecture (CL), Hands on examples and discussion (HOED) | Labs(L), Homework(H), Exams(E), Projects(P) |
| Describe how sensors common to the transportation, engineering, and environmental fields operate such as dissolved oxygen sensors, turbidity sensors, microphones, cameras, load cells, thermistors, voltage and current meters, electromyography, and accelerometers. | CL, HOED | LHEP |
| Perform instrumentation system calibration techniques and understanding of relevant system properties such as sensitivity, accuracy and precision. | CL, HOED | LHEP |
| Perform Excel tasks as they pertain to gathering and analysis of data from sensor output. | CL, HOED | LHEP |
| Gather and process data using a data acquisition system involving modern data acquisition techniques utilizing computer and sensor system. | CL, HOED | LHEP |
| Design and implement an appropriate experimental plan to gather randomized data, and to use a spreadsheet to record the data. | CL, HOED | LHEP |
| Describe data using summary statistics (measures of central tendency and variability) and/or graphs and charts, by use of spreadsheets. | CL, HOED | LHEP |
| Interpret graphical summaries of data. | CL, HOED | LHEP |
| Interpret numerical summaries of data. | CL, HOED | LHEP |
| Demonstrate written and oral communications | HOED, Project Preview | P |
| Use Computer Aided Design software to design experimental set-ups | CL, HOED | L, P |

**Course Requirements and Grading:**

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| --- | --- |
| Quizzes & attendance | 10% |
| Lab Work (8 Labs) | 20% |
| Projects (2, first 10%, second 20%) | 30% |
| Exam | 20% |
| Final exam | 20% |

Final letter grades are determined based on the following grading scale:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| [0,60) | [60,70) | [70,80) | [80,90) | [90,100] |
| F | D | C | B | A |

The instructor reserves the right to change these values depending on the overall class performance and/or extenuating circumstances.

**Lab activities:** Lab activities include group discussions, participatory reviews, experiments and computer exercises. Lab activities will be collected in lab.

**Homework assignments:** Late assignments and labs will not be accepted.

**Exams**: There will be no make-up chances for missed exams unless a proper action has been taken for an excused absence.

**Attendance Policy:** Attendance is strongly encouraged. If necessary, quizzes will be given to ensure

your interest in attending. Students generally perform much better if their attendance is consistent. Low

attendance is often a strong indication to a failing grade. If you are absent, it is your responsibility to find

out what you missed, e.g. announcements, assignments, etc.

**Class preparation:** Preparation is necessary for learning. ***For this class, reading the textbook chapters before coming to class is an absolute necessity.*** In class quizzes will be used to assess this.

University Computing Services’ Acceptable Use Policy: All students are responsible for knowing this policy, which can be found on the web at [http://www.marshall.edu/ucs/CS/accptuse.asp.](http://www.marshall.edu/ucs/CS/accptuse.asp)

Academic Dishonesty Policy: All students should be familiar with the university’s policy concerning academic dishonesty. This policy can be found on pp. 102–106 of the undergraduate catalog   
[http: //www.marshall.edu/catalog/undergraduate/ug\_09-10.pdf.](http://www.marshall.edu/catalog/undergraduate/ug_09-10.pdf) or on pp. 61–64 in the spring 2009 online graduate catalog [http://www.marshall.edu/catalog/Graduate/S2009/gr\_sp09\_published.pdf.](http://www.marshall.edu/catalog/Graduate/S2009/gr_sp09_published.pdf)

Policy for Students with Disabilities: Marshall University is committed to equal opportunity in education for all students, including those with physical, learning and psychological disabilities. University policy states that it is the responsibility of students with disabilities to contact the Oﬃce of Disabled Student Services (DSS) in Prichard Hall 117, phone 304 696-2271 to provide documentation of their disability. Following this, the DSS Coordinator will send a letter to each of the student’s instructors outlining the academic accommodation he/she will need to ensure equality in classroom experiences, outside assignment, testing and grading. The instructor and student will meet to discuss how the accommodation(s) requested will be provided. For more information, please visit <http://www.marshall.edu/disabled>or contact Disabled Student Services Oﬃce at Prichard Hall 117, phone 304-696-2271.

**Tentative Course Outline**

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| --- | --- | --- | --- | --- |
|  | **Weekof** |  | **Topics to be covered** | **Labs, Quizzes, Exams and Projects** |
| 1 | 8/25 | MWF | Syllabus; Overview of a Sensor System  Calibration Lab | Project 1 Assigned |
| 2 | 9/1 | MWF | Sensor Systems Projects | Q1  Project 1 Due |
| 3 | 9/8 | MWF | Sensor Systems Labs 1 and 2 | Q2, Labs 1 and 2 |
| 4 | 9/15 | MWF | CADD | Lab 3, 4 |
| 5 | 9/22 | MWF | CADD | Lab 5, 6 |
| 6 | 9/29 | MWF | Project Maintenance and Review  Exam 1 | Project 2 Begins |
| 7 | 10/6 | MWF | CADD | Lab 5, 6 |
| 8 | 10/13 | MWF | GPS and Vision Labs | Q3 |
| 9 | 10/20 | MWF | Project Week | Q4 |
| 10 | 10/27 | MWF | Project Previews |  |
| 11 | 11/3 | MWF | Statistics Review | Q5 |
| 12 | 11/10 | MWF | Project Reviews | Q6 |
| 13 | 11/17 | MWF | Project Week | Project Ends, Final Discussed |
| 14 | 11/24 | MWF | Thanksgiving Week |  |
| 15 | 12/1 | MWF | Dead Week, Review |  |
| 16 | 12/15 |  | Final exam |  |

Project One, Presenting a Set of Sensor Systems for various Dependent Variables.

Due September 4, 2014

Sensors track continuous dependent variables in an experiment. Since the entire point of an experiment is the collecting, analysis, and conclusions drawn from dependent variables (DVs), then it is important that you learn what instruments are used in their collection. You have to look under the curtain, pull open the black box as it were.

Your assignment is to look under the hood of some devices that are used to measure common phenomena. You will present both a written and oral presentation on one DV sensing system of interest.

Each group will present one system that will measure ONE dependent variable, e.g., temperature, which will include

* What is the dependent variable being sensed (define it)
* Diagram of the system (General, then your specific one)
  + DV environment
  + Sensor
  + Output of sensor
  + Conditioning of output signal
  + Final output for human or computer consumption
* Explanation of each part of the diagram
* Sensitivity of measurement
* Calibration of system
* Applications of the sensor system

With each presentation, begin with the general sensor system diagram, and then get into your DV.

DVs

Light I (photoelectric counters)

Light 2 (photography, vision)

Dissolved Oxygen in fresh water environments

pH in water and or/soil

Sound (Microphone)

Temperature

Electromyography

Acceleration

Vibration

Velocity

Force

Turbidity

Conductivity

Strain

PC controllers (mouse, haptic feedback, eye tracking)

Gamers (xbox, kinect, wii controller, joysticks, etc…)

Grading Rubric: Names \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
|  | Written Report | Sy1 | Oral Report |
| Grammar | 10 |  | 10 |
| Spelling | 10 |  | 10 |
| Neatness | 10 |  | 10 |
| Use of personnel |  |  | 10 |
| Knows material well enough to have a conversation with me. |  |  | 50 |
| Description of DV sensed | 5 |  |  |
| Diagram of each system | 10 |  |  |
| Environment of Sensor | 4 |  |  |
| The Sensor (in all its glory!)  Picture and Basic description | 10 |  |  |
| What parts of the sensor are the most critical? | 10 |  |  |
| Basically, how the sensor convert outside DV to usable data we can output? | 20 |  |  |
| Output of Sensor | 4 |  |  |
| Signal Conditioning | 4 |  |  |
| Final Output | 4 |  |  |
| Sensitivity Issues | 4 |  |  |
| Calibration | 10 |  |  |
| Applications | 10 |  | 10 |
| Total | 120 |  | 100 |

Final Project Rubric

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| --- | --- | --- | --- |
|  |  | Written Report | Oral Report |
| Grammar | 3 |  |  |
| Spelling | 3 |  |  |
| Neatness | 3 |  |  |
| Use of personnel | 3 |  |  |
|  |  |  |  |
| Introduction |  |  |  |
| * Motivation | 3 |  |  |
| * Literature review | 3 |  |  |
| Methods |  |  |  |
| * Sensor Description | 3 |  |  |
| * Environment | 3 |  |  |
| * Calibration | 3 |  |  |
| * Experiments | 5 |  |  |
| Results and Discussion |  |  |  |
| * Data Shown | 5 |  |  |
| * Discussion | 5 |  |  |
| Conclusion |  |  |  |
| * Summary | 5 |  |  |
| * Limitations | 5 |  |  |
| Works Cited | 3 |  |  |
| Description of DV sensed | 3 |  |  |
| Diagram of each system | 3 |  |  |
| Total |  |  |  |
|  |  |  |  |