West Virginia University

MAE 211 Mechatronics

Spring 2013

Lecture:	ESB G39	TR 8:00am ~ 9:15am
Lab:	ESB G22	TWR 2:00pm ~ 4:45pm

OBJECTIVE: The course objective is to introduce students to the design of systems containing mechanical, electrical, and electronic components.

INSTRUCTOR: Dr. Yu Gu
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OFFICE HOURS: I will try to keep regular office hours on Tuesday and Thursday from 11:00am -12:00 am. I am also happy to see you for individual help. You can make an appointment to see me by email or by talking to me before or after class.

TEXT: There is no required text for this course, however you may find the following reference useful: *SolidWorks 2011: for Designers*, Sham Tickoo, 2011, ISBN: 978-1932709896. *Mechatronics – Electronic Control Systems in Mechanical and Electrical Engineering*, W. Bolton, Prentice Hall, 4th Ed., 2008, ISBN: 978-0132407632.

COURSE CONTENT: Mechatronics design refers to the design of systems using a combination of mechanical engineering, electronic and electrical engineering, control theory, sensor and actuator technology, and computer science. It is the way the world works in the 21st century. We now have electric motors that are smaller than the period at the end of this sentence (Really!!). Microprocessors run everything from your MP3 player to the airbags in your car to your Mr. Coffee. To prepare you for designing the newest and coolest stuff, we have created this course, which looks at some basic design problems that mechanical engineers face every day, and shows you how to solve them using modern, mechatronic methods. In this class you will design gear trains and power transmission systems, and will couple them to optical encoders and a microcontroller for position and speed control. You will learn about a variety of sensors useful in robotics, manufacturing, the automotive, aerospace industries, and medicine among others. You will learn how to connect sensors and actuators to a microcontroller and how to write control programs to make good things happen. This will be one of the coolest courses you ever take.

LEARNING OUTCOMES: This is your first real Mechanical Engineering design course, although you may have done some team design projects in Engr 101. By the end of this course you should:

- Know how to create mechanical drawings of some basic items using SolidWorks (Supports ABET Outcome *c*).
- Know how to specify and use basic mechanical design elements, such as gears, belts, bearings, lead screws, universal joints, differentials and others. We will study these mechanisms at the level of functionality and application.

- Know how to read and generate simple wiring schematics, and how to construct circuits using standard industrial components (Supports ABET Outcome *d*).
- Know some basics of Matlab, and how to use it to perform data acquisition and control functions. Know how to set up logic-based sequential control algorithms and simple single-loop feedback control programs.
- Know how to specify and use common electro-mechanical sensors and actuators, including DC motors, stepper motors, relays, solenoid valves, optical encoders, proximity sensors, temperature sensors and micro-switches (Supports ABET Outcome *d*).
- Know how to write a simple engineering proposal for design and development of a product in response to a design specification (Supports ABET Outcome *c*).
- Know how to work in a team to subdivide, coordinate and integrate pieces of a design project and to develop a working prototype (Supports ABET Outcome *c*).

More detailed learning outcomes are included within the last page of the syllabus.

GRADING POLICY:

Quizzes and Homework	10%
Lab Reports	20%
Projects	20%
Class Exams	25%
Comprehensive Final	25%

Letter grades are typically assigned with respect to total percentages earned based upon the standard university policy described in the catalog.
(100% – 90%: A, 80% - 89%: B, 70% - 79%: C, 60% - 69%: D, <60%: F)

Exams and Quizzes: You will sometimes take a short quiz over the material covered during the preceding weeks. The quizzes will cover both lecture material and lab material. Quizzes will be announced at least one class period ahead of time. **There will be no makeup quizzes.** There will be two midterm exams and a final exam. The final exam will cover material from the whole course, including labs. If you must miss an exam, you must inform the instructor **BEFORE** the scheduled start of the exam. Failure to do so will result in denial of the opportunity to make up the exam.

Homeworks: Homeworks may be assigned before quizzes.

Lab Reports: SolidWorks assignments must be done individually. All other "regular" labs will have one report for each lab group. All submissions must have a title page with your name, the lab number and your lab section time. A sample lab report will be provided with the expected format. It is STRONGLY advised that the format be followed as grading of lab reports will be strict. All lab assignments are due at the beginning of lab on the day of your lab. Any work submitted after this time will be accepted at a deduction of 20% per day. Lab reports submitted for labs not attended will not be accepted. If you have any questions about the grading of a particular lab assignment, you are welcome to discuss it with one of the TAs and they will review the grade and explain the reasoning for any missed points.

LAB ATTENDANCE: Lab Attendance: There will be approximately one lab per week at the beginning of the semester, giving way to projects later in the semester. Attendance for all labs is mandatory.

Some labs will have a quiz at the beginning of the lab period over the material covered either in class or in the preceding lab. Attendance will be taken at the completion of each lab. If you miss a lab you must make it up. This can be done either during one of the other lab sections or during "off hours" by making arrangements with one of the TAs.

PROJECTS: You will be divided into teams and will undertake a design project, as specified in a request for proposal, which will be distributed by the instructor. The project will require you to apply the material learned in the lectures and labs, and will consist of two phases: development of a design proposal and the actual construction of the hardware and software for the project. We generally set a final contest among all the teams to evaluate the "winning" projects. Note that each member of the group will be asked to compile a contribution form to evaluate the contribution of the other group members. The evaluation will be used to determine your grade of project.

STUDENT OBLIGATIONS: Un-excused absences from tests and failure to attend required lectures may result in failing grades. It is your responsibility to keep abreast of class procedural announcements, obtain handouts, etc.

ACADEMIC HONESTY: The highest level of academic honesty is expected of all WVU students. While cooperation is encouraged on lab reports, unique and individual efforts must be demonstrated for evaluation. Individual efforts on quizzes, exams, and the final are demanded. **Cheating on exams and quizzes will result in a grade of 'F'.** Please don't assume that I can't catch cheating: solving procedures that are too similar to other students' with the same mistakes may constitute cheating. If you engage in academic dishonesty, I will notify you that you will receive an 'F' in the course. Please see the Student Conduct Code for details at http://studentlife.wvu.edu/office_of_student_conduct/student_conduct_code.

Statement on Social Justice: WVU is committed to social justice. The instructor of this course concurs with WVU's commitment and expects to maintain a positive learning environment, based upon open communication, mutual respect and nondiscrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color, or national origin. Any suggestions are encouraged as to how to further such a positive and open environment and to anticipate needing any type of accommodation in order to participate in this class. Please advise us and make appropriate arrangements with Disability Services (293-6700).

TENTATIVE COURSE OUTLINE

Date	Topics	Notes
Week 1 Jan 14 ~ 18	Introduction to Mechatronics and Measurement	
Week 2 Jan 21 ~ 25	Measurement, Gear Trains Lab 1 Introduction of Solidworks and Instrument in Mechatronics Lab	
Week 3 Jan 28 ~ Feb 1	Gear Trains, Linear Motion Lab 2 Application of Solidworks and Basic Circuits	
Week 4 Feb 4 ~ Feb 8	Introduction to Bearings No Lab	
Week 5 Feb 11 ~ 15	Basic Electricity Lab 3 Gears	
Week 6 Feb 18 ~ 22	Exam 1 Lab 4 Application of Solidworks and Review of MATLAB	
Week 7 Feb 25 ~ Mar 1	Kirchhoff's Law and Analysis of Circuits Lab 5 Digital I/O	
Week 8 Mar 4 ~ Mar 8	Digital I/O Lab 6 Analog I/O and Operational Amplifier	
Week 9 Mar 11 ~ 15	Motors and Actuators Lab 7 Optical Encoder	
Week 10 Mar 18 ~ 22	Position Control Open Lab	
Week 11 Mar 25 ~ 29	Spring Break	
Week 12 Apr 1 ~ 5	Data Acquisition and Sampling Theory Open Lab	**Due of project proposal**
Week 13 Apr 8 ~ 12	Exam 2 Open Lab	
Week 14 Apr 15 ~ 19	Data Acquisition and Sampling Theory Open Lab	
Week 15 Apr 22 ~ 26	Grounding Open Lab	
Week 16 Apr 29 ~ May 3	Basic Statistics Demonstration of Project	
Week 17 May 6 ~ May 10	Final Exam	