Advanced Mechatronic Engineering 1: Hardware and Control - Course Outline

ECEN 425: 2010 Trimester 1

This document sets out the workload and assessment requirements for ECEN 425. It also provides contact information for staff involved in the course. If the contents of this document are altered during the course, you will be advised of the change by an announcement in lectures and/or on the course web site. A printed copy of this document is held in the School Office.

Course Description

Mechatronics, unlike traditional engineering techniques, is a multi-disciplinary approach to solving engineering problems. In its simplest form it is the intelligent control of an electromechanical systems, and as such, practitioners must be skilled in electronics, mechanics, and software, and also understand the underlying physics, mathematics and even marketing.

This course provides an introduction to the techniques of mechatronics. It begins by covering the engineering concepts of compromise in the choice of sensors. It then covers basic signal conditioning and noise concepts, derivation of the transfer function, and the output from a mechatronic system - specifically some form of actuator. The course continues with some specific ranging sensor circuits and applications, including practical implementation. Practical control systems for industrial plant and mechatronic systems are detailed. Mechatronic design considerations are discussed based on implementation through the SolidWorks CAD package.

The practical nature of this course is emphasised through the design assignments (100% of the course mark), where the student will implement Microcontroller circuit, range finding system and advanced CAD simulations.

Prerequisites

Prerequisites: ECEN301 (or CSEN 301 or PHYS340)

Restrictions:CSEN 401

Objectives

By the end of the course, students should be able to:

1. Skilled in the high-level use of a modern microcontroller to solve a variety of real-world problems 3(a).

2. Be able to design and construct a microcontroller development board. 3(f).

3. Understand the sensor and circuit issues involved in ranging systems and be able to construct an integrated infrared and ultrasonic ranging system. 3(e).

4. Understand the issues involving motor driver circuits and be able to design a driver circuit for dc motors. 3(b).

5. Understand the fundamentals of source impedance and cable termination techniques. 3(c).

6. Understand, and implement, Mechanical Engineering design principles within Mechatronics systems 3(a).

7. Able to use the Laplace transform, to derive the transfer function for a variety of electromechanical systems. 3(c).

8. Able to implement a simple digital control with regard to practical implications of PID control 3(f).

9. Understand and implement Mechatronics design principles, including the multi-objective and iterative nature of design. 1(a).

10. Design and present a Mechatronic system as part of a larger team 2(a),2(b), 1(b).

11. Utilise an industry standard CAD package, e.g. SolidWorks, for Mechatronic design 3(f).

Course Material and Textbook

Outline notes will be provided, but students are advised to also take down their own notes in class. These should then be combined with further reading from the recommended reading for the course.

The textbook for ECEN 425 is: Shigley's Mechanical Engineering Design (Hardcover) McGraw-Hill Science/Engineering/Math; 9 edition (January 15, 2010).

See Also "Control Systems Engineering" by Norman S. Nise is also be available in the 3 day reserve section of the library. (Level 3). Any further textbooks to be used for recommended reading will be detailed when appropriate.

Lectures, Tutorials, Laboratories, and Practical work

The following is the material to be covered during the lectures. However, this is subject to change. An approximate lecture schedule is as follows:

Lecture # Topic

1 Introduction/Micros1 Intro to Mechatronics, Controller overview

2 Micros II Elements of a microcontroller system

3 Micro Construction I Microcontroller board construction

4 Ranging Sensors I Infra-red and ultrasonic sensors and circuits

5 Ranging Sensors II Infra-red and ultrasonic sensors and circuits

6 Other Sensors Inertial navigation, accelerometers, gyroscopes

7 Inter-device communication

8 Mechatronic design

9 Power Electronic Devices I Overview of power electronic devices

10 Power Electronics/Motors I Power electronics, inductors and switches

11 Motor Driver Circuits II Motor driver circuitry

12 Design presentations (note: this may occupy up to 4 lecture slots)

13 Systems Analysis I Introduction, poles and zeros

14 Systems Analysis II Transfer functions

15 Systems Analysis III Controllers

16 Systems Analysis Practical implementations and implications of controllers

17 SolidWorks I

18 SolidWorks II

19 Mechactronics Design I Gears

20 Mechactronics Design II Pulleys & Belts

21 Mechactronics Design III Bearings

22 Mechactronics Design IV Joining & Fabrication

Note this schedule is subject to change, depending on progress through the material.

Lectures for ECEN 425 are:

Lectures: Monday, Tuesday and Friday 9-10 am in Cotton 523A. There are approximately 21 scheduled lectures.

Assignments and Projects

Critical dates:

1 March: First lecture

Five assignments.

The Microprocessor, Range finding and Team design project assignments will be worth 60% of the course.

The Solidworks ' Design for functionality, assembly and manufacture' and 'Mechanical elements' assignments will be worth 20% each.

Workload

On average, students should plan to spend a minimum of 10 hours per point i.e. 150 hours for a 15 point course, or 10-12 hours per week, in order to achieve an average grade in this course. A further time of approximately 30 hours will be required during the study and examination period.

School of Engineering and Computer Science

The School office is located on level three of the Cotton Building (Cotton 358).

The notice board for ECEN 425 is located on the second floor of the Cotton Building.

Staff

Coordinator and lecturer: Professor Dale Carnegie, Office LB 502, Telephone: 463-7485, Email: dale.carnegie@vuw.ac.nz.

Lecturer: Dr. Will Browne, Office: Cotton 341, Telephone: ext 8489, Email: will.browne@vuw.ac.nz

Announcements and Communication

This course uses Blackboard. Course materials and other information will be posted on Blackboard. Students should check Blackboard regularly. Email will also be used for communication, so please ensure that your email address is correct in the VUW system.

Assessment

Your grade for ECEN 425 will be determined based on the following assessment weightings:

Many of the assessment items are practical ones to be undertaken in the laboratory. There will not be dedicated laboratory session times assigned. You are to work on this in your own time in one of the available labs. Co250 should generally be available for this.

Bachelor of Engineering students should be aware that copies of their assessed work may be retained for inspection by accreditation panel.

Tests and Exams

None

The timetable for final examinations will be available from the University web site and will be posted on a notice board outside the faculty office. The final examination will be three hours long. No computers, electronic calculators or similar device will be allowed in the final examination. Paper non-English to English dictionaries will be permitted. The examination period for trimester 1 is 7 June - 30 June.

Practical Work

Description of assignments / projects / etc, including rough dates and submission processes

All work is due in on the due date. Work will not be marked if more than 1 week late. Assignments and laboratory reports need to be handed in on the assigned dates - typically one week after the experiment was performed or the assignment was handed out. Work submitted after the due date will incur a penalty. Marks will be deducted at a rate of 10% of the full mark for each working day late. Any work handed in after the model solutions have been made available will not be graded at all. Extensions will be given only in exceptional circumstances, and if agreed before the due date. In the event of an aegrotat application, regular submission and performance in assignments and laboratories will contribute substantially to the outcome.

Plagiarism

Working Together and Plagiarism

We encourage you to discuss the principles of the course and assignments with other students, to help and seek help with programming details, problems involving the lab machines. However, any work you hand in must be your own work.

The School policy on Plagiarism (claiming other people's work as your own) is available from the course home page. Please read it. We will penalise anyone we find plagiarising, whether from students currently doing the course, or from other sources. Students who knowingly allow other students to copy their work may also be penalised. If you have had help from someone else (other than a tutor), it is always safe to state the help that you got. For example, if you had help from someone else in writing a component of your code, it is not plagiarism as long as you state (eg, as a comment in the code) who helped you in writing the method.

Mandatory Requirements

To obtain a pass, a student must obtain a minimum of 50% of the possible marks for the course while attend at least 80% of the assignments and tests. Also, the final laboratory report must have been submitted.

Passing ECEN 425

To pass ECEN 425, a student must satisfy mandatory requirements and gain at least a **C** grade overall.

Withdrawal

The last date for withdrawal from ECEN 425 with entitlement to a refund of tuition fees is Friday, 12th March 2010 (the end of week 2 of trimester). The last date for withdrawal without being regarded as having failed the course is Friday, 14th May 2010 (the end of week 9) -- though later withdrawals may be approved by the Dean in special circumstances.

Rules & Policies

Find key dates, explanations of grades and other useful information at http://www.victoria.ac.nz/home/study.

Find out about academic progress and restricted enrolment at http://www.victoria.ac.nz/home/study/academic-progress.

The University's statutes and policies are available at http://www.victoria.ac.nz/home/about/policy, except qualification statutes, which are available via the Calendar webpage at http://www.victoria.ac.nz/home/study/calendar (See Section C).

Further information about the University's academic processes can be found on the website of the Assistant Vice-Chancellor (Academic) at http://www.victoria.ac.nz/home/about/avcacademic

All students are expected to be familiar with the following regulations and policies, which are available from the school web site:

Grievances
Student and Staff Conduct
Meeting the Needs of Students with Disabilities
Student Support
Academic Integrity and Plagiarism
Dates and Deadlines including Withdrawal dates
School Laboratory Hours and Rules
Printing Allocations
Expectations of Students in ECS courses

The School of Engineering and Computer Science strives to anticipate all problems associated with its courses, laboratories and equipment. We hope you will find that your courses meet your expectations of a quality learning experience.

If you think we have overlooked something or would like to make a suggestion feel free to talk to your course organiser or lecturer.