Advanced Mechatronic Engineering 1: Hardware and Control - Course Outline

ECEN 425: 2012 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.

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.

Prerequisites: ECEN301 (or CSEN 301 or PHYS340)

Restrictions: CSEN 401, ECSE425

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 (Graduate attribute 1(a)).
2. Be able to design and construct a microcontroller development board. (Graduate attribute 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. (Graduate attribute 3(e)).
4. Understand the issues involving motor driver circuits and be able to design a driver circuit for dc motors. (Graduate attribute 3(b)).
5. Understand the fundamentals of source impedance and cable termination techniques. (Graduate attribute 3(c)).
6. Understand, and implement, Mechanical Engineering design principles within Mechatronics systems (Graduate attribute 3(a)).
7. Able to use the Laplace transform, to derive the transfer function for a variety of electromechanical systems. (Graduate attribute 3(c)).
8. Able to implement a simple digital control with regard to practical implications of PID control (Graduate attribute 3(f)).
9. Understand and implement Mechatronics design principles, including the multi-objective and iterative nature of design. (Graduate attribute 1(a)).
10. Design and present a Mechatronic system as part of a larger team (Graduate attributes 2(a),2(b), 1(b)).
11. Utilise an industry standard CAD package, e.g. SolidWorks, for Mechatronic design (Graduate attribute 3(f)).

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

A schedule of lecture topics, readings, and assignment due dates is available below

Lectures for ECEN 425 are:

ECEN 425 18524 L1 Trimester 1 MWR 15:10 16:00 CO119

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. Power Electronic Devices I Overview of power electronic devices
5. Power Electronics/Motors I Power electronics, inductors and switches
6. Motor Driver Circuits II Motor driver circuitry
7. Ranging Sensors I Infra-red and ultrasonic sensors and circuits
8. Ranging Sensors II Infra-red and ultrasonic sensors and circuits
9. Other Sensors Inertial navigation, accelerometers, gyroscopes
10. Mechatronic design
11. Design presentations (note: this may occupy up to 3 lecture slots)
12. Systems Analysis I Introduction, poles and zeros
13. Systems Analysis II Transfer functions
14. Systems Analysis III Controllers
15. Systems Analysis Practical implementations and implications of controllers
16. SolidWorks I
17. SolidWorks II
18. Mechactronics Design I Gears
19. Mechactronics Design II Pulleys & Belts
20. Mechactronics Design III Bearings
21. Mechactronics Design IV Joining & Fabrication

Practical Work

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.

All work is due in on the due date. Work will not be marked if more than 1 week late unless an extension has been previously arranged. Please note that extensions will only be provided in exceptional circumstances. Work submitted after the due date will incur a penalty. Unless otherwise advised (for example in Assignment 1 interim hand-in dates) 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. In the event of an aegrotat application, regular submission and performance in assignments and laboratories will contribute substantially to the outcome.

Workload

In order to maintain satisfactory progress in ECEN 425, you should plan to spend an average of at least *10* hours per week on this paper. A plausible and approximate breakdown for these hours would be:

- Lectures and tutorials: 2
- Readings: 1
- Assignments: 7

In ECEN 425 the expectation is that you will do roughly 10 hours of work per week over 15 weeks as no exam. This workload is not evenly spread – some weeks with heavy practical assessment will require considerably more than 10 hours, at other times, particularly at the beginning of the course, substantially fewer hours will be required.

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

The course organiser for ECEN 425 is Will Browne. The lecturers for the course are Will Browne and Dale Carnegie. Their contact details are:

- *WillBrowne*
- Cotton 341
- +64 4 463 -5233 x8489
- will.browne @vuw.ac.nz

- *DaleCarnegie*
- AM 224
- +64 4 463 -7485
- dale.carnegie@vuw.ac.nz

Tutor details: Luke Frogley

Course representative Deepak Ravindran

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.

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

Assessment

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

Weight	Item
20%	Microcontroller design and reports:
15%	Range finder construction and integration
5%	Survey and presentation assignment
15%	Mechatronic group design
10%	Gear design
25%	Passive dynamic walker design
10%	Test

Tests and Exams

Critical dates and relation to learning objectives []:

- First lecture: 5 March
- Microcontroller survey report due: 19 March. [1, 2]
- Range finder assignment due: 12 April. [3, 5, 6]
- Microcontroller design assignment due: 19 April. [1, 2]
- Mechatronic design written reports due. [4, 6, 9, 10]
- Mechatronic design presentations. [4, 6, 9, 10]
- Test. [1, 2, 3, 4, 5, 7, 8]
- SolidWorks gear assignment due. [11]
- SolidWorks passive dynamic walker assignment due. [11] (word limit for reports to be confirmed on assignment hand out)

There is NO formal examination for this course. Work submitted after the due date will incur a penalty. Unless otherwise advised (for example in Assignment 1 interim hand-in dates) 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. 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.

Use of Turnitin.com

Student work provided for assessment in this course may be checked for academic integrity by the electronic search engine http:/www.turnitin.com. Turnitin is an online plagiarism prevention tool which compares submitted work with a very large database of existing material. Turnitin will retain a copy of submitted material on behalf of the University for detection of future plagiarism, but access to the full text of submissions is not made available to any other party.

Mandatory Requirements

To obtain a pass, a student must obtain a minimum of 50% of the possible marks for the course while submitting at least 75% of the assignments and tests.

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 16 March 2012. The last date for withdrawal without being regarded as having failed the course is Friday 18 May 2012 -- 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.