Embedded Systems - Course Outline

ECEN 301: 2010 Trimester 1

This document sets out the workload and assessment requirements for ECEN 301. 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.

Lecturer and Laboratory Demonstrator

The course lecturer is Professor Dale Carnegie, Office MD 224, Telephone: 463-7485, Email: dale.carnegie@vuw.ac.nz. A senior graduate student will supervise the laboratory work. This person's details will be provided during the lectures.

Objectives

On completing ECEN 301, a student should:

- 1. Be skilled in the high-level use of a modern microcontroller to solve a variety of real-world problems
- 2. Understand the advantages and disadvantages of a range of different sensors, signal conditioning and signal processing elements of an embedded control system and be able to select the option best suited for a variety of engineering applications.
- 3. Be able to implement a variety of signal conditioning techniques including bridges, passive and active filters.
- 4. Understand the design compromises relating to serial versus parallel data transmission.
- 5. Be familiar with the physical principles of analogue to digital conversion and sampling theorems. From a knowledge of the advantages and disadvantages of a variety of ADC techniques, the student will be able to select the appropriate device for a range of engineering applications.
- 6. Understand the variety of memory devices available complete with an appreciation of their advantages and disadvantages. The student should be able to interface DRAM, SRAM and ROM memory devices to a microcontroller, and understand the timing and control functions.
- 7. Have a basic understanding of classical PID control theory and Fuzzy logic
- 8. Be able to understand and summarise literature available online and elsewhere in order to supplement the information provided during the lectures. Several assessment questions will require the student to undertake such independent research.
- 9. Be able to effectively communicate in a written manner the methodology, design compromises, results and evaluation of a variety of microcontroller based solutions to real-world problems. This will cumulate in a report detailing these considerations for the design of a PID controller for a DC motor operating under varying loads.

There will be two tests designed to assess analytical skills and the knowledge base of students (objectives 2-8). The laboratory part of the course assessment is designed to test the student's ability to design and debug microprocessor code and circuits (objective 1), to maintain a reliable laboratory notebook, and to report in written form on their design work (objective 9).

Course Material and Textbook

Students will be provided with a comprehensive study guide which contains all the lecture OHTs but with blanks that will need to be filled-in during the lectures. A complete pdf of these slides is available via BlackBoard for students who have either missed the lecture or wish to have the material entered in advance.

Students will also be issued with a set of comprehensive notes. This set of notes covers all the material that will be covered in the lecture other than material that you will be required to independently research.

A laboratory manual with the laboratory exercises is also provided as well as a user manual for the microcontroller that you will be using.

No textbook is required, however students may consider purchasing one of these texts as an additional source of information. In order of preference, some suggestions are:

Bolton , W. “Mechatronics”, 3rd edition.

Bateson, R. “Introduction to Control System Technology” 7th edition.

Alciatore, D and Hisand, M, “Introduction to Mechatronics and Measurement Systems” 2nd edition.

Horowitz & Hill “The Art of Electronics”, 2nd Edition, (a little out of date, but contains many practical details - a must for people who are seriously interested in electronics).

Lectures, Tutorials, Laboratories, and Practical work

Lectures for ECEN 301 are:

Monday 3:00pm – 5.00 pm,

Tuesday 3:00pm – 4:50pm in Cotton 228.

Lecture Topics

1 Introduction/

An approximate lecture schedule is as follows:

Lecture Topics

- 1 Introduction/Interfacing I Transducer parameters, software interfacing
- 2 Interfacing II Sensors - Resistive, capacitive, inductive
- 3 Interfacing III Sensors - inductive, solid state
- 4 Interfacing IV Sensors - self-generating
- 5 Signal Conditioning I Voltage dividers, deflection bridges
- 6 Signal Conditioning II Operational Amplifiers - a review
- 7 Signal Conditioning III Filters - passive, active
- 8 Signal Conditioning IV Filters, active and digital
- 9 Interfacing IV Noise, ground, reflections, cabling
- 10 Analysis I Transfer function, poles and zeroes
- 11 Analysis II Frequency Response, Bode Approximation
- 12 ADC I ADC overview, servo and integrating ADCs
- 13 ADC II Charge balance ADCs, sample and hold
- 14 Sampling Nyquist and sample and hold circuits
- 15 Interfacing V I/O ports, polling, interrupts, serial transmission
- 16 Test 1
- 17 Memory I Overview, types of memory, applications
- 18 Memory II Embedded memory organisation data/program
- 19 Memory III Memory structures
- 20 Memory IV Memory interfacing
- 21 Control Theory Classical PID control and Fuzzy Logic
- 22 Test 2

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

Laboratories

The course includes seven 3-hour experiments and one major practical assignment design exercises.

Laboratory sessions will be scheduled in the first week of term and will commence in the second week. The laboratory sessions will be held in Co249.

Laboratory Reports

You are required to submit a formal laboratory report for each of the assigned labs. These should be of professional standard detailing the objective of the laboratory exercise, the methodology employed, a justification for any design decisions, results obtained and an analysis or evaluation of your results. You should answer any questions asked of you in the laboratory manual.

Workload

The expectation is that you will do roughly 10 hours of work per week on average. This will normally comprise 2 hours of lectures, 1 hour tutorial, 3 – 4 hours of laboratory work, and an average of 3 – 4 hours of assignment work, laboratory write-ups, and background reading.

Announcements and Communication

The main means of communication outside of lectures will be the ECEN 301 entry on BlackBoard. Students should monitor BlackBoard rather than any ECS site.

Assessment

The course is entirely internally assessed (there is no formal examination), compromising 33.3% written assignments, 33.4% tests and quizzes and 33.3% laboratory work, detailed as follows:

11.2% term test 1

16.7% term test 2

5.5% closed book quizzes administered during lecture time

33.3% three internal written assignments.

33.3% laboratory work including major practical assignment, laboratory write-ups and laboratory practical marks.

Note, there is a non-linear relationship between the write-up mark and your overall laboratory grade. For example, a mark of 8/10 for a write-up certainly does not guarantee you an A grade for the laboratory work since several of these lab assessments are designated as mastery assessment items. This will be further explained in the lectures.

Late assessment is penalised at a rate of 5% per day the assessment is late.

Major Assignment

The real test of what you have learnt from this course is your ability to design a useful microprocessor- / microcontroller-based instrument or circuit. The last practical assignment involves the control of a dc motor using the microcontroller and a classical control algorithm. This assignment brings together most of the material you have covered in the preceding laboratory exercises.

Mandatory Requirements

1. It is expected that ALL work will be completed and handed in for marking. An incomplete or fail grade will be issued to any student who satisfies ANY of the below requirements
    1. Satisfactorily completes less than 5 of the 7 assigned labs (a demonstrator must verify all lab work). Note that sessions 6 & 7, is a double lab session intended to take two weeks to complete. Failure to satisfactorily complete one of these double labs will count as two failures to this mandatory standard.
    2. Does not turn up for either of the two assigned internal tests
    3. Hands in less than 3 assignments
    4. Is caught cheating in any form (this includes laboratory work)
    5. Scores less than 40% on **both** the internal tests

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.

Passing ECEN 301

To pass ECEN 301, a student must satisfy mandatory requirements and gain at least a **C** grade overall.

School of Engineering and Computer Science

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

Withdrawal

The last date for withdrawal from ECEN 301 with entitlement to a refund of tuition fees is Fri 12 March 2010. The last date for withdrawal without being regarded as having failed the course is Fri 14 May 2010 -- 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.