Unit Outline
MTRX 2700: Mechatronics 2

Unit of Study Description
6 credit points.
Classes: 2.5 hr lectures and a 3 hr lab/wk.
Assessment: 2 hr exam plus project work.

Second year core unit of study for the degree in Mechatronic Engineering.

Webpage: https://elearning.sydney.edu.au/webapps/portal/frameset.jsp (Blackboard)

Syllabus Summary:
This unit of study is intended to teach the fundamental principals of microcontroller system design. This involves a thorough understanding of the interaction between hardware and software at the assembly language level, and of interfacing to external devices. The course will focus each year on a particular microcontroller which is widely used in industry. The aim of the unit is to introduce students to microprocessor and microcomputer systems, emphasizing assembly language programming and building on the digital logic foundations from first year. In particular, the following subjects are addressed;

- Introduction to microprocessors, stored-program computer architecture, instruction codes and addressing modes, instruction execution cycle; Memory devices.
- Computer architecture and assembly language programming.
- Microprocessor and microcontroller systems, memory and IO interfacing, interrupts and interrupt handling.
- Serial and parallel communications.
- System design, documentation, implementation, debugging and testing.

Unit of Study Aims/Goals:
By the end of Semester, students should
1. Gain an intimate understanding of the way in which microcontrollers operate;
2. Understand the relationship between the software and hardware used in a Mechatronic system;
3. Learn concepts useful in the design and implementation of simple Mechatronic systems;
4. Apply their knowledge to implement a simple Mechatronic system given a design specification.

Student Learning Outcomes:
By the end of this Unit of Study, students will be able to demonstrate an in-depth knowledge of the syllabus, both through examination, and laboratory assessment. Primarily this will involve the understanding of microcontrollers and their application in real Mechatronic systems.

In particular, students who have passed this course will have demonstrated the following;

1. The ability to apply the knowledge gained in this course (as well as in other relevant prior courses) to solve real-world engineering problems involving hardware, software and microcontrollers.
2. The ability to exercise critical decision making in defining solutions to the problems presented in the laboratory sessions (and in the exam).
3. The ability to independently identify, locate and utilize appropriate information resources in order to aid the problem solving process.
4. The ability to think creatively about problem solving, and the application of ‘engineering judgment’ in order to choose the most appropriate solution to a problem from many possibilities.
5. The ability to function effectively as an individual even within the context of teamwork, whilst being able to clearly maintain the group objective.
6. An understanding and demonstration of various forms of communication including; listening, oral, written electronic, graphical and mathematical, both for assessment purposes and for interpersonal communication.
Relationship between this UoS and University generic attributes:

The University of Sydney has a policy regarding generic attributes which it believes a graduate should attain upon completion of their degree, which will provide them with the opportunity of being “more employable, more able to cope with change and more developed as people”. These attributes can be seen in the policy document available at [http://www.itl.usyd.edu.au/graduateAttributes/unipolicy.pdf](http://www.itl.usyd.edu.au/graduateAttributes/unipolicy.pdf). You may also be interested in how these attributes may be interpreted for an Engineering graduate. A draft is available at; [http://www.itl.usyd.edu.au/GraduateAttributes/facultyGA.cfm?faculty=Engineering](http://www.itl.usyd.edu.au/GraduateAttributes/facultyGA.cfm?faculty=Engineering)

This UoS specifically targets the following generic attributes:

- **Research and Inquiry** – through real-world problem solving and the research needed for such tasks.
- **Information Literacy** – through the use of the many disparate sources of information needed to solve Engineering tasks.
- **Personal and Intellectual Autonomy** – through the encouragement of autonomy, even in group situations.
- **Communication** – through the written, verbal and interpersonal communication needed to solve the tasks presented.

Relationship to other Units of Study:

MTRX2700 is the introductory course in the basics of real Mechatronic systems. This course builds on knowledge obtained in the courses ENGG1801, MTRX1701, ELEC1103 and MTRX1702. This course extends this knowledge by introducing students to their first practical applications in Mechatronic Engineering.

By passing this subject, the student will have obtained the necessary skills to tackle later courses such as Computers in Real-Time Control (MECH4730), Experimental Robotics (MTRX4700), as well as be better prepared for Mechatronics 3 (MTRX3700).

Learning Situations:

This UoS consists of 2.5 hours Lectures per week in Semester 1 and one 3 hour laboratory per week (Mechatronics teaching lab in the link building). There are two laboratory sessions. Allocations to labs are automatic and will not be negotiated.

Learner Preparation:

In attempting this UoS, students are expected to have a thorough knowledge of computer software and basic electronics, as taught in previous courses (outlined above).

In addition, students will be expected to prepare for the laboratory sessions as directed in the laboratory handouts.

Learning Commitments:

By undertaking this subject, the student is committing to:
- Learn the subject, not just memorize notes;
- Attend all lectures, with the aim of learning and understanding, not just note taking;
- Attend all laboratory sessions, with the aim of maximizing your understanding of the course material;
- Study this topic for at least 4 - 6 hours per week outside of allocated class time;
- Being familiar with, and adhering to the University’s policies, in particular the policy on academic honesty.

Assessment:

Assessment is based on an end of semester open-book exam, as well as a mark obtained in the laboratory sessions. The laboratory sessions are broken into two main sections. From weeks 2 – 8, students will be given a mark based on successful completion of laboratory experiments, whilst in weeks 9 – 13 students will be undertaking a major assignment. The breakdown of marks is as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
<th>Due Date</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exam:</strong> (Min Mark required 50/100)</td>
<td>40%</td>
<td>End of Semester</td>
</tr>
<tr>
<td>Laboratory (Short labs):</td>
<td>30%</td>
<td>Weeks 4, 6 and 8</td>
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</tbody>
</table>
| Laboratory (Major Assignment): | 30%    | Week 13 }
GRADE DESCRIPTORS

HD | You will be able to appraise and assess the knowledge gained in class and in private study, and be able to use this knowledge holistically in areas unrelated to those studied in class, as well as;
D | You should be able to create new knowledge to approach the topics covered in the course, based on this course, other courses undertaken, and private study, as well as;
CR | Analyse and question this knowledge in order to exercise Engineering judgment in problem solving for problems closely or distantly related to those covered in the course, as well as;
P | You must be able to demonstrate a basic understanding of the topics covered, be able to recall the facts, and show how this information may be applied to problems closely related to those that have been studied in class.

Unit of Study Program:

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Laboratories</th>
<th>Assessments</th>
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<tbody>
<tr>
<td>1</td>
<td>Admin and 68HC11 Introduction</td>
<td>Lab Induction</td>
<td></td>
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<tr>
<td>2</td>
<td>Programmers View of Microcontrollers</td>
<td>Intro/ monitor program / CRO / DIO</td>
<td></td>
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<tr>
<td>3</td>
<td>Programmers View of the 68HC11</td>
<td>Intro/ monitor program / CRO / DIO</td>
<td></td>
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<tr>
<td>4</td>
<td>68HC11 On-Board Peripherals</td>
<td>Intro/ monitor program / CRO / DIO</td>
<td>Lab 1 Due</td>
</tr>
<tr>
<td>5</td>
<td>68HC11 On-Board Peripherals</td>
<td>Serial I/O, Timing and Interrupts</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Timing and Memory Types</td>
<td>Serial I/O, Timing and Interrupts</td>
<td>Lab 2 Due</td>
</tr>
<tr>
<td>7</td>
<td>C Programming for uC’s</td>
<td>C programming --&gt; AIO and Serial I/O</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>C Programming for uC’s</td>
<td>C programming --&gt; AIO and Serial I/O</td>
<td>Lab 3 Due</td>
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<tr>
<td>9</td>
<td>Large Project Design and Management</td>
<td>Major Assignment</td>
<td></td>
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<tr>
<td>10</td>
<td>Interfacing to Off-Board Peripherals</td>
<td>Major Assignment</td>
<td></td>
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<tr>
<td>11</td>
<td>Interfacing to Off-Board Peripherals</td>
<td>Major Assignment</td>
<td></td>
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<tr>
<td>12</td>
<td>Embedded UC’s</td>
<td>Major Assignment</td>
<td></td>
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<tr>
<td>13</td>
<td>Revision</td>
<td>Major Assignment</td>
<td>Major Due</td>
</tr>
</tbody>
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Mandatory Unit of Study References:


MTRX 2700 Course Notes: available from the University Copy Centre.

Other Unit of Study References:

Chesmond, C.J. Control system hardware. 2ed., RelF Publishing, Brisbane, 1981. 629.8315/3
Rohner, P. *Pneumatic control for industrial automation*. A E Press, Melbourne, 1984. 629.8045/5/A
Stone, H.S. *Microcomputer interfacing*. Addison-Wesley, Reading, 1982. 621.3819583/12
Williams, T. *Circuit designer's companion*. Butterworth Heinmann, Kent, 1991. 621.3815/118

**Unit of Study Policies**

**Use of Mechatronics Lab**

Students enrolled in MTRX 2700 may use the Mechatronics Lab for their work in MTRX 2700 whenever the Lab is not formally timetabled for another Unit of Study. Further information on the Lab is provided in the *Mechatronics Laboratory Introductory Notes*, available at the MTRX 2700 WebCT site and the course notes.

**Moderation of Group Work Marks**

Group marks for Lab Work will be moderated on the basis of individual effort and understanding, as perceived by the Lecturer and Tutors.

**Method of Submission of Written Work**

Written work must be submitted electronically in either PDF or Word format, PDF format is preferred. Further information will be given in assignment handouts.

**Method of Submission of Software Work**

Software work must be submitted electronically in original format. Software submissions must be compressed in a zip archive format, and this archive must also include an HTML Doxygen build of the source tree.

**Assignment Extensions and Deadlines**

No extension of the published due dates and times will be given unless exceptional circumstances apply. In such cases, application for an extension must be submitted in writing (email to nebot@acfr.usyd.edu.au), citing those circumstances. A decision will be given in writing (email).

**Late Submission of Assignments**

Late submissions will be penalized 20% of the full mark for every day or part thereof that the assignment is late.

**Must Pass Both Components**

To pass this unit of study it is necessary to obtain a mark of not less than 45% in BOTH the assignment and examination components. If you fail either the assignment component or the exam (even after supplementary results) the maximum mark you can get for the unit of study is 45%.

**Staff Contact Information**

<table>
<thead>
<tr>
<th>Position</th>
<th>Name</th>
<th>Email</th>
<th>Telephone</th>
<th>Room Number</th>
</tr>
</thead>
<tbody>
<tr>
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