UNSW AUSTRALIA

Course Outline

Semester 1 2015

Never Stand Still | Faculty of Engineering | School of Mechanical and Manufacturing Engineering

MTRN3200

Elements of Mechatronic Systems

Contents

Course Outline

MTRN3200 Elements of Mechatronic Systems

1. COURSE STAFF

Contact details and consultation times for course convener

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Fax (02) 96631222
Email nmkwok@unsw.edu.au

Consultation concerning this course is available by appointment. Direct consultation is preferred; email may also be used.

Contact details and consultation times for additional lecturers and demonstration/laboratory teaching staff

Nil.

2. COURSE DETAILS

Units of credit

This is a 6 unit-of-credit (UoC) course, and involves 6 hours per week (6h/w) of face-to-face contact.

The UNSW website states “The normal workload expectations of a student are approximately 25 hours per semester for each UoC, including class contact hours, other learning activities, preparation and time spent on all assessable work.”

For a standard 24 UoC in the semester, this means 600 hours, spread over an effective 15 weeks of the semester (thirteen weeks plus stuvac plus one effective exam week), or 40 hours per week, for an average student aiming for a credit grade. Various factors, such as your own ability, your target grade, etc., will influence the time needed in your case.

Some students spend much more than 40 h/w, but you should aim for not less than 40 h/w on coursework for 24 UoC. This means that you should aim to spend not less than about 10 h/w on this course, i.e. an additional 4 h/w of your own time. This should be spent in making sure that you understand the lecture material, completing the set assignments, further reading about the course material, and revising and learning for the examination.

There is no parallel teaching in this course.

Summary of the course

This course focuses on the building blocks in digital logic circuitry, microprocessor architecture and programming techniques that are required for the development and construction of a mechatronic system.

Aims of the course

This course aims to give students a thorough understanding of the essential elements of mechatronic systems. Primarily, these include topics in digital electronics and their uses, microprocessors and their uses and, their integration into a working mechatronic system. The basic need is to recognize that these elements form the backbone of the hardware and is necessary for the automation of mechanical systems leading to advance machineries. The course also aims to give students an opportunity to familiarize with the handling and use of some of these elements in a laboratory set up. Ultimately, the course expects to give students a good exposure to the vast possibilities that exist in the world of automation so that the creativity of the individual is stimulated.

Student learning outcomes

At the conclusion of this course, it is expected that you will be able to:

- Develop an understanding to extract information from data sheets that describe hardware.
- Be familiar with the terminology used in digital electronics and micro-processors.
- Have a thorough understanding of the function and usage of a variety of electronic components.
- Have developed a thorough understanding of how microprocessor systems work.
- Have acquired the programming skills to enable the programming of a microprocessor based system.
- Have developed the ability to employ a small computer system that can be used in an automation task.
- Have experienced the use of digital electronics and microprocessor-controlled systems to actually control one or more of many physical systems available in the laboratory.
- Have had an exposure to the vast possibilities in the world of automation and developed the ability to create innovative solutions to automation problems.

Graduate attributes

UNSW's graduate attributes are shown at
https://my.unsw.edu.au/student/atoz/GraduateAttributes.html

UNSW aspires to develop graduates who are rigorous scholars, capable of leadership and professional practice in a global community. The university has, thus, articulated the following Graduate Attributes as desired learning outcomes for ALL UNSW students.

UNSW graduates will be

1. Scholars who are:
   - (a) understanding of their discipline in its interdisciplinary context ✓
   - (b) capable of independent and collaborative enquiry
   - (c) rigorous in their analysis, critique, and reflection
   - (d) able to apply their knowledge and skills to solving problems ✓
   - (e) ethical practitioners
   - (f) capable of effective communication ✓
   - (g) information literate ✓
   - (h) digitally literate

2. Leaders who are:
   - (a) enterprising, innovative and creative
   - (b) capable of initiating as well as embracing change
   - (c) collaborative team workers ✓

3. Professionals who are:
   - (a) capable of independent, self-directed practice ✓
   - (b) capable of lifelong learning
   - (c) capable of operating within an agreed Code of Practice

4. Global Citizens who are:
   - (a) capable of applying their discipline in local, national and international contexts
   - (b) culturally aware and capable of respecting diversity and acting in socially just/responsible ways
   - (c) capable of environmental responsibility

   ✓ = Developed in this course

In this course, you will be encouraged to develop graduate attributes 1(a), 1(d), 1(f), 1(g), 2(c), and 3(a) by undertaking the selected activities and knowledge content. These attributes will be assessed within the prescribed assessment tasks.

You will be supported in developing the above attributes through:
(i) the design of academic programs;
(ii) course planning and documentation;
(iii) learning and teaching strategies; and
(iv) assessment strategies.

3. RATIONALE FOR INCLUSION OF CONTENT AND TEACHING APPROACH

Our primary goal is to provide students a learning atmosphere within which knowledge dissemination by the lecturer and knowledge extraction by the student are facilitated. Within this atmosphere the student will be given a sound theoretical basis for the subject matter. They will also be provided stimuli and resources that they can use to extract further knowledge outside the classroom. This will further be enhance by the compulsory laboratory meetings in which the students will be guided to develop their own (i) understanding of principles and, (ii) development of solutions related to the use of digital logic components/circuits and microprocessor controlled systems.

Students learn most effectively when they are confronted with problems arising from practical systems that relate to lecture contents on a continuous basis. This will be achieved in this course by requiring compulsory laboratory meetings.

Effective learning requires a system that demands problem solving by students rather than problems solved by the teacher. To facilitate the development of problem solving ability, students are provided ample guidance to develop solutions to problems. In each laboratory meeting, there will be a demonstrator in a class so that the required input is available when a student needs it.

The essential student attributes are; the desire to continuously find out the methodologies available in digital electronics and microprocessor controls primarily through web searches on new products, and the ability to expand thinking horizons to generate innovative solutions and to develop problem solving skills.

4. TEACHING STRATEGIES

Lectures in the course are designed to cover the terminology, core concepts and theories in mechatronic systems. They are built on the lecture topics using examples taken from practice to show how the theory is applied and the details of when, where and how it should be applied.

Part of the laboratory demonstrations are designed to provide you with feedback and discussion on the exercises, and to investigate problem areas in greater depth to ensure that you understand the application and can avoid making the same mistake again.

Teaching of this course is through lectures and laboratory meetings only. There are no demonstrations. All demonstration help can be obtained either in the laboratory meetings or during consultation times.

5. ASSESSMENT

General

The assessment of this course consists of two components: laboratory work and examination. Laboratory instructions will be available on UNSW Moodle. You are strongly encouraged to conduct preparation studies before commencing the laboratory work.

Laboratory

You are required to participate in continuous laboratory exercises which are scheduled through week 2 to week 13. You will build up your knowledge through the scheduled exercises of gradually increasing complexity in digital logic and microprocessor programming. You will discharge the acquired knowledge to design and build an integrated mechatronics system by employing techniques in digital logic and microprocessor programming.

Submission

Laboratory reports are due on the scheduled day of the laboratory class in the week nominated in the Laboratory Schedule given below. Reports should be uploaded to Moodle online.

The School guidelines recommend that late submissions incur a penalty of 10% of the total marks awarded for each calendar day the assignment is late. An extension may only be granted in exceptional circumstances. Where an assessment task is worth less than 20% of the total course mark and you have a compelling reason for being unable to submit your work on time, you must seek approval for an extension from the course convenor before the due date. Special consideration for assessment tasks of 20% or greater must be processed through https://student.unsw.edu.au/special-consideration

Please note that late penalties are at the discretion of the course convenor and in some cases late work may not be assessed. It is always worth submitting late assessment tasks when possible. Completion of the work, even late, may be taken into account in cases of special consideration.

Criteria

The following criteria will be used to grade assignments:

For reports:

- Identification of key facts and the integration of those facts in a logical development.
- Clarity of communication, this includes development of a clear and orderly structure and the highlighting of core arguments.
- Sentences in clear and plain English, this includes correct grammar, spelling and punctuation.

- Correct referencing in accordance with the prescribed citation and style guide.

For numerical calculations:
- Accuracy of numerical answers.
- All working shown.
- Use of diagrams, where appropriate, to support or illustrate the calculations.
- Use of graphs, were appropriate, to support or illustrate the calculations.
- Use of tables, where appropriate, to support or shorten the calculations.

Examination

There will one two-hour examination at the end of the semester, covering all material in the whole semester.

You will need to provide your own calculator, of a make and model approved by UNSW, for the examination. The list of approved calculators is shown at https://student.unsw.edu.au/exam-approved-calculators-and-computers

It is your responsibility to ensure that your calculator is of an approved make and model, and to obtain an "Approved" sticker for it from the School Office or the Engineering Student Centre prior to the examination. Calculators not bearing an "Approved" sticker will not be allowed into the examination room.

Special Consideration and Supplementary Assessment

For details of applying for special consideration and conditions for the award of supplementary assessment, see *Administrative Matters for All Courses*, available from the School website.

Assessment scheme

The breakdown of the assessment scheme is summarized below.

Laboratory assessment and report	50 marks
End of semester examination	50 marks
Mark required to pass the course	**50 marks**

6. ACADEMIC HONESTY AND PLAGIARISM

Plagiarism is using the words or ideas of others and presenting them as your own. Plagiarism is a type of intellectual theft. It can take many forms, from deliberate cheating to accidentally copying from a source without acknowledgement. UNSW has produced a booklet which provides essential information for avoiding plagiarism: https://my.unsw.edu.au/student/academiclife/Plagiarism.pdf

There is a range of resources to support students to avoid plagiarism. The Learning Centre assists students with understanding academic integrity and how not to

plagiarise. They also hold workshops and can help students one-on-one. Information is available on the dedicated website Plagiarism and Academic Integrity website: http://www.lc.unsw.edu.au/plagiarism/index.html

You are also reminded that careful time management is an important part of study and one of the identified causes of plagiarism is poor time management. Students should allow sufficient time for research, drafting and the proper referencing of sources in preparing all assessment tasks.

If plagiarism is found in your work when you are in first year, your lecturer will offer you assistance to improve your academic skills. They may ask you to look at some online resources, attend the Learning Centre, or sometimes resubmit your work with the problem fixed. However more serious instances in first year, such as stealing another student's work or paying someone to do your work, may be investigated under the Student Misconduct Procedures.

Repeated plagiarism (even in first year), plagiarism after first year, or serious instances, may also be investigated under the Student Misconduct Procedures. The penalties under the procedures can include a reduction in marks, failing a course or for the most serious matters (like plagiarism in an honours thesis) even suspension from the university. The Student Misconduct Procedures are available here: http://www.gs.unsw.edu.au/policy/documents/studentmisconductprocedures.pdf

Further information on School policy and procedures in the event of plagiarism is presented in a School handout, *Administrative Matters for All Courses*, available on the School website.

7. COURSE SCHEDULE

All lectures in this course are given on Tue 09:00-10:30 Blockhouse 205 (K-G6-205) and Fri 09:00-10:30 Electrical Eng 418 (K-G17-418). You have to attend the lectures as well as your enrolled laboratory classes at the scheduled date and time.

Lecture Schedule	
Week	**Topic**
1	Course introduction, Digital number systems
	Number systems conversion, addition/subtraction
2	Boolean algebra, truth tables, expressions
	Digital logic gates, functions, logic families
3	Binary arithmetic, complement, signed number, codes
	Combinational logic 1, adder/subtracter, en/decoder, selector
4	Combinational logic 2, converter, programmable logic devices
	Boolean simplification 1, Karnough maps
5	Boolean simplification 2, tabulation method
	Sequential logic 1, state diagram, flip-flops, counter types
6	Sequential logic 2, analysis, modulo-counters
	Sequential logic 3, sequence generator, pattern detector
7	Overview of microprocessors

	Microcontroller, features, programming model
8	Microcontroller, instruction set, programming
	On-chip input/output resources
9	Interrupt mechanism
	General interfacing
10	Microcontroller-based control and instrumentation
	Programmable timer
11	Analog-to-digital converter
	Serial communication interface
12	Revision

Laboratory Schedule		
Week	**Topic**	**Report Due**
2	Digital logic – simulator/CAD software	
3	Digital logic – combinational logic, logic gate characteristics 1	
4	Digital logic – combinational logic, logic gate characteristics 2	
5	Digital logic – combinational logic, adder/selector 1	Report 1
6	Digital logic – combinational logic, adder/selector 2	
7	Digital logic – sequential logic, finite state machines 1	Report 2
8	Digital logic – sequential logic, finite state machines 2	
9	Microprocessor – assembly programming, I/O and interrupt 1	Report 3
10	Microprocessor – assembly programming, I/O and interrupt 2	
11	Microprocessor – assembly programming, device control 1	Report 4
12	Microprocessor – assembly programming, device control 2	
13	Contingency	Report 5

The schedule shown may be subject to change at short notice to suit exigencies.

8. RESOURCES FOR STUDENTS

Recommended Readings

1. Gajski, D.D. “Principles of Digital Design,” Prentice Hall
2. Wakerly, J.F., “Digital Design - Principles and Practices,” Prentice Hall
3. Steven F. Barrett and Daniel J. Pack, “Atmel AVR Microcontroller Primer: Programming and Interfacing,” Morgan & Claypool

Suggested Additional Readings

1. Morris Mano, M. and Kime, C.R., “Logic and Computer Design Fundamental”, Prentice Hall
2. Morris Mano, M. and Ciletti, M.D., “Digital Design” Prentice Hall
3. Stiffler, A.K., “Design with Microprocessors for Mechanical Engineers”, McGraw-Hill

Additional materials provided in UNSW Moodle

This course has a website on UNSW Moodle which includes:

- lecture materials;
- laboratory instructions;
- relevant data sheets;
- sample examination papers.

A discussion forum is intended for you to use with other enrolled students. The course convenor will occasionally look at the forum, monitor the language used and take note of any frequently-asked questions, but will not respond to questions on the forum. If you want help from the convenor then direct contact is preferred.

Recommended Internet sites

Information on the digital logic and microprocessor devices can be found in the following web sites:

- http://www.datasheetcatalog.com
- http://category.alldatasheet.com
- http://www.datasheetarchive.com

You may like to access the above web sites as entry-points to obtain data sheets, software user instructions and manuals.

Other Resources

If you wish to explore any of the lecture topics in more depth, then other resources are available and assistance may be obtained from the UNSW Library. One starting point for assistance is: www.library.unsw.edu.au/servicesfor/index.html

9. COURSE EVALUATION AND DEVELOPMENT

Feedback on the course is gathered periodically using various means, including the Course and Teaching Evaluation and Improvement (CATEI) process, informal discussion in the final demonstration class for the course, and the School's Student/Staff meetings. Your feedback is taken seriously, and continual improvements are made to the course based, in part, on such feedback.

In this course, recent improvements resulting from student feedback include the re-design of experiment exercises and introduction of experimental equipments. Exercises and experiments are streamlined and scheduled in the Mechatronic teaching laboratory.

10. ADMINISTRATIVE MATTERS

You are expected to have read and be familiar with *Administrative Matters for All Courses*, available on the School website. This document contains important information on student responsibilities and support, including special consideration, assessment, health and safety, and student equity and diversity.

N.M. Kwok
20 February 2015