ELEC2117
Electrical Systems Design
Course Outline – Semester 1, 2016

Never Stand Still | Faculty of Engineering | School of Electrical Engineering and Telecommunications

Course Staff

Course Convener: Dr Chamith Wijenayake, Material Science Building (E10) room 643
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Tutor(s): TBA

Consultations: You are encouraged to ask questions on the course material during the class times in the first instance, rather than via email. You are welcome to email the lecturer, who can provide you with consultation times. ALL email enquiries should be made from your student email address with ELEC2117 in the subject line, otherwise they will not be answered.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

Course Summary

Contact hours

The course consists of 2 hours of lectures, and a 3-hour laboratory session each week. A new method of teaching known as “flipped classes” or “inverted classroom model” will be implemented in this course, where after two weeks of face-to-face lectures, the remaining lectures and labs are integrated into lab-based learning.

	Day	Time	Location
Lectures	Tuesday	1pm-3pm	ElecEng-Room113 (subject to change)
Laboratory	Wednesday	2pm-5pm	ElecEng-Room113 (subject to change)

Context and aims

Programmable microcontrollers are used in embedded system applications, such as toys, implantable medical devices, remote controls, washing machines, automobiles etc. ELEC2117 is an introductory course which takes students through steps necessary to develop real world applications using a microcontroller (PIC16F886). The students will explore the microcontroller architecture and gain experience of jointly developing software and hardware.

Aims

The course aims to equip students to do the following:

- Develop the knowledge and skills required to understand embedded systems, in terms of both software and hardware

- Understand the fundamental internal architecture of an 8-bit microcontroller and its instruction set
- Understand microcontroller based interfacing circuits and write assembly language programs to interact with peripheral devices.
- Be able to demonstrate the design and implementation of an embedded system.

Indicative Lecture/Lab Schedule

Week	Date/Time	Activity
1	1 March/1-3pm	Lecture: Introduction to Embedded Systems (Room: Mathews 104)
	2 March/2-5pm	Lecture: PIC16F886 Overview (Room: Mathews 104)
2	8 March/1-3 pm	Lecture: PIC16F886 Instruction Set (Room: Old Main Building 151)
	9 March/2-5pm	Flipped Class 1: First Assembly Program
3	15 March/1-3pm	Flipped Class 2: Delay Loops with LEDs
	16 March/2-5pm	
4	22 March/1-3pm	Flipped Class 3: Push Buttons, Seven Segment Displays and Look-up Tables
	23 March/2-5pm	
Break		
5	5 April/1-3pm	Flipped Class 4: Key Pad Interfacing
	6 April/2-5pm	
6	12 April/1-3pm	Flipped Class 5: Seven Segment Display Multiplexing
	13 April/2-5pm	Flipped Class 6: LCD Interfacing. Project Announcement
7	19 April/1-3pm	Mid-term Exam – Theory Test (Room: Old Main Building G31)
	20 April/2-5pm	Mid-term Exam – Lab Test
8	26 April/1-3pm	Flipped Class 6: LCD Interfacing (cont…)
	27 April/2-5pm	Design Project
9	3 May/1-3pm	
	4 May/2-5pm	
10	10 May/1-3pm	
	11 May/2-5pm	
11	17 May/1-3pm	
	18 May/2-5pm	
12	24 May/1-3pm	
	25 May/2-5 pm	Design Project Evaluations
13	Design Project Evaluations/Revision	

Assessment

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Assessment in this course consists of the following:

Final Exam (written)	30%
Mid-term – theory test (written)	10%
Mid-term – lab test	15%
Project	40%
On-going lab check points	5% (plus 5% bonus extra lab exercises)

Course Details

Credits

This is a 6 UoC course and the expected workload is 10–12 hours per week throughout the 13 week semester.

Relationship to Other Courses

This second year design course complements the design thread in the School, drawing from knowledge gained in first year courses on electronic circuits, programming, and digital circuits. It is also assumed that students would have been exposed to introductory engineering design concepts, such as those gained from the first year ENGG1000 course. This is a core course for students following a BE ME in Electrical Engineering program.

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is ELEC2141: Digital Circuit Design and ENGG1000: Engineering design. It is essential that students are familiar with basic electronics. It is further assumed that the students are familiar with the programming environment, and have completed the first year computer programming course (COMP1917/COMP1911).

Learning outcomes (LO)

At the end of the course the student should:

1. Understand the internal architecture and capabilities of 8-bit PIC microcontrollers.
2. Be able to write assembly language programs for microcontrollers (with RISC architecture).
3. Understand microcontroller interfacing techniques.
4. Be able to interface peripheral devices (e.g. keypads, LCDs, LEDs, photo-sensors, other ICs, etc.) with microcontrollers.
5. Be able to design, build and test a microcontroller based system to satisfy given design specifications.

This course is designed to provide the above four learning outcomes which arise from targeted graduate capabilities listed in ***Appendix A*** **and** ***B***. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate attributes. This course also addresses the Engineers Australia (National Accreditation Body) Stage I competency standard as outlined in ***Appendix C***.

Syllabus

ELEC2117 is a design oriented course, in which students will carry out practical electrical engineering design project in the second half of the semester, solving an electrical engineering problem involving the computer interfacing of electrical/electronic circuits. The design will be supported by relevant theory and practical proficiency gained in the first half of the semester. It is proposed that the design will also feature the use of a microcontroller with appropriate hardware and software support. Assessment of the course will be designed around the practical components of the course, as well as the relevant supporting theory.

Teaching strategies

Learning in the course

The laboratories and support lectures will form the primary method of instruction for this course. During the lab sessions, students will be guided and supported by lab demonstrators. Students are expected to attend all laboratories as lectures and labs are

integrated to form a *smart classroom teaching* model. Students must prepare well for laboratory classes and will have a lab examination in Week 7. The students will also work on a project (individual) from Week 8 to Week 12, which will be assessed in Week 12/13.

Laboratory Exemption

There is no laboratory exemption for this course. Regardless of whether equivalent labs have been completed in previous courses, all students enrolled in this course for Semester 1, 2016 must take the labs.
If, for medical reasons, (note that a valid medical certificate must be provided) you are unable to attend a lab, you will need to apply for a catch-up lab during another lab time, as agreed by the tutor.

Pre-requisite to pass the course

A satisfactory performance (50% or greater) in **each** of the following, is a necessary requirement to pass this course:

- **Design Project**
- **Final Exam**

Mid-Semester Examinations (25% total)

The mid-semester examination consists of a theory test (10%) and laboratory assessment (15%) as indicated in the activity summary above. If for medical reasons (note that a valid medical certificate must be provided) or any other reasons, you are unable to attend the mid-semester exam, you will be given one supplementary exam.

On-going Lab Check Points (5%)

Each flipped class is based on a lab activity. You will be given a lab check point signature sheet. Upon completion of each flipped class activity you should get your signature sheet signed by the tutor/lab demonstrator. There will be a few bonus lab tasks (worth of 5% bonus marks in total) for those who complete all the compulsory tasks and have remaining time.

Design Project (40%)

Details of the design project will be released in Week 6 and will have to be completed by Week 12. Project work will include 5 hours of lab contact (scheduled lecture/lab times) per week and will involve the design, implementation and testing of an embedded system using a PIC16F886 microcontroller. The project will be assessed in Week 12/13 and you must submit a project report at the time of assessment. The assessment will be based on the demonstration of a working system and an oral examination.

Submit a **typed** report (pdf format) which should be clear, comprehensive, and include the following:

- A brief description of the design project.
- Detailed design criteria
- Relevant block diagrams of the design
- All interfacing circuit diagrams
- Details of software design
- Include assembly code you have written.
- All appropriate test results.
- A discussion/comparative analysis showing clear understanding of project.

Note

- This project involves a substantial time commitment to successfully complete all parts. It is suggested that you commence work on this project straight away.
- As a guide, each report should be at least 4 pages long (excluding code).

Final Exam (30%)

There will be one final written examination. If for medical reasons, (note that a valid medical certificate must be provided to the university) you are unable to attend the final exam, you will be given one supplementary exam.

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes				
Assessment	**1**	**2**	**3**	**4**	**5**
On-going lab check points (5%)	✓	✓	✓	✓	✓
Mid-semester examination (10 %)	✓	✓	✓	-	-
Mid-semester lab assessment (15%)	✓	✓	✓	✓	-
Project (40%)	✓	✓	✓	✓	✓
Final examination (30%)	✓	✓	✓	-	-

Learning outcomes:

1. Understand the internal architecture and capabilities of 8-bit PIC microcontrollers.
2. Be able to write assembly language programs for microcontrollers (with RISC architecture).
3. Understand microcontroller interfacing techniques.
4. Be able to interface peripheral devices (e.g. keypads, LCDs, LEDs, photo-sensors, other ICs, etc.) with microcontrollers.
5. Be able to design, build and test a microcontroller based system to satisfy given design specifications.

Course Resources

Textbooks

Prescribed textbook

- ELEC2117 course notes provided by course convenor

Reference books

- Designing Embedded Systems with PIC Microcontrollers – Tim Wilmshurst, Elsevier, 2010
- PIC Microcontrollers –Free online book – mikroElektronika; http://www.mikroe.com/products/view/11/book-pic-microcontrollers/
- PIC 16F886 Data Sheet (2007), Microchip Technology; www.microchip.com

On-line resources

Moodle

As a part of the teaching component, Moodle will also be used. Mid-semester examination results and mid-semester lab assessment marks will also be available via Moodle.

Mailing list

Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

Other matters

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see http://www.lc.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

Student Responsibilities and Conduct

Students are expected to be familiar with and adhere to all UNSW policies (see https://my.unsw.edu.au/student/atoz/ABC.html), and particular attention is drawn to the following:

Workload

It is expected that you will spend at least **ten to twelve hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and *independent, self-directed study*. In periods where you need to need to complete assignments or prepare for examinations, the workload may be greater. Over-commitment has been a common source of failure for many students. You should take the required workload into account when planning how to balance study with employment and other activities.

Attendance

Regular and punctual attendance at all classes is expected. UNSW regulations state that if students attend less than 80% of scheduled classes they may be refused final assessment.

General Conduct and Behaviour

Consideration and respect for the needs of your fellow students and teaching staff is an expectation. Conduct which unduly disrupts or interferes with a class is not acceptable and students may be asked to leave the class.

Work Health and Safety

UNSW policy requires each person to work safely and responsibly, in order to avoid personal injury and to protect the safety of others.

Special Consideration and Supplementary Examinations

You must submit all assignments and attend all examinations scheduled for your course. You should seek assistance early if you suffer illness or misadventure which affects your

course progress. All applications for special consideration must be lodged online through myUNSW within 3 working days of the assessment, not to course or school staff. For more detail, consult https://my.unsw.edu.au/student/atoz/SpecialConsideration.html.

Continual Course Improvement

This course is under constant revision in order to improve the learning outcomes for all students. Please forward any feedback (positive or negative) on the course to the course convener or via the Course and Teaching Evaluation and Improvement Process. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As part of the continuing improvements course notes are revised and a set of flipped-class-room activity guidelines is introduced.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:
http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures
https://my.unsw.edu.au/student/atoz/ABC.html

Appendix A: Targeted Graduate Capabilities

The Electrical Engineering and Telecommunications programmes are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

Appendix B: UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in laboratory sessions and assessed by laboratory assignments, design project and written examination.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments and interactive checkpoint assessments and lab exams during the labs.
- Developing capable independent enquiry, through a series of laboratory sessions spanning the duration of the course.
- Developing digital and information literacy and lifelong learning skills through design project and laboratory work.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.

Appendix C: Engineers Australia (EA) Stage 1 Competency standard

	Program Intended Learning Outcomes	ELEC2117
PE1: Knowledge and Skill Base	PE1.1 Comprehensive, theory-based understanding of underpinning fundamentals	✓
	PE1.2 Conceptual understanding of underpinning maths, analysis, statistics, computing	✓
	PE1.3 In-depth understanding of specialist bodies of knowledge	✓
	PE1.4 Discernment of knowledge development and research directions	✓
	PE1.5 Knowledge of engineering design practice	✓
	PE1.6 Understanding of scope, principles, norms, accountabilities of sustainable engineering practice	
PE2: Engineering Application Ability	PE2.1 Application of established engineering methods to complex problem solving	
	PE2.2 Fluent application of engineering techniques, tools and resources	✓
	PE2.3 Application of systematic engineering synthesis and design processes	✓
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects	
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability	✓
	PE3.2 Effective oral and written communication (professional and lay domains)	
	PE3.3 Creative, innovative and pro-active demeanour	✓
	PE3.4 Professional use and management of information	✓
	PE3.5 Orderly management of self, and professional conduct	✓
	PE3.6 Effective team membership and team leadership	