School of Electrical Engineering and Telecommunications

Semester 1, 2018
Course Outline

ELEC2117
Electrical System Design

COURSE STAFF

Course Convener: Dr Phu N. Le (phule@unsw.edu.au)
Tutor: Dr Phu N. Le (phule@unsw.edu.au)
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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 Dr Phu Le, who can provide you with consultations.

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 "blended learning" or "inverted classroom model" will be implemented in this course where face-to-face lectures, and labs are integrated into laboratory learning.

	Day	Time	Location
Lectures	Tuesday	9am – 11am	ElecEngG14
Laboratories	Tuesday	1pm – 4pm	ElecEngG14

Notice: Due to the renovation of EET building, the ElecEngG14 may not be available hence the lab time and venue on week 1 may be changed. Please check your email by 26th of February for the updated information.

Context and Aims

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 programmable 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: the schedule is listed in the following table. These lectures will be supported by pre-recorded videos where possible. Details will be on Moodle.

Week	Date	Topic
1	27 February	Introduction to computers/microcontrollers PIC16F886 architecture overview
2	6 March	PIC16F886 instruction set Assembly language programming
3	13 March	Flipped classroom learning – interactive lectures and labs
4	20 March	Flipped classroom learning – interactive lectures and labs
5	27 March	Flipped classroom learning – interactive lectures and labs
Break		
6	10 April	Flipped classroom learning – interactive lectures and Labs
7	17 April	Flipped classroom learning - interactive lectures and Labs (9am-11am) Mid-semester lab exam and Design Project details release (1pm-4pm)
8	24 April	Mid-semester lab feedback
9	1 May	Design Project
10	8 May	
11	15 May	
12	22 May	
13	29 May	Design project assessment and revision

Assessment

Mid-Semester Lab Assessment	20%
Design Project	45%
Final Exam (2 hours)	35%

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 Digital Circuit Design (ELEC2141) and Engineering design (ENGG1000). 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)

Following Courses

The course is a pre-requisite for ELEC2142, ELEC3117, ELEC4123.

Learning outcomes

After successful completion of this course, you should be able to:

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 learning outcomes which arise from targeted graduate capabilities listed in ***Appendix A***. The targeted graduate capabilities broadly support the UNSW and Faculty of Engineering graduate capabilities (listed in ***Appendix B***). 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 (s) 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

Delivery Mode

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 required to attend all laboratories as lectures and labs are integrated to form an inverted 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 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, 2018 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 laboratory tutor.

ASSESSMENT

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**

Laboratory Assessment: Laboratories are primarily about learning, and the laboratory assessment is designed mainly to check your knowledge as you progress through each stage of the laboratory tasks. You are required to maintain a lab book for recording all your design sketches, implementation notes and observations. A lab book is an A4 size notebook containing ruled/plain pages. You have to purchase your own lab book from any stores.

It is essential that you complete the laboratory preparation before coming to the lab. You are required to write the aim of the lab session or experiment and draw the circuit diagram if any in your lab book. This will be verified and signed by your demonstrators in the lab.

Laboratory Exam (20%)

There will be one mid-semester lab assessment, testing your programming and interfacing skills.

- Mid-Semester Lab assessment: **Tuesday, 17th April, 2018: 1pm –4pm**
- Location of the lab assessment : ElecEngG14
- Covers lecture and lab material from Weeks 1 to 6

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 lab assessment, your laboratory assessment will be rescheduled.

Design Project (45%)

Details of the design project will be released in Week 7 and will have to be completed by Week 12. Project work will include 5 hours of lab contact (scheduled lecture and 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 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 (starting from week 7).

Final Exam (35%)

There will be one final examination, testing your understanding of the principles and your programming skills. 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 another exam (either oral or written, at the discretion of the course convenor).

- The final exam will be 2 hours long
- The final exam consists of 3 questions (with many parts) and all of them must be answered
- The final exam will cover all material covered from Week 1 to Week 12.

Assessment methods linked to learning outcomes

	Learning outcomes				
Assessment	**1**	**2**	**3**	**4**	**5**
Mid-semester lab assessment (20%)	✓	✓	✓	✓	-
Project (45%)	✓	✓	✓	✓	✓
Final examination (35%)	✓	✓	✓	-	-

Learning outcomes (LO):

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 be used to disseminate teaching materials and host forums. Assessment marks will also be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

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

Dates to note

Important Dates available at: https://student.unsw.edu.au/dates

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 https://student.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://student.unsw.edu.au/guide), 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://student.unsw.edu.au/special-consideration.

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 online student survey myExperience. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings. As a result of previous feedback obtained for this course and in our efforts to provide a rich and meaningful learning experience, we have continued to evaluate and modify our delivery and assessment methods.

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:
https://student.unsw.edu.au/guide
https://www.engineering.unsw.edu.au/electrical-engineering/resources

APPENDICES

Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs 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 tutorials and assessed by assignments and written examinations.
- 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 and collaborative enquiry, through a series of tutorials spanning the duration of the course.
- Developing digital and information literacy and lifelong learning skills through assignment work.
- Developing ethical practitioners who are collaborative and effective team workers, through group activities, seminars and tutorials.
- Developing independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.
- Developing citizens who can apply their discipline in other contexts, are culturally aware and environmentally responsible, through interdisciplinary tasks, seminars and group activities.

Appendix C: Engineers Australia (EA) Professional Engineer Competency Standard

	Program Intended Learning Outcomes	
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	✓