School of Electrical Engineering and Telecommunications

Term 1, 2020
Course Outline

ELEC 2117
Electrical System Design

COURSE STAFF

Course Convener: Dr. Kaavya Sriskandaraja, Room 414, k.sriskandaraja@unsw.edu.au
Laboratory Contact: TBC
Laboratory Demonstrators TBC

Consultations: You are encouraged to ask questions on the course material, after each face-to-face session in the first instance, rather than via email. Lecturer consultation times are indicated below. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. **ALL email enquiries should be made from your student email address with ELEC 2117 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

This course is conducted in a *flipped-classroom* approach, where most of the face-to-face contact hours are spent in the laboratory involving hands-on lab-based activities. Except for the first two weeks, there won't be any formal lectures. The course consists of 5 hours of laboratory sessions each week with a 15-min lunch break.

	Day	Time	Location
Lecture + Lab	Wednesday	9am-2pm	ElecEng 201
Consultation	Thursday	4pm-5pm	ElecEng 414

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). Students will explore the microcontroller architecture and gain experience of developing software and hardware.
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 design aspects
- Understand the basic 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

Period	Summary of Lecture/Lab Program

Week 1	Introductory lecture and introductory lab activity 0
Week 2	Flipped mode lab activity 1 – General purpose input output and delay loops
Week 3	Flipped mode lab activity 2 – Look-up tables and seven segment displays
Week 4	Flipped mode lab activity 3 – More on I/O interfacing, keypads, interrupts
Week 5	Mid-term exam and flipped mode lab activity 4 – More on I/O interfacing, LCDs
Week 6	Release of the design project and flipped mode activity 5 – LCD interfacing, PWM
Week 7	Design project
Week 8	Design project
Week 9	Design project
Week 10	Design project and Project Evaluations

Assessment

Ongoing laboratory activities	5%
Mid-term exam (theory and lab)	20%
Design project	45%
Final Exam (2 hours)	30%

COURSE DETAILS

Credits

This is a 6 UoC course and the expected workload is 15 hours per week throughout the 10-week term.

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 basic programming concepts and have completed the first-year computer programming course.

Learning outcomes

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 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 projects in the second half of the term, 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 term. 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

This course is run in a flipped-classroom model where standard lectures and labs are integrated to hands-on activity-based learning in a laboratory environment. 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 the laboratory classes and will have a mid-term lab examination in Week 5. The students will also work on a design project (individual) from Week 6 to Week 10, which will be assessed in Week 10 (assessment time will be confirmed later).

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 term 1, 2020 must take all 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 (20%)

The mid-semester examination consists of a theory test (5%) and a hands-on practical assessment (15%).

On-going Lab Check Points (5%)

For each lab activity from weeks 1-6 you will be required to get yourself marked by a lab demonstrator. These ongoing lab activities will form the basis for your design project and will contribute towards 5% of your total course assessment.

Design Project (45%)

Details of the design project will be released in Week 6 and will have to be completed by Week 10. 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 11 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 (or a link to your code if it is too long)
- 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 a 2-hour final examination.

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes				
Assessment	**1**	**2**	**3**	**4**	**5**
On-going lab check points (5%)	✓	✓	✓	✓	✓
Mid-semester examination (20 %)	✓	✓	✓	✓	-
Project (45%)	✓	✓	✓	✓	✓
Final examination (30%)	✓	✓	✓	-	-

Course Resources

Primary source of reference will be the ELEC 2117 lecture notes provided and relevant datasheets and manuals of the microcontrollers and other peripherals used. Following textbooks/resources are definitely worth considering.

- 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, host forums and occasionally quizzes. 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 **15 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. As of Term 1 2020, assessment of applications for Special Consideration will be managed centrally and the University has introduced a "fit to sit/submit" rule. You will no longer be required to take your original documentation to The Nucleus for verification. Instead, UNSW will conduct source checks on documentation for verification purposes. You can apply for special consideration when illness or other circumstances beyond your control interfere with an assessment performance. If you need to submit an application for special consideration for an exam or assessment, you must submit the application **prior to the start** of the exam or before the assessment is submitted, except where illness or misadventure prevent you from doing so. If you sit an exam or submit an assignment, you are declaring yourself well enough to do so.

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. In particular, lecture notes have been revised and new digital resources are added to support the blended learning aspects.

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 independent, self-directed professionals who are enterprising, innovative, creative and responsive to change, through challenging design and project tasks.

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	