School of Electrical Engineering and Telecommunications

Term 3, 2020
Course Outline

ELEC3117
Electrical Engineering Design

COURSE STAFF

Course Convener: Dr. Beena Ahmed, EE&T 444, beena.ahmed@unsw.edu.au
Laboratory Contact: Scott Watts scott.watts@unsw.edu.au

Consultations: Lecturer consultation times will be on Monday and Thursday 2-4 pm. You are welcome to email the laboratory demonstrators 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 ELEC3117 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 a 3-hour laboratory session and a 1-hour mentorship session in Weeks 1 – 5 each and two 3-hour labs in weeks 6 – 10. The laboratories begin in Week 1. Pre-recorded lectures will be available online.

	Day	Time	Location	Day	Time	Location
Lectures	**Pre-recorded available on Moodle**					
Mentorship	Thursday	12 – 2 pm	online			
Laboratories	**Laboratory 1 (Weeks 1-10)**			**Laboratory 2 (Weeks 6-10)**		
H09A	Thursday	9 am – 12 pm	EE225	Friday	1 pm – 4 pm	EE224
M09A	Monday	9 am – 12 pm	G14	Thursday	3 pm – 6 pm	EE225
M13A	Monday	1 pm – 4 pm	EE224	Thursday	9 am –12 pm	G14
M13B	Monday	1 pm – 4 pm	EE225	Thursday	3 pm – 6 pm	EE224
M13C	Monday	1 pm – 4 pm	G14	Thursday	3 pm – 6 pm	G14
M13D	Monday	1 pm – 4 pm	EE201	Wednesday	1 pm – 4 pm	EE224
W09A	Wednesday	9 am – 12 pm	EE201	Thursday	6 pm – 9 pm	EE225
W12A	Wednesday	12 pm –3 pm	EE225	Thursday	9 am – 12 pm	EE224

Context and Aims

The course aims to provide students with a first-hand experience in open-ended electronic design. In this regard, the course specifically aims to:

- Expose students to the practical and technical challenges of serious Electrical Engineering design.
- Develop teamwork and project management skills.
- Provide a practical context for learning in other courses to cement practical skills in electronic circuit.
- Design and reinforce the importance of disciplines such as control, signal processing, embedded systems, etc.
- Impart an appreciation for the broader aspects of design, including consumer needs, marketing, product economics, manufacturing, standards, intellectual property and systems thinking.
- Further develop written and oral technical communication skills.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction to Design and Needs Assessment
Week 2	Marketing Tools and Requirements Analysis
Week 3	High-Level Designs, Design & Product Concepts
Week 4	Microcontroller Selection, Issues in Electronic Components and Circuits
Week 5	Project Management and Business Plans
Week 6	No lecture
Week 7	Intellectual Property and Legal Considerations
Week 8	Standards and Quality Assurance

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 1	Find Project Partner and Discuss Ideas with Tutors and Lecturers **Project Selection Form Due**
Week 2	Needs Assessment and Requirements Analysis
Week 3	High-Level System Design, Concept Generation and Selection
Week 4	Identify Critical Elements/Source Critical Components. Source Reference Designs
Week 5	Detailed Circuit Design **Development Proposal Due**
Week 6 (x2)	Continue Design
Week 7 (x2)	Functional Prototype, Refine Specifications
Week 8 (x2)	Prototype Testing and Refinement
Week 9 (x2)	Final Testing, Finalise Demonstration, Prepare Presentation
Week 10 (x2)	**Project Seminar and Demonstration** **Final Report Due**

Assessment

Project Development	25%
Project Seminar and Presentation	25%
Final Report	25%
Final Exam (2 hours)	25%

Important Health Related Notice

Your health and the health of those in your class is critically important. You must stay at home if you are sick or have been advised to self-isolate by NSW health or government authorities. Current alerts and a list of hotspots can be found here. **You will not be penalised for missing a face-to-face activity due to illness or a requirement to self-isolate**. We will work with you to ensure continuity of learning during your isolation and have plans in place for you to catch up on any content or learning activities you may miss. Where this might not be possible, an application for fee remission may be discussed.

If you are required to self-isolate and/or need emotional or financial support, please contact the Nucleus: Student Hub. If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for special consideration through the Special Consideration portal. To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this form.

UNSW requires all staff and students to follow NSW Health advice. Any failure to act in accordance with that advice may amount to a breach of the Student Code of Conduct. Please refer to the Safe Return to Campus guide for students for more information on safe practices.

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 is a 3rd year course in the School of Electrical Engineering and Telecommunications. For most students in Electrical or Telecommunications Engineering, this should be your second core design subject, the first having been ENGG1000. Some students may also have completed ELEC2117: Electrical Systems Design. The subject draws heavily on skills in electronic circuit design, which you are expected to have developed through previously taken subjects. Without these, it will be difficult to complete a meaningful design. You are also expected to have developed a habit of maintaining a laboratory notebook, which you will find particularly important for this course. Through this subject, you should gain additional insight into the importance of technical courses such as control, signal processing, embedded systems and the like, although not all ELEC3117 projects depend on such knowledge.

Pre-requisites and Assumed Knowledge

The pre-requisite for this course is ELEC2133, Analogue Electronics. It is essential that you have a reasonable background in Electronic Circuits before this course is attempted. It is further assumed that students have some familiarity with microcontrollers, as would be gained from ELEC2142, Embedded System Design, or similar.

Following Courses

The course is a pre-requisite for under-taking ELEC4951, Thesis A.

The following course in the design stream is ELEC4123, Electrical Design Proficiency – this is a core, Level 4 course. For students wishing to develop further in the entrepreneurial and small-business aspects should consider ELEC4445, Entrepreneurial Engineering, offered as a fourth-year technical elective.

Learning outcomes

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

1. Be capable of initiating, designing, and managing an electronic design project.
2. Have developed skills with project management and circuit schematic software.
3. Be able to work in a small development team, write formal project reports, deliver a product development proposal, and present a technical seminar.
4. Recognize the conditions under which it is important to conduct patent searches, file patents, follow and/or contribute to standards.
5. Be able to apply knowledge of manufacturing processes, electromagnetic compatibility, safety, and other areas to the design of quality products.

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

Design Project Management: Introduction to scheduling, costing, marketing, standards, patents, quality, safety, (electronic) manufacturing methods, engineering innovation, Report Writing and Oral Presentations. Design Methodology: Systematic design procedures, design documentation. Designing for quality, manufacture, maintenance, minimum life cycle cost. Aspects of Electronic Design: Component selection, tolerances, passive component characteristics. Also EMC, Earthing, and PCB layout principles. Engineering Drawing and Graphical Communications: Projections, dimensioning and drawing interpretation. Group Project: Students are required to design and build an electrical engineering project. This process will include producing specifications, detailed design, prototype production and testing. The Design will be presented in a seminar and documented in two formal technical reports that also consider scheduling, marketing and business plans.

TEACHING STRATEGIES

Delivery Mode

The design project plays a major role in the learning process for this course, since it provides an opportunity for you to practice many of the methods which are taught in lectures. In particular, project management, electronic prototyping, properties of electronic components and many other areas of teaching in this course cannot be properly appreciated without undertaking a serious concurrent design project. Pre-recorded lectures will be made available weekly on Moodle and supported with an at-home activity followed by peer review pertaining to the current topic, with each of these activities assessed. The lectures, notes and at-home activities will provide valuable information to assist students in their projects, while also providing a broad framework for design, including many facets that cannot be experienced properly within a student project.

Learning in this course

You are expected to attend all labs and mentorship sessions in order to maximise learning. The design project is at the centre of the course, and it is expected that it will require a significant amount of your time beyond the face-to-face scheduled class time (recall that the expectation for a 6 UoC course is that it would occupy 15 hours of student time per week). In addition to the lecture videos and notes, you should read widely from a variety of relevant sources – the lectures cannot cover the specific technical details pertaining to your specific project, and you are expected to develop the skills to be able to research technical concepts independently. Reading additional texts will further enhance your learning experience. Group learning is also encouraged. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending formal classes throughout the course.

Lectures

Lecture videos cover technical aspects of detailed design, as well as broader aspects of design, including marketing and economics. All material covered in lecture notes is examinable, not just that which directly relates to student projects. Lecture notes and slides will constitute the reading material for each topic. By and large, the lecture notes are carefully prepared written materials, designed to be read.

Project/Laboratory program

The project is the major component of the work in ELEC3117. It represents over half of the total marks for the subject. Therefore, to do well in this subject you must do well in your design project. Even more importantly, you must pass the laboratory component. Failure to do so may result in a UF (Unacceptable Fail), even if your overall final mark is greater than 50%. This project requires much more than just designing and constructing an electronic circuit. It requires the consideration of a broad range of engineering and strategic business issues, such as target market, competition, costing, timing etc.

You are required to attend all laboratory and mentorship sessions. Attendance WILL be kept, and you MUST attend at least 80% of the laboratory and mentorship sessions. All laboratory sessions will be conducted in the laboratories in EE&T while the mentorship sessions will be conducted on online. In the sessions in weeks 1 – 5 (labs once a week), your focus should be on designing your project while in weeks 6 – 10 (labs twice a week) on building your project. In the mentorship sessions in Weeks 1 – 5 you will have the opportunity to discuss your projects and issues you are facing with a demonstrator and other teams.

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 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 coordinator.

ASSESSMENT

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through the project assessment tasks – laboratory attendance and in-class activities, project development proposal and the project seminar.

Project Selection

You need to choose your project in a two-step process. In the first step, on Moodle you need to choose a partner from your lab section and a group of 3 projects from the list posted on Moodle by Monday of Week 1. You then need to select one project from the group of 3 projects by Sunday of Week 1. Your selection is to be submitted on Moodle. More information may be found on the course website.

Project design teams are nominally composed of only two students. If you have not been able to find a lab partner, it is possible to submit an individual team and a partner will be found for you. In order to achieve project teams of two, it is typically necessary for some students to change the laboratory session in which they are enrolled. This is because project team members must all attend the same scheduled laboratory session. Project teams of three will be considered only where otherwise unavoidable.

Advisory Board

Each project team will be assigned 2 other teams to act as their advisory board. The role of the advisory board will be to provide each team with advice of project directions and peer review their work.

Lab attendance and at-home activities

Attendance in the labs will be recorded and account for 5% of the total course marks. At-homes activities will account for 5% of the total course marks also. Examples of the assessed activities will include reflection memos about guest video lectures and peer review reports.

Project Development Proposal

The first major group assessment for the design project is the Project Development Proposal, due at the end of Week 5. This is a formal engineering report, containing a description of the product and design concepts, market assessment and analysis, economic and cost estimates, and development plan. The Project Development Proposal will account for 15% of the total course marks. Further details, including the detailed marking scheme, will be made available closer to the date. The Report must be submitted via Moodle.

Project Seminar and Demonstration

During the laboratory sessions in Week 10, you will be asked to present your design and demonstrate a functional prototype. Each project team will be allocated 15 minutes for the seminar and demonstration – a timetable will be posted closer to the date. This assessment task accounts for 25% of the total course grade. The focus of the presentation is for you to emphasize the novelty of your design, the technical challenges and improvements required for the design to move into commercial development and demonstrate the functional prototype. The aim of this assessment is to give students experience in communicating technical ideas.

Final Report

The final report is due by 10 pm of the Thursday in Week 11, submitted through Moodle. The focus of the final report is on describing the detailed design and the subsequent plan for manufacturing/further development as well as the business plan. This assessment task contributes 25% of the total course grade. Further details of the final report will be provided closer to the date.

Late reports will attract a penalty of 10% of the maximum attainable mark per day late (including weekends). For example, if the report is two days late and achieves a raw mark of 87%, the final result for this report will be 80% (since this is the maximum attainable mark, given it is two days late). However, a report achieving a raw mark of 67% that is two days late will still achieve a final mark of 67.

Final Exam

The exam in this course will be a take home open-book written examination, comprising three compulsory questions. The examination for this course focuses on the important aspects of the course curriculum that are difficult to cover through a student project – technical aspects such as electromagnetic compatibility and manufacturing limitations, as well as the important non-technical aspects of engineering design, such as patents, quality, safety, and standards. The final exam accounts 25% of the total course grade. *Please note that you must pass the final exam in order to pass the course.*

Relationship of Assessment Methods to Learning Outcomes

Assessment	1	2	3	4	5
Project Development	✓	✓	✓	-	-
Project Seminar and Demonstration	✓	✓	✓	-	-
Final Report	✓	✓	✓	✓	✓
Final exam	-	-	-	✓	✓

COURSE RESOURCES

Textbooks

There are no required texts for this course. If there were one, it would be the first text from the following list of recommended books:

Reference books:

- **K.T. Ulrich and S.D. Eppinger, Product Design and Development, McGraw-Hill, 2000 (2nd edition)**. This book provides a good overview of the design process with a number of relevant case studies to illustrate the methods discussed. It includes sections on product costing and project management, as well as methodologies for market analysis and concept generation. This text is easy and enjoyable to read and may be purchased from the UNSW bookstore. However, it does not touch on the details of electronic design, or a number of other topics covered in the course.
- **J.E. Salt and R Rothery, Design For Electrical and Computer Engineers, John Wiley & Sons, 2002**. This book covers key aspects of design at a high level, but with quite a few examples. Strong on user needs/requirements and high level design. Covers a variety of design approaches, project management, and costing issues. This text is easy to read and may be purchased from the UNSW bookstore. However, it does not touch on the details of electronic design, or a number of other topics covered in the course.
- **P. Horowitz and W. Hill, The Art of Electronics, Cambridge University Press, 1989 (2nd edition).** This book is an excellent reference for electronic design issues that may be required to complete your project.
- **D. A. Norman, The Design of Everyday Things, Currency-Doubleday, 1990**. A very interesting read. Ever wondered why you just walked into a door, or tried to pull a sliding door? This book discusses the design of the everyday objects that we take for granted.

Students are reminded that the UNSW library is an excellent resource.

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/policy), 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 formal classes and *independent, self-directed study*. In periods where you 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 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. Be aware of the "fit to sit/submit" rule which means that if you sit an exam or submit an assignment, you are declaring yourself well enough to do so and cannot later apply for Special Consideration. For more information and how to apply, see 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. Based on feedback from students last, a mentorship session has been added to help teams with their project design and the exam format has been changed to align it with the strong focus on design in the course.

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 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	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	✓