School of Electrical Engineering and Telecommunications

Term 1, 2021
Course Outline

ELEC4123
Electrical Design Proficiency

COURSE STAFF

Course Convener: Professor David Taubman, Room 446, d.taubman@unsw.edu.au

Consultations: The lecturer will be available in EE201 (primary course lab) during at least one of the Tuesday or Friday OTH timeslots on your schedule.

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 1 hour of lectures, and two primary 3-hour laboratory sessions each week. The primary laboratory sessions are those listed as OTH on your timetable and will be hosted in EE201 and EE224. Each of these primary 3-hour lab sessions is prepended by a 1 hour open lab, at which attendance is optional. You will also have enrolled in one 3-hour TLB slot each week, which may be used for late assessment of the tasks in the first three (core) proficiency topics, but may not be required until the final (elective) topic.

	Day	**Time**	**Location**
Lectures	Monday	9am-10am	Microsoft Teams Meeting
Primary Lab Slot 1	Tuesday + Friday	9am-12noon	EE201 + EE224 + Online
Primary Lab Slot 2	Tuesday + Friday	5pm-8pm	EE201 + EE224 + Online
TLB Slot 1 (not heavily used)	Monday	10am-1pm	EE201 + EE224 + Online
TLB Slot 2 (not heavily used)	Monday	5pm-8pm	EE201 + EE224 + Online

Online Arrangements

This course is configured to support both local students and students who have no choice but to participate online, including students trapped overseas and students who are required to quarantine or self-isolate for any reason. For this reason, all laboratories are listed as both online and physical.

For the first three (core) topics, all students are grouped in pairs; pairings will be assigned automatically and will generally change from topic to topic. For the last (elective) topic, students will work in groups of 4 and will be able to select their own groups, subject to certain constraints related to students who are unable to attend in person. In all cases, **at least one student in each pair or group of 4 is required to attend online, while at least one student is required to attend in person.**

If all students in a pair or group are local, the pair or group must ensure that online attendance is distributed equitably amongst group members, so that all members of a pair or group have equal access to physical laboratory attendance, subject to other constraints such as ill-health, quarantine or self-isolation requirements and so forth.

Students working in a pair or group are required to work together, whether phyiscally present or online, which means that the student working online must be in constant communication with the other member(s) of the pair or group during the primary laboratory sessions, preferably via Microsoft Teams. Students are recommended to use their own laptops, if possible, for such online interaction, but webcams and Microsoft Teams will also be available in the labs for students who cannot use a laptop for this purpose.

Students in a pair or group should generally work on design problems together. Partners can pursue different approaches simultaneously, and this is not discouraged, so long as there is sufficient lab time available to support the implementation and testing of the different solutions.

Importantly, the physical implementation of every design needs to be done in the lab, even if a student is online. This means that the student who is physically present in the lab is responsible for implementing the solution and operating the test equipment. Online students will need to be marked by a lab demonstrator who will sit in the place normally occupied by their team member and communicate via the same Microsoft Teams session as the local team member. Moreover, the online student will always be marked first for a given task, rather than the local student. All students are expected to have a full understanding of the design and its implementation, whether local or located online.

As noted above, an extra hour has been reserved prior to the start of each laboratory session – i.e., 8am-9am for the 9am-12noon primary lab slots, and 4pm-5pm for the 5pm-8pm primary lab slots. This extra hour is optional, but is subject to the same constraint that at least one member of each pair or group may not attend physically. However, the student who participates online in the regular 3-hour lab session can participate physically (in place of another team member) in the extra hour, if this is agreeable to all members of the pair or group.

Context and Aims

This is a rather unusual course, in that there is no final or mid-term examination and the majority of your contact hours are spent in the laboratory (physically or remotely, as explained above). The course is arranged into four proficiency topics, each occupying two weeks, where each week has two primary 3-hour labs. That is, each topic is composed of 12 primary laboratory hours. In addition, one hour has been reserved prior to the start of each laboratory session, which you will be able to use to help prepare. You can interpret these extra 4 hours per topic as a supervised open-lab.

The purpose of lectures is to keep the course on track and to help to correct weaknesses in your understanding. The intent is to make lectures as interactive as possible – even though they are online. You should come prepared with questions, rather than expecting to just be told everything you might need to know. Topics covered in these interactive lectures will be based on a combination of questions raised by students, as well as the lecturer's observation of common issues that arise during laboratory sessions.

The principle purpose of this course is to test your design proficiency, through a sequence of design challenges. Some of the challenges are very basic, but there is also plenty of scope for you to demonstrate superior skills. The design challenges within each of the first three (core) topics are organized into 5 or 6 tasks that can be undertaken and assessed progressively. Your assessment for the core topics is done on an individual basis, not as group work. However, you are encouraged to work closely with your assigned partner, since only one of the two of you can be physically present in the lab for any given session. Collaborating on a design with other students in the course (other than your assigned partner) is not encouraged, but you are encouraged to discuss ideas and problems with your friends and colleagues.

A secondary aim of the course is to fill in any major holes in your fundamental design knowledge, so as to ensure that all graduating students have at least a minimum level of proficiency. Although some of you might initially feel uncomfortable about this, it is important to realize that prospective employers will be very pleased indeed to know that you are able to demonstrate your proficiency. You should expect that this course will reinforce your existing knowledge and increase your confidence in design and some of the fundamental disciplines you have been studying. Opportunities to correct misunderstandings mostly occur between laboratory sessions, including within the course lectures.

A third objective of the course is to expose you to a healthy balance between team work and individual responsibility. In this course you are in fact forced to work closely with at least one other student in each topic, because you are not permitted to be physically present at all lab sessions, unless your assigned partner is not able to attend physically for some reason. The elective topic expands the collaboration from pairs to a group of 4

students and is assessed very differently from the other topics. In place of the weekly lecture, you will be assigned to tutorial groups for these last three weeks of the course, with a tutor who can both help to keep you on track and also keep an eye on the functioning of your team and the level of contribution that each team member appears to be making to the design. These tutorials will take place within the TLB slot on your timetable. The elective topic will involve both individual and group assessment components.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction to the Electronics topic
Week 2	Q&A session for the Electronics topic
Week 3	Electronics Postmortem + Introduction to the Signal Processing topic
Week 4	Q&A session for the Signal Processing topic
Week 5	Signal Processing Postmortem + Introduction to the Control topic
Week 6	Q&A session for the Control topic
Week 7	Q&A session for the Control topic
Week 8	Control Postmortem + Introdution to the elective topics
Week 9	No lecture, but tutorials in the TLB slot – **these are assessed (compulsory)**
Week 10	No lecture, but tutorials in the TLB slot – **these are assessed (compulsory)**

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 1	Topic 1 – Electronics
Week 2	Topic 1 – Electronics
Week 3	Topic 2 – Signal Processing
Week 4	Topic 2 – Signal Processing
Week 5	Topic 3 – Control
Week 6	Flexibility week (labs might be open)
Week 7	Topic 3 – Control
Week 8	sabbatical – take a short break and plan for the elective topic
Week 9	Topic 4 – Elective
Week 10	Topic 4 – Elective

The marks for this course will be assigned as follows:

Assessment Component	Basis	Marks
Achievement of design objectives, as demonstrated in labs, core topics T1-T3	pair	24% (3x8%)
Understanding of relevant subject material, as demonstrated in labs, core topics T1-T3	individual	36% (3x12%)
Elective tutor mark: team performance T4	group	5%
Elective tutor mark: individual contribution T4	individual	5%
Elective interview: design understanding T4	individual	5%
Elective performance: design performance T4	group	10%
Team report on elective topic T4	group + individual	10% + 5%

COVID19 - 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.

NOTE: If you are required to quarantine or self-isolate, or if you are trapped overseas, you must notify the lecturer immediately, since this will impact how you can be paired with other students subject to the requirement that one student in each pair be physically present in the lab.

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 4th year core course in the School of Electrical Engineering and Telecommunications.

Pre-requisites and Assumed Knowledge

It is essential that you are familiar with the material in ELEC3104 (Signal Processing), ELEC3106 (Electronics) and ELEC3114 (Control), before this course is attempted, since these correspond to the three core proficiency topics tested.

Learning outcomes

Upon successful completion of this course, the student should:

1. Have demonstrated an ability to work both individually and within a group, to produce designs which draw upon a number of disciplines previously studied in other courses.
    - *The 4 design topics and formal laboratory sessions all reinforce and assess these abilities.*
2. Have demonstrated an ability to contribute to and learn from peers.
    - *The remote pairing strategy, elective design topic and interactive lectures all reinforce this ability, while the tutorial sessions for the elective topic both reinforce and assess it.*
3. Have demonstrated a sufficient level of understanding and skill within a range of disciplines, together with an ability to explain design decisions.
    - *The assessment methodology in laboratories deliberately reinforce and assess these outcomes.*

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

The course involves three core competency components, as follows:

- Electronic Circuit Design: Devices, amplifiers, tuned circuits, opamp circuits, etc.
- Control System Design: Feedback and stability, linear control, non-linear control, data acquisition and sampling, etc.
- Signal Processing Design: Filter design, frequency response, spectrum analysis, BIBO analysis, etc.

The elective component of the course involves competency components in at least one of the following areas:

- Power System Design: Transformer, motor, power electronic converter, power factor, harmonics, etc.
- Networked Communications: Computer programming, socket programming, network protocols, distributed asynchronous systems, estimation and exploitation of local and system-wide timing information, etc.
- Physical Communications: Modulation schemes, robust detection of signals in noise, multiplexing and interference suppression, efficient bandwidth utilization, error control, etc.

Laboratory assessment requires the design, construction and understanding of working solutions to specified problems.

TEACHING STRATEGIES

The teaching in this subject is heavily focused on laboratories. Each of 4 design topics has 4 assigned laboratories, each 3 hours in duration. The laboratories are designed to develop and assess proficiency. The majority of the assessment is individual, with a focus on design understanding and objectively working solution.

The laboratories are complemented by a mix of lectures and tutorials. For the first 3 topics, weekly lectures provide both input and an opportunity for class interaction, albeit on a large scale. Lectures are intended both to address knowledge gaps and also to reinforce an approach to design, which focusses on **the need to identify early what is most problematic about a design problem**. Through this process, students are expected to be better prepared to approach the larger design problem that they will face as a team during the fourth (elective) design topic.

A very important aspect of the teaching in this course is the allocation of 4 lab sessions to each topic, which allows students to attempt design tasks multiple times and to learn from their mistakes between attempts. This strategy facilitates a reflective learning cycle.

Through these mechanisms, the course aims to build and ensure proficiency in the core areas of your program of study.

Design Topics

The course is divided into a sequence of three "core design topics" and one "elective design topic," each of which is assigned 3 formal laboratory sessions of 4 hours each. The core design topics are: 1) Electronic Circuits; 2) Signal Processing; and 3) Control Systems. The elective topics are: 4a) Energy Systems; 4b) Data Networks; and 4c) Telecommunications.

Each of the core topics consists of a sequence of design tasks, with progressively higher complexity. Design tasks for the core topics must be completed individually, although you are encouraged to discuss the topics with your fellow students **outside the formal laboratory hours**.

The elective design is performed in groups of at most 4 students; you must nominate which of the elective topics you intend to pursue by the end of Week 6, at which point you will also have an opportunity to propose a design team. If you are not part of a proposed team, or if unavoidable circumstances require it, you will be assigned to a team at the Course Convener's discretion. You will be provided with further instructions on how to submit elective topic and team nominations. Unlike the first three design topics, the elective design is assessed only in the final week.

Individual Learning

Preparation for labs is essential to success in this course. You should find yourself revising material from previous courses, discussing problems with your peers, raising questions in lectures, and perhaps struggling to find and solve problems you encounter with your design or implementation in the laboratory. All of these are outstanding learning opportunities.

Group Learning

You are strongly encouraged to discuss the design tasks with your class mates outside the laboratory sessions – laboratories themselves, however, are not the place for helping your friends or discussing design solutions with anybody other than your assigned lab partner.

The elective topic is a team effort, having larger scope and less incremental objectives than the first three design topics. To succeed in this topic, you will need to work effectively as a team member or leader. Moreover, each team is required to submit a report describing the design principles, implementation, outcomes and final reflections. The report will also need to be a team effort.

Laboratory Exemption

There is no laboratory exemption for this course. If, for medical reasons, (note that a valid medical certificate must be provided) you are unable to be assessed for your laboratory work, you will need to **seek permission from the course convener** to be assessed in a subsequent week. If, for medical reasons, you are unable to participate multiple laboratory sessions, you may be allowed to withdraw from the course without penalty.

Since laboratory arrangements involve a significant amount of online participation, there will often be ways to participate in labs even if you are not able to be physically present. However, you must discuss any special needs that you have with the lecturer in charge.

ASSESSMENT

Assessment of core design tasks

All completed tasks for the three core design topics are to be assessed during the laboratory sessions by one of the laboratory demonstrators. Once you have completed a task, you should add your name(s) to a list maintained by the demonstrators in your laboratory, so that you can be assessed as quickly as possible. You cannot expect to be assessed for all of the tasks you have completed during the final laboratory session of the topic, since this can place an unacceptable burden on the demonstrators' time.

Of the 20% of the overall course assessment that is associated with each core design topic, 8% is awarded based on actual outcomes. You cannot expect to obtain any of these marks for a solution which does not actually work or achieve the task objectives to some extent. The remaining 12% is awarded for your understanding of the design problem and your own design. To obtain these marks, you will need to convince the marker (one of the demonstrators) that you thoroughly understand your design and why you have selected it.

Assessment is individual, even though you work in pairs for the core design tasks. The design itself will most likely be developed jointly by the students in a pair, but both students must be individually able to demonstrate the solution and explain it at any required level of detail. You are not to develop solutions to core design tasks jointly with any other students in the course – doing so may result in a determination of plagiarism by the demonstrator, in which case both you and your partner will necessarily receive 0 marks for the task.

Assessment for the elective design topic

The elective design topic is a group activity, for which all assessment will take place in Week 10. 40% of the overall course assessment is related to the elective topic, but only 15% is awarded by the lab demonstrators in Week 10. 5% is awarded based on an individual interview of each team member, to determine their level of understanding of both the overall design and their contribution to it. The other 10% is awarded based on objective performance of the final design, a component of which will be competitive, meaning that teams will be ranked within each topic, based on the objective performance of their designs.

Tutorials are important for the elective design topics. There will typically be several teams within a single tutorial. Your tutor will ask each team to work by themselves within the tutorial room, circulating between teams to observe their interaction and thought processes, and to offer suggestions where appropriate. Your tutor will especially be interested in the way in which you approach the design problem, how you ensure that you focus on the most challenging parts of the problem first, how you reach an overall design that is likely to work, and how your team manages the resources at its disposal. Your tutor will also observe how individuals contribute to the team's deliberations, design and interaction. Based on these observations, the tutor will award team and individual marks, each worth 5% of the overall assessment for the course.

Your team's final report for the elective topic is an essential part of the reflective process. You will be expected to have a preliminary version of the report available during the laboratory assessment exercise in Week 10. However, the report should be finalized afterwards, including a reflection on the design process that you followed, in light of your design's performance. The report is due on Wednesday of Week 11. While the overall report is a group activity, **each team member must have an identified individual contribution to the report** that will be used to generate an individual mark. Specifically, of the 15% weighting assigned to the report, 10% will be common to all members of the group, while 5% will be individual.

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes		
Assessment	**1**	**2**	**3**
Core design tasks	✓	-	✓
Elective design topic	✓	✓	✓
Elective design group report	✓	✓	✓

COURSE RESOURCES

Textbooks

There are no specific texts for this course, but you should consider your lecture notes and text books from earlier classes in Electronics, Signal Processing, Control, Telecommunications, Data Networks and/or Energy Systems to be useful resources.

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.

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 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 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.

Appendix C: Engineers Australia (EA) Professional Engineer Stage 1 Competency Standards

Competency Standards		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	1, 3
	PE1.4 Discernment of knowledge development and research directions	
	PE1.5 Knowledge of engineering design practice	1, 3
	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	1, 3
	PE2.2 Fluent application of engineering techniques, tools and resources	1, 2, 3
	PE2.3 Application of systematic engineering synthesis and design processes	1, 3
	PE2.4 Application of systematic approaches to the conduct and management of engineering projects	1, 2, 3
PE3: Professional and Personal Attributes	PE3.1 Ethical conduct and professional accountability	
	PE3.2 Effective oral and written communication (professional and lay domains)	2, 3
	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	1, 2