School of Electrical Engineering and Telecommunications

Term 3, 2020
Electrical Engineering Technical Stream Outline

ENGG1000
Engineering Design and Innovation

COURSE STAFF

Technical Stream Convener: Dr. Siyuan Chen, Room 447, siyuan.chen@unsw.edu.au
Laboratory Contact: Dr. Siyuan Chen, Room 447, siyuan.chen@unsw.edu.au

Consultations: Lecturer consultation times will be advised during the first lecture. You are welcome to email the 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 ENGG1000 ELEC Tech Stream 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 Electrical Technical Stream course consists of 1 hour of lectures, and a 1-hour laboratory session each week from **Weeks 3 to 8 inclusive**, as indicated in the Faculty Course Outline (please refer to the faculty-wide schedule in the Faculty ENGG1000 Course Outline).

	Day	**Time**	**Location**
Lectures	Thursday	2pm – 3pm	Blackboard Collaborate Ultra on Moodle
Labs	Thursday	3pm – 4pm	Blackboard Collaborate Ultra on Moodle

Context and Aims

Good ideas for products could worth million dollars. How would you implement your ideas into a circuit prototype to attract investors' attentions ? What design choice do you need to consider for a simple circuit prototype ? What circuit theories do you need to design and evaluate a circuit rather than depending on trial and error ?

The Electrical Tech Stream aims to (I) convey some basic principles of electronic components/devices, circuit construction and analysis techniques, in order to design, build and test simple circuits, (ii) familiarize students with simulation tools, basic circuit theories in order to design and evaluate circuits effectively, and (iii) provide hands-on experience through solving practical design problems.

At the end of the course, students will be confident to take the steps to implement their ideas into a circuit system and showcase their prototype. Students will master the principles of electronic circuit design and apply it to any

product idea in the future as a hobby lover or a professional engineer. Students will be able to justify their circuit design choices to show the value of their ideas.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	N/A
Week 2	N/A
Week 3 (Thursday, 1 Oct)	Introduction to Electronics + Resistors & circuit theories
Week 4 (Thursday, 8 Oct)	Diodes and Transistors
Week 5 (Thursday, 15 Oct)	DC Motor and drive circuits
Week 6	N/A
Week 7 (Thursday, 29 Oct)	Op-Amps and applications
Week 8 (Thursday, 11 Nov)	Capacitors and Filters + course summary
Week 9	N/A
Week 10	N/A

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 1	N/A
Week 2	N/A
Week 3 (Thursday, 1 Oct)	TinkerCAD introduction and voltage regulator circuit design
Week 4 (Thursday, 8 Oct)	Diodes and transistor circuit design
Week 5 (Thursday, 15 Oct)	DC motor circuit design
Week 6	N/A
Week 7 (Thursday, 29 Oct)	Comparator circuit design
Week 8 (Thursday, 11 Nov)	Filter circuit design
Week 9	N/A
Week 10	Lab exam (at allocated timeslot)

Assessment

Laboratory Exercise	10%
Lab Exam (20 minutes)	10%

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 technical stream course offered within ENGG1000 (a 6-UoC course). Please read the faculty-wide course outline for the credits. The expected workload for this technical stream is 3 hours per week from week 3 to 5 and from week 7 to 8, including 2 hours for lectures and labs, and 1 hour for preparation and time spend on assessable work.

Learning outcomes

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

1. Identify typical design challenges faced by electrical, telecommunications and photonics engineers, and what kinds of skills and knowledge are needed to tackle them.
2. Construct simple circuits to meet required specifications and justify design trade-offs typically experienced during electrical design.
3. Explain the electrical characteristics of simple electronic components and use their electrical characteristics to justify component choices in circuit designs for simple problems.
4. Analyse basic electrical quantities using circuit theories and evaluate a given circuit design.
5. Design simple circuits and debug circuit problems.

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***.

TEACHING STRATEGIES

Delivery Mode

The teaching in this course aims at establishing a good fundamental understanding of the areas covered using:

- Formal online lectures, which provide you with a focus on the electrical characteristics of the components used in the course, together with circuit theories for quantity calculation, to aid you make good design choices in circuit prototyping;
- Online periodic quizzes, which allow for exercises in problem solving for each lecture topic and self-assessing your understanding of lecture material;
- Virtual laboratory sessions, which support hands-on experience to design circuits and also provide you with practical construction, measurement and debugging skills as well as communication skills, where justifications of design choices will be shared and discussed and you help each other debug circuit problems in a group;
- video lectures recorded in previous years, which provide a deeper background knowledge and is optional to watch, which are for students who want to know more about these technical and theorical knowledge which cannot be adequately explained in limited lecture time.

Learning in this course

You are expected to attend <u>all</u> lectures and labs in order to maximise learning. You must prepare well for your laboratory classes and your lab work will be assessed. In addition to the lecture notes/video, you should read relevant sections of the recommended text. 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.

Laboratory program

The laboratory schedule is deliberately designed to provide practical exposure to the concepts conveyed in lectures soon after they are covered in class. You are required to attend laboratory. Laboratory attendance WILL be kept, and you MUST attend at least 80% of labs.

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.

Laboratory Preparation

- Ensure you have a working camera and microphone to attend the online lab class
- For the online labs, TinkCAD will be used to build and simulate circuits on breadboard in virtual environment. Students are required to register an online account with TinkCAD before week 3.
- Read the laboratory exercises in advance. Attempting the tasks at home before the lab is highly encouraged so you have sufficient time to discuss your circuits with peers and lab demonstrators and revise them if needed.
- Read the related lecture notes in advance of each lab, and bring them to the online lab for an easy access.
- Get a lab notebook and bring it to every lab to note down your design ideas, calculations and learning reflections. You may find it helpful to your project and your final lab exam.
- You are welcome to implement your circuit designs using real breadboard and electronic components for your project after week 8 provided your online circuit simulation works. If the school permits, you can pick up the available electronic components from the Electrical Engineering Workshop located in room G15, Electrical Engineering Building. If you do not own a breadboard, you can purchase one from the Electrical Engineering Workshop. Physical implementation is optional. If you would like to do it, please make a request to the ELEC tech stream convener.
- There are laboratory equipment video guides available online on UNSW eLearning YouTube Channel (click here). It is highly recommended to watch these videos to better familiarize yourself on how to work with Electrical Engineering laboratory equipment. They may not be the same with the measurement equipment in TinkCAD, but give you some ideas of how to use them in the virtual labs.
- If you need to use the lab facility at Electronics Labs in the Electrical Engineering Building at any circumstances, you are required to enrol (enrolment key is 'elecmood') and complete an Occupational Health and Safety Course prior entry. You can find this course by searching the course name on Moodle. Completion of this course is a requirement to access the Electrical Engineering Lab rooms. Also wear covered shoes. Without these you will be refused to entry. Under no circumstances is mains voltage (230V) to be used at any stage. If you expect to do soldering (more likely in the later labs), bring safety goggles or purchase them from the Electrical Engineering Workshop.

ASSESSMENT

The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through the online quizzes, lab exercise assessment, and lab exam.

Pre- and post-lecture online quiz

Online quizzes are served to consolidate the understanding of lecture materials and test your understanding through problem solving.

Before each lecture, an online quiz for the specific topic will be open on Moodle. Students are encouraged to try the quiz before and/or after the lecture and attempt as many times as wish. These quizzes are made of multiple choices and provide correct answers after each attempt.

They are for self-assessment purpose. There are no marks allocated for these quizzes.

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. It is essential that you complete the laboratory preparation before attending the lab.

You are required to maintain a lab book for recording your observations. A lab book is an A4 size notebook containing a mix of plain pages and graph sheets. You are required to write the aim of the experiment and draw the circuit diagram if any in your lab book. You will be recording your observations/readings, calculations, and learning reflections in your lab book.

The virtual labs take place in Blackboard Collaborate Ultra on Moodle. There are two stages in each lab. In the first stage, students build a circuit on **breadboard** and simulate it on an online platform independently for a given lab task. Help from a lab demonstrator will be provided if needed. In the second stage, students share their circuits and simulation results within a group and discuss their design choices and circuit theories behind it. Students will be exposed to different circuit examples within a group and learn from each other about the best idea of circuit design. Students will help their group member to debug the circuit that does not work. Students will receive verbal feedback from the lab demonstrator and peers on their work.

The lab demonstrator in the designated group plays a role of both discussion facilitator and assessor. The lab demonstrator will mark students' work based on the lab task completeness (i.e. the simulation results meet the task specification) at the end and their contributions to the discussion and circuit debugging.

Students who cannot complete the lab task at the end of the lab have a chance to submit a photo or short video showing their functioning circuits and simulation results to the Gallery on Moodle before the end of the lab week without penalty. However, the mark for the contributions to the discussion and circuit debugging during lab class cannot be changed. Submissions after each lab week do not change the lab mark any more.

The five one-hour labs have equal weight in the assessment. Each account for 2% and in total lab assessment worth 10%.

Laboratory Exam

To check that you have achieved the practical learning outcomes for the course, you will be examined in the laboratory. The final Laboratory Exam is an online open book practical exam that includes 15 minutes of designing a circuit on **breadboard** and simulating it in the online platform according to a given specification and 5 minutes of verbally justifying the design decisions and analytical calculations. The design questions will be based on what you have learned in your laboratory classes and lectures, and marks will be awarded for the correct understanding of practical and relevant theoretical concepts, correct operation of laboratory equipment, and correct interpretation of measured results.

This exam will be held in Week 10. Students must enroll a specific timeslot on Moodle, ELEC Stream section, one full week prior to this exam, by Friday, 6-Nov-2020, 11.55pm (Week 8)

The lecturer will assess all the students' lab exam online. Marks will be assigned according to pre-determined criteria, which will be posted on Moodle in Week 9.

This lab exam accounts for 10% in total.

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes				
Assessment	**1**	**2**	**3**	**4**	**5**
Online quizzes	✓	-	✓	✓	-
Laboratory practical assessments	✓	✓	✓	✓	✓
Lab exam	-	✓	✓	✓	✓

COURSE RESOURCES

Textbooks

The recommended text book for ENGG1000:

- Dym, C.L. and Little, P., Engineering Design: A Project-Based Introduction, 3rd Edition, John Wiley & Sons, 2009

Another good one for introductory engineering design is:

- Voland, G., Engineering By Design, 2nd Edition, Pearson/Prentice Hall, 2004
- Horenstein, M. N., Design Concepts for Engineers, Pearson/Prentice Hall, 2006 (this is an excellent text on engineering design that is better than Voland in various respects. It is written by a large team of authors, has great examples and has a fresher, more up-to-date feel than Voland)

More specifically for electrical engineering design there is:

- Wilcox, A. D., Engineering Design for Electrical Engineers, Pearson/Prentice-Hall, 1989 (this interprets design perhaps more closely to EE&T than the others, and in various sections discusses aspects of specific relevance to Electrical Engineering)
- J.E. Salt and R Rothery, Design For Electrical and Computer Engineers, John Wiley & Sons 2002.
- Stadtmiller, D. J., Applied Electronic Design, Prentice-Hall, NJ, 2003.

More technical books that may help include:

- Brindley, K., Starting Electronics, Elsevier, Burlington, MA, 2005. (very clearly written, this is an excellent introduction to electronics for anyone new to the subject) – in UNSW library
- Kybett, H., and Boysen, E., All new electronics self-teaching guide, Wiley, Indianapolis, IN, 2008. (another great book for getting started on electronics principles, includes revision exercises) – available online from UNSW library
- Scherz, P., Practical Electronics for Inventors, McGraw-Hill, 2000 (this is a very helpful book on introductory electronics, and includes example circuits and practical design tips) – in UNSW library
- Slone, G. R., Tab Electronics Guide to Understanding Electricity and Electronics, McGraw-Hill, 2000. – Google books
- Mims, F. M., Getting Started in Electronics, Master Publishing Inc, 2003. (practical set of notes at a very introductory level, still mainly theory)
- Radio Society of Great Britain, Radio and Electronics Cookbook, Newnes, Woburn, MA, 2001 (maybe some useful circuit ideas) – Google books
- Carlson, A. B., and Gisser, D. G., Electrical Engineering: Concepts and Applications (this is not a design text, but is written at about the right level to provide a useful resource for circuit analysis)

Also:

- Kerzner, H., Project Management: A Systems Approach to Planning, Scheduling and Controlling, Wiley, 2007
- D. A. Norman, The Design of Everyday Things, Currency-Doubleday, 1990. (a general text on design by a design guru)
- Selinger, C., Stuff you don’t learn in engineering school: Skills for success in the real world, Wiley, 2004 (how to work in a team, etc. Read it for interest, or before you do your industrial training)
- P. Horowitz and W. Hill, The Art of Electronics, Cambridge University Press, 1989 (this is not an introductory book, but is full of insightful design tips).

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).

Circuit example web sites, for example:
https://www.arduino.cc/
http://www.aldinc.com/ald_circuitideas.htm
http://www.discovercircuits.com/list.htm
http://www.allaboutcircuits.com/
http://www.kpsec.freeuk.com/trancirc.htm

Other resources

CREATE - Supporting Hobby-tronics at UNSW
Of interest to Teams from all design projects will be Create - a UNSW club supporting practical electronics skills on campus, and who also sell electronic components and devices on campus. Please see their website at: http://www.createunsw.com.au/store/ or contact them via email (sales@createunsw.com.au) for any purchases or advice on your projects.

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.

Lecture and lab hours are reduced from 4 hours to 2 hours per week to be consistent with other technical streams' teaching hours. The contents relevant to students' projects are kept and rearranged in response to previous feedback of not finding enough relevance to their projects. The lectures and labs are converted to online mode in response to COVID19 situation.

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	