Unofficial guide to UNSW Electrical Engineering Electives

ELEC Boomer Team *

February 9, 2022

1 Introduction

This guide is intended to provide 3rd+ year students an idea of what L3 and L4 electives offer. Many students entering 3rd/4th year do not know what electives to pick so hopefully something here will interest you! Course/teaching quality is not examined but rather the relationship with previous work, content of interest and relation with industry or thesis (I also do not want to get sued for libel). We strongly recommended you to pick courses based on interest rather than metrics like difficulty/WAM boosters to get the most out of your degree. WAM does not matter after you get your first job!

The guide is contributed by students who have taken the listed courses in previous offerings and although we would try to keep the information as accurate as possible, changes to course structure and content does occur. Always read the course outline before picking a course, you can find EE course outlines here. If you would like to contribute or add a course not listed, you can find that information at end of the document.

2 Degree Structure

2.1 Electrical Engineering (Hons) Single Degree

Electrical Engineering (Hons) 3707 is broken down into 3 main portions outlined in the handbook with a total of 192 UOC. You have a 168 UOC portion called a major or stream, in this case ELECAH. There are also 12 UOC of general education and 12 UOC of free electives. Free electives can be used to take any course whether it is 1st or 4th year courses.

The ELECAH stream (168 UOC) mandates one L3 elective and two L4 electives. If you elect not to take any 1st year electives as free electives, you will gain 2 extra electives that can be used for L3 or L4 courses. The electrical engineering program can be found on the School of EE site.

*List of contributors at the end of document

3 L3 Electives

3.1 L3 Elective List

ENGG courses and MATH courses not listed, courses with * denote no entry.

- COMP2041: Software Construction: Techniques and Tools
- COMP3211: Computer Architecture
- COMP3231: Operating Systems
- ELEC3146: Electrical Engineering Modelling and Simulation (New offering starting 2022)*
- ELEC3111: Distributed Energy Generation*
- ELEC3145: Real Time Instrumentation*
- ELEC3705: Fundamentals of Quantum Engineering
- TELE3118: Network Technologies
- TELE3119: Trusted Networks

3.2 L3 Courses Guide

Remember to check teaching period when planning your courses to avoid clashes with core subjects.

- COMP2041 Software Construction: Techniques and Tools
  - Lecturer: Dr. Andrew Taylor
  - Teaching Period: T2
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: COMP2041 introduces you to the basics of automated testing, industry standard development tools (e.g. git) and an introduction to writing industry standard software. By the end of this course, you will understand the capabilities of many tools, able to select the appropriate tool for particular requirements and additional tools supplementing the software development process. COMP2041 teaches the application and limitations of scripting languages like Bash and Python with relevant concepts such as regular expressions. This knowledge is then reinforced in tutorials, practical lab exercises (challenge labs as well) and assignments.
  - Industry: Bash scripting and Git very important in software development. Instead of writing *'code'*, you are working on a product that is well documented.
  - Research: COMP2041 is too broad and generalised to be of research significance
  - Comments: This course does teach you how to use scripting languages but focus on proper programming practice skills which will be more useful for a job.

- COMP3211 Computer Architecture
  - Lecturer: Dr. Hui Guo
  - Teaching Period: T1
  - Textbook(s): **Patterson, Hennessy**, *Computer Organization and Design: The Hardware/Software Interface.*
  - Summary: Ever wondered how CPUs and GPUs are designed? What are some challenges and design decisions one may face when developing a processor? COMP3211 covers topics like pipelining, hierarchical memory systems and design techniques to improve performance. Labs and projects are completed in VHDL where you simulate and implement CPU features like multicycle processing, hazard detection and branch prediction. You will become very familiar with VHDL at the end of the course and understand how processors work in a high level. There is relatively little maths and the majority of explainable material involve explaining the operation of processors and design trade offs.
  - Industry: HDL experience valued for many companies using FPGAs like fintech, hardware/chip design. Relevant companies include; Optiver, IMC Trading, Arista, Morse Micro, Baraja, AMD and more.
  - Research: EE and CSE offers projects utilising FPGAs, applicable to many disciplines including control systems, signal processing and space engineering; ACSER GNSS receivers are designed with the help of microcontrollers with FPGA fabric.
  - Comments: Good if you want to learn about how to design CPUs at a higher level without all the gritty maths. It goes into a decent depth and you can expect to have a fairly good understanding of RISC processors. For silicon design/timing see ELEC4602. COMP3231 strongly recommended to see how hardware-software are interfaced and managed.

- COMP3231 Operating Systems
  - Lecturer: A/Prof Kevin Elphinstone
  - Teaching Period: T1
  - Textbook(s): **Tannenbaum**, *Modern Operating Systems*.
  - Summary: How do hard drives know how to interface when functions like *fread* are used? 400 Chrome tabs on a laptop with 4GB RAM? COMP3231 tackles the challenges of merging hardware and software with topics covering process management, physical and virtual memory management and storage methods in file systems. Learning is done by completing projects where you will be implementing concepts taught in the lectures. The code base has an predefined structure and you will be working in pairs. Everything is done in C and expect lots of low level memory management, using tools like GDB and coding as a team balancing work allocation and collaboration. COMP3231 contains a good balance of theory and practical works due to the lecture and labs, additionally tutorials will support your learning covering any gaps in understanding.
  - Industry: C experience especially in low level memory management highly valued in all software companies. Strongly recommended for students taking EE/CS double.
  - Research: Most interesting/publishable OS research is focused around the seL4 microkernel a formally verified OS microkernel. Advanced operating systems (COMP9242) is necessary for students looking to work on seL4.
  - Comments: Take this course if you want to be confident in C programming including memory management (pointers and malloc) by the end of your degree. Complements COMP3211 (Computer Architecture) especially if taken at the same time, software-hardware understanding. COMP9242 (Advanced Operating Systems) may be taken in the following term (subject to school approval/degree plan). COMP2521 is recommended as a prerequsite but not secretly necessary as long as ELEC2142/DESN2000 is completed.

- ELEC3705: Fundamentals of Quantum Engineering
  - Lecturer: Sci Prof. Andrea Morello
  - Teaching Period: T3
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: ELEC3705 lays the foundation for anyone wishing to study quantum engineering. There is no expectation of prior quantum knowledge and course material is taught in a mostly qualitative manner with some mathematics to deepen understanding. Topics include evolution of quantum systems in time and space, in the beginning single atoms systems are observed and by the end of the course you will be able to solve complex systems with multiple molecules linking concepts like entanglement and probability. Labs and projects are done using Python and is focused on improving understanding of quantum systems as well as utilising tools to solve quantum systems.
  - Industry: CSIRO and universities all have research in quantum engineering. Microsoft and Google have projects in quantum computing research. Sydney Quantum Academy also has resources for those wanting to work in the quantum industry.
  - Research: Strongly recommended for students looking for topics with supervisors in the quantum team. Sydney Quantum Academy offers undergrad research projects as well as PhD scholarships for those hoping to dive into quantum engineering.
  - Comments: This course is a prerequisite for ELEC4605 Quantum Devices and Computers.

- TELE3118: Network Technologies
  - Lecturer: Dr. Hassan Habibi Gharakheili
  - Teaching Period: T3
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: Ethernet, WiFi 802.11, TCP, HTTP, how do all these protocols and applications communicate between each other? What are the differences between physical, data link, network, transport and application layers? TELE3118 addresses these questions with a qualitative view ideal for those wanting an introduction to networking. Labs are hands on and you use Wireshark, an industry tool to inspect and debug all the networking layers. You build your own router network and verify operation and ensure it can communicate between each other. If you want to setup a home/office network, this course will teach you the skills required to construct and troubleshoot one.
  - Industry: Understanding of networking protocols useful for firmware/software engineering roles. CISCO, Juniper Networks and Arista are some possible companies.
  - Research: TELE3118 provides a broad overview ideal for those looking to do network security, programmable networks, internet-of-things (IoT) topics.
  - Comments: Don't tell people you did this course as they will ask you to solve networking issues.
- TELE3119: Trusted Networks
  - Lecturer: Prof. Aruna Seneviratne
  - Teaching Period: T1
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: How do you transmit and receive information securely? What goes on to ensure the password you type is secure? TELE3119 focuses on cyber security networking and covers topics like cryptography, encryption, authentication protocols and blockchains. You learn the backbone of modern communication systems and is a practical course where you use tools like Wireshark in the project and labs. Projects include physically buying and testing an off the shelf IoT device to evaluate security. TELE3119 is a good introduction into cyber security and favours breadth over depth.
  - Industry: The course teaches HTTPS and other encryption protocols which is favoured by companies looking for engineers in cyber security. Networking companies include Arista and knowledge of protocols is very useful for software/firmware companies implementing cyber security policies/framework.
  - Research: Cyber security and trusted systems thesis are offered in CSE, some projects in telecommunication may benefit from knowledge of communication protocols.
  - Comments: Comp sci double students may also take COMP6441 for those wanting an introduction for cyber security. This leads to more electives and may be more useful for those pursuing a cyber security career.

4 L4 Electives

4.1 L4 Elective List

School of Electrical Engineering in most cases will approve one substitution of a L5 elective (ELEC9XXX) as a L4 elective. * Denotes course lacking entry.

- Microelectronics and Quantum
  - ELEC4601: Digital and Embedded Systems Design (Mothballed)*
  - ELEC4602: Microelectronic Design and Technology
  - ELEC4603: Solid State Electronics
  - ELEC4604: RF Circuit Design - Theory and Applications
  - ELEC4605: Quantum Devices and Computers*
- Energy Systems
  - ELEC4611: Power System Equipment
  - ELEC4612: Power System Analysis
  - ELEC4613: Electrical Drive Systems*
  - ELEC4614: Power Electronics*
  - ELEC4617: Power System Protection*
- Signal Processing
  - ELEC4621: Advanced Digital Signal Processing
  - ELEC4622: Multimedia Signal Processing
  - ELEC4623: Biomedical Instrumentation, Measurement and Design (Mothballed)*
- Control Systems
  - ELEC4631: Continuous-Time Control System Design
  - ELEC4632: Computer Control Systems
  - ELEC4633: Real-Time Engineering
- Data and Mobile Communications
  - TELE4642: Network Performance*
  - TELE4651: Wireless Communication Technologies*
  - TELE4652: Mobile and Satellite Communication Systems
  - TELE4653: Digital Modulation and Coding*
- Photonics
  - PHTN4661: Optical Circuits and Fibres*
  - PHTN4662: Photonic Networks*
- Other Electives
  - ELEC4445: Entrepreneurial Engineering

4.2 L4 Courses Guide

- ELEC4602 Microelectronic Design and Technology
  - Lecturer: A/Prof. Torsten Lehmann
  - Teaching Period: T3
  - Textbook(s): **Baker**, *CMOS Circuit Design, Layout and Simulation.* **Sedra & Smith**, *Microelectronic Circuits.*
  - Summary: In ELEC2133 you are taught how opamps try to keep the voltage in the inverting and non-inverting pins the same, this course teaches you what happens on the inside. Likewise in ELEC2141 you learn about digital logic and how to design using them, but what if you need to build something complex or fast and you cannot use an FPGA. Welcome to the world of microelectronics design. In ELEC4602 you will encounter a broad range of topics including analogue design (you make your own opamp), digital circuits (combination and sequential) and data converters/data samplers (analogue to digital converters). The labs teaches you how to implement such designs in silicon by using industry standard tools such as Cadence Virtuoso on TSMC 180nm nodes and hopefully by the end you will be very familiar with it. You be drawing individual transistors and simulating analogue and digital designs. This is predominately a design course and is strongly recommended if you want to go into the semiconductor industry especially for design.
  - Industry: Australia contains predominately fabless companies, companies include Morse Micro for WiFi chips, Perceptia Devices for clocking devices, Blackmagic Design for sound/video equipment. Multi-national companies with design houses in Australia include Analogue Devices, Imagination Technologies and AMD. Silanna is the only company in Australia that owns a fabrication facility and manufactures their design.
  - Research: Topics include neural interfaces (amplifiers, stimulators, ADCs), wireless transceivers and high-speed serial interfaces.
  - Comments: This course is very broad and is an introduction to microelectronics. For a deeper look consider ELEC9701 Mixed Signal Microelectronic Design which is a continuation of ELEC4602. Course website can be found here (you will need to login with zid).

- ELEC4603 Solid State Electronics
  - Lecturer: Dr. Henry Yang & Dr. Andre Saraiva
  - Teaching Period: T3
  - Textbook(s): **Bhattacharya & Sharma**, *Solid State Electronic Devices.*
  - Summary: PN junctions, BJTs, MOSFETS, you hear about these devices in ELEC2133 but how do they work from the ground up? Solid states takes the concepts taught in ELEC2133 and reteaches it from the ground up starting with quantum mechanics. It also introduces optoelectronic devices (lasers) and transistor fabrication. This is predominately a physics course with a bit of design sprinkled around. By the end of the course you will have a deep understanding of the physics behind solid state devices, fabrication processes and design trade offs between different silicon devices.
  - Industry: Relevant companies fall under material science and silicon fabrication. ANFF, Silanna and BluGlass are the main players with fabrication facilities. Microsoft and Google has quantum computing research in collaboration with universities.
  - Research: This course is strongly recommended for anyone pursuing a topic in quantum engineering. Silicon quantum devices is the main speciality of the quantum team at UNSW and ELEC4603 is required for most research projects. Phd scholarship opportunities are readily available for quantum topics.
  - Comments: Consider ELEC4602 for the design side of silicon devices, these two courses complement each other well.

- ELEC4604: RF Circuit Design - Theory and Applications
  - Lecturer: Prof. Rodica Ramer
  - Teaching Period: T1
  - Textbook(s): **Ludwig & Bogdanov**, *RF Circuit Design: Theory and Applications.*
  - Summary: Ever wonder how wireless systems are designed from a hardware perspective? How do you build build RF filters, amplifiers and what technologies can be used to create such elements. Welcome to RF electronics, this course is a natural continuation of ELEC3115 (Electromagnetic Engineering, 2nd half) and deal with signals as low as 20kHz all the way up to 100GHz. Smith charts will be your friend and by the end of the course you will be familiar with using them. This course is a good introduction into design and hardware used in communication equipment. Labs use Advanced Design System (ADS), an industry standard to design microwave elements as well as equipment like Vector Network Analysers (VNA), these machines are costs over 20k so don't blow them up! ELEC4604 mostly focuses on microwave circuits and is ideal for those wanting to dip their toes into RF design.
  - Industry: Relevant industries include defence such as Lockheed Martin and Boeing, projects like JORN work with radars. Telecommunications include Telstra and Optus, CSIRO also has projects in astronomy and quantum requiring RF engineers. Having experience in RF is strongly recommended for those pursuing a degree in telecommunication engineering or high-speed circuit design as it helps deepens understanding of the underlying hardware.
  - Research: Wave guides, micro-strips and MEMS (Microelectromechanical systems) research up to the terahertz range are the main projects at UNSW. Those looking for a topic in RF engineering, beware of degree scheduling due to the prerequisite of ELEC3106 and this course being offered in T1 so delaying graduation may be required.
  - Comments: This course is useful for those wanting to do high-speed PCB designs in digital systems (impedance matching, transmission line design).

- ELEC4611 Power Systems Equipment
  - Lecturer: A/Prof. Toan Phung
  - Teaching Period: T1
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: Ever wondered how electrical grids operate without failing? ELEC4611 covers the challenges and hazards encountered in high voltage transmission systems and associated infrastructure. How are problems like overvoltage/overcurrent rectified? What are the implications it can have on the grid if neglected. Topics include equipment design, mechanical, thermal and electrical stress analysis, diagnostic techniques. Labs involve working with high-voltage systems where you will be testing and measuring equipment like transformers, insulators as well as playing with circuit breakers. The course builds upon the concepts from ELEC3115 (Electromagnetic Engineering) and has a good mix of qualitative and quantitative concepts.
  - Industry: Power companies like Energy Australia, Origin, Westernpower for infrastructure. Railway infrastructure companies may also have opportunities.
  - Research: Dielectrics and electrical insulation, partial discharge and grid protection mechanisms, this can be detection or rectification.
  - Comments: Nil

- ELEC4612 Power System Analysis
  - Lecturer: Dr. Jayashri Ravishankar
  - Teaching Period: T1
  - Textbook(s): **Glover & Sarma & Overbye**, *Power System Analysis and Design.*
  - Summary: How are power systems connected and what is required to keep them functioning? ELEC4612 attempts to address these in a mathematical sense by introducing powerflow calculations of steady state, dynamic and transient systems. Three phase systems, modelling and stability are covered with a focus on microgrids in the labs and you learn how to use Power World Simulator.
  - Industry: Energy modelling with Ernst & Young, AECOM and Schneider Electric, energy grid companies like Energy Australia, Origin Energy.
  - Research: Thesis in microgrid are available from school of EE.
  - Comments: ELEC9715 is an advanced version covering the same topics in more depth.
- ELEC4621 Advanced Digital Signal Processing
  - Lecturer: A/Prof. Elias Aboutanios
  - Teaching Period: T1
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: ELEC4621 expands greatly upon ELEC3104 (Digital Signal Processing), it is broken down into two portions, deterministic signal processing and statistical signal processing linking concepts from other fields like information theory and statistics. Deterministic signal processing builds upon the concepts covered in ELEC3104 with a deeper analysis on topics like discrete and continual signals, interpolation and sampling. Statistical signal processing include autocorrelation, noise estimation and maximum likelihood estimation for noisy signals. Alternatives to the DFT and sinc kernel from a statistic point of view are also covered. ELEC4621 is very theoretical and math heavy and is a good indicator of some of the work that may be covered in a Phd.
  - Industry: Research and development such as Dolby, Neurode and even GNSS signal processing.
  - Research: Very useful for those pursuing Phd in signal processing especially the mathematics side.
  - Comments: Concepts are surprisingly interdisciplinary, you will come across some of these techniques when you least expect it (i.e. motion artifact removal from biomedical signals with adaptive filtering). Expect to see a lot of cross over with bio-med, data science, and classical control.

- ELEC4622 Multimedia Signal Processing
  - Lecturer: Prof. David Taubman
  - Teaching Period: T2
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: ELEC3104 (Digital Signal Processing) introduces you to signal processing, ELEC4622 expands upon this in the 2nd and 3rd dimension with images and videos. Concepts such as image resampling, shape (morphology), texture, colour and motion are taught from a mathematical perspective with a mix of practical work. Some interesting topics include the issues with aliasing in images, video and games, compression techniques of images and problems related to motion and optical flow. The course is primarily project based with emphasis on C/C++ programming and is very practical. You can take this course with limited C experience as the assignments and labs guide students quite well. C is used over MATLAB due to the nature of images and video sizes leading to limitation in computation and requiring efficient programming and optimisations. This means students will need to understand how to manage memory and write functional code.
  - Industry: Concepts can be applied to game engine development in companies such as Wargaming Sydney, media companies like Dolby and Blackmagic Design and C/C++ experience with low level memory management suitable for many software companies.
  - Research: Introduces fundamentals which can be used to develop AI models in pattern/image recognition. Compression algorithms such as JPEG2000 is a current research field at UNSW.
  - Comments: Good elective for people wanting to see the practical side of signal processing, the concepts covered here can be seen in day to day life.

- ELEC4631 Continuous-Time Control System Design
  - Lecturer: Dr. Hendra Nurdin
  - Teaching Period: T2
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: ELEC4631 expands upon the knowledge learned in ELEC3114 (Control Systems) with a focus on stability including non-linear systems. Topics include advanced state space models, controllability and implementation costs. Much of the work is done mathematically by hand and using computer software and leans towards theory more than practicality. Labs are primarily conducted in MATLAB with a focus of implementing the theory covered in the lectures.
  - Industry: Ideal for those wanting to specalise as a control engineer; aircraft, automation and industrial process control.
  - Research: More theoretical control topics such as chaotic (double pendulum), quantum control systems, dynamical systems. See Siemens.
  - Comments: More focused on S-plane Laplace transforms.

- ELEC4632 Computer Control Systems
  - Lecturer: Prof. Andrey Savkine
  - Teaching Period: T3
  - Textbook(s): **Astrom & Wittenmark**, *Computer-Controlled Systems.*
  - Summary: ELEC4632 expands your understanding of control systems with an emphasis on digital systems. Topics include review for linear algebra, controllability and observability. The labs are practical and you will analyse systems similar to those found in industrial process system, in this case a water tank with controllable levels. Work involves designing a controller, evaluate the step response bringing concepts like controlability and observability in MATLAB. Lectures and assessments are fairly maths heavy similar to control systems and expands further on existing concepts.
  - Industry: Industrial control processes and mechanical control, systems taught here are somewhat slower. See Siemens.
  - Research: Moar control stuff.
  - Comments: More focused on Z-plane, bilinear transforms.
- ELEC4633 Real-Time Engineering
  - Lecturer: Dr. Branislav Hredzak
  - Teaching Period: T1
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: Control loops are often implemented in hardware and software, when feeding back variables and processing calculations how do you ensure the data is processed in the correct order? ELEC4633 addresses these issues by covering topics like concurrency and scheduling and is reminiscent of concepts found in operating systems. Lab work is conducted in C where you will be working with equipment like DC motors and updating variables like position and spin rate. Server-client communication is also covered introducing remote control of systems. This is a practical course for those wanting to see how computer based control systems are applied in the real world. There is little maths and most of the time is spent time explaining how control loops process data and what sequence to ensure correct operation.
  - Industry: Automation engineers and real time operating systems, HVAC systems or manufacturing production lines.
  - Research: Real time operating systems, automation and remote control systems.
  - Comments: Refresh on C programming before starting the course may be helpful.
- ELEC4445 Entrepreneurial Engineering
  - Lecturer: Prof. Francois Ladouceur
  - Teaching Period: T2
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: Have a good design from ELEC3117 (Electrical Engineering Design) you want to market? Ever wondered what it's like running a start-up? ELEC4445 covers these ideas with bi-weekly guest lectures from people at start-ups, venture capitals and UNSW grads working in start-up space. Not particularly electrical engineering specific although you gain some insight into the work current start-ups are doing. Basic financial concepts such as NPV and cash flow are covered reminiscent of the work done in ELEC3117. Main workload is major group assignments covering interesting topics.
  - Industry: Start-up space is very diverse and some interesting stuff especially out of UNSW. Check out UNSW Founders.
  - Research: Start-up venture specific.
  - Comments: Fairly different compared to other courses and ideal for those wanting to join a startup early.

- TELE4652 Mobile and Satellite Communication Systems
  - Lecturer: Dr. Derrick Wing Kwa Ng
  - Teaching Period: T2
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: TELE4652 covers digital cellular mobile communication and digital satellite communication system. The concepts are taught from an operations and network perspective with a focus on system architecture and system design. Technologies like 3G, 4G and GSM operation is covered with focus on reducing interference and losses. Labs are practical with a focus on modulation, antenna design and satellite budget link. The course has very little maths with a focus on understanding.
  - Industry: Telecommunication companies like Telstra, Optus, satellite communications/projects like JP 9012.
  - Research: Wireless communication technologies like MIMO, coding systems and 5/6G.
  - Comments: May be good to also do TELE4653 and TELE4651 for those wanting a broader understanding.

5 L5 Electives

5.1 L5 Electives

Many L5 electives run once every 2 years or offered as special topics, other electives may also be mothballed. This only lists L5 courses students have taken.

5.2 L5 Elective List

This only lists L5 courses students have taken.

- ELEC9701: Mixed Signal Microelectronic Design
- ELEC9703: Microsystems Design and Technology
- ELEC9714: Electricity Industry Planning and Economics
- ELEC9715: Electricity Industry Operation and Control
- TELE9782: Special Topics in Telecommunications 2 - Antenna and Propagation

5.3 L5 Courses Guide

- ELEC9701 Mixed Signal Microelectronics Design
  - Lecturer: A/Prof. Torsten Lehmann
  - Teaching Period: T3 (every 2nd year)
  - Textbook(s): **Baker**, *CMOS Circuit Design, Layout and Simulation*.
  - Summary: ELEC9701 is the advanced version of ELEC4602, going much deeper with an emphasis on mixed-signal design. The structure is shaken up compared to the previous course and is taught more like a tutorial. There are no labs but retains projects and quizzes you would be familiar with from ELEC4602. New additions include changes to the course delivery where during the last 30 minutes of the lecture, a new group will present and discuss a research paper selected by the lecturer. The topics can be quite advanced and involve current research including novel designs/implementation favouring depth and understanding over breadth. Course topics are predominately advanced versions of what is covered in ELEC4602 (e.g. integrated technology/devices, amplifiers and data converters). Quizzes and finals are very similar in style to ELEC4602 and ELEC3106.
  - Industry: Same as ELEC4602 and additional knowledge may allow you to differentiate from other students.
  - Research: Recommended for those wanting to do microelectronics design, it can be useful to take it at the before/same time as Thesis A.
  - Comments: It is possible to take it at the same time as ELEC4602 but can be quite challenging if you end up disliking microelectronics. Course website can be found here (you will need to login with zid).

- ELEC9703: Microsystems Design and Technology
  - Lecturer: Dr Aron Michael
  - Teaching Period: T1
  - Textbook(s): No prescribed textbook, refer to course notes.
  - Summary: Ever wondered how accelerometer, gyroscopes and optical switching works on silicon? Welcome to the world of MEMS (Micro-electromechanical systems), ELEC9703 covers the fabrication, design and application of MEMS devices. The work is multidisciplinary and brings concepts from mechanical and material science to see ways that silicon can be designed for physical applications. Coursework involves assignments and quizzes with an equal focus on mathematics and understanding and you may have the opportunity to work with software like ANSYS.
  - Industry: Very specalised with a focus on research & development, companies include Panorama Synergy part of Hydrix, Defence Science and Technology.
  - Research: Research for RF MEMS, piezoelectric and optical at UNSW and ANFF.
  - Comments: ELEC9704 teaches fabrication in detail. Interesting video on helium killing iPhones due to the interaction between the molecules and the MEMS oscillator.

- ELEC9714: Electricity Industry Planning and Economics
  - Lecturer: A/Prof. Iain MacGill
  - Teaching Period: T2
  - Textbook(s): None prescribed, AEMO Integrated System Plan (ISP) is strongly recommended.
  - Summary: ELEC9714 is specifically targeted towards the economics side of the power industry (mind you this is still linked to what's happening from technical sense, e.g. with respect to generation technologies). Key topics look into CapEx and OpEx of generation technologies, resource planning and investment, the role of derivatives in energy sector and networks (both transmission and distribution level). Retail markets and demand-side overlaps with ELEC9715. Overall the course is relevant in current context of net-zero energy transition and decarbonisation.
  - Industry: Another course with *industry* in its title. ELEC9714 can be considered the 102 guide working in the energy industry.
  - Research: Predominantly industry focused area so in general the course is a good foundation and breadth of knowledge. Research in this space is very industry focused to the NEM. Refer to UNSW CEEM.
  - Comments: Good to do for those looking for insight into the energy industry and can be taken after ELEC9714.
- ELEC9715: Electricity Industry Operation and Control
  - Lecturer: A/Prof. Iain MacGill
  - Teaching Period: T1
  - Textbook(s): None prescribed, AEMO Integrated System Plan (ISP) is strongly recommended.
  - Summary: ELEC9715 is an introduction into the electricity industry predominately focusing on the NEM (National Electricity Market) within Australia. Concepts covered include key generation technologies and their operational characteristics, the process of economic dispatch, unit commitment and other energy market mechanisms such as frequency control and those related to security/reliability. Other topics target more distributed technology, retail energy markets and demand-side. Majority of the content is not seen elsewhere (except ELEC9714) although it may sound familiar from being brushed over in ELEC4612 (Power System Analysis). It is somewhat content heavy but there is a fair amount of problem solving with assignments and research-oriented tasks (major group project) in an area of your choice.
  - Industry: Through overview of what each corporate/utility/agency responsibilities and function within the energy industry. Strong emphasis on industry and can be considered the 101 guide to working in the energy industry sector. Also good introduction into the NEM (National Electricity Market).
  - Research: Predominantly industry focused area so in general the course is a good foundation and breadth of knowledge. Research in this space is very industry focused to the NEM. Refer to UNSW CEEM.
  - Comments: Consider ELEC9715 for those wanting to do more power.
- Differences between ELEC9714 and ELEC9715
  - There is some overlap between 9714/15, mostly in the introductory topics in early term weeks. 9715 is effectively the 'engineering' variant of the course, where 9714 offers more an economics perspective. Both do shed light on technical, economic and policy issues within the industry at large. 9714 has a greater presence of distribution-level content than what you'll see in 9715. Most people only take one of the two, but if you're super keen its worth the while doing both.

- TELE9782: Special Topics in Telecommunications 2 - Antenna and Propagation
  - Lecturer: Dr Shaghik Atakaramians
  - Teaching Period: T3
  - Textbook(s): **Balanis**, *Antenna Theory : Analysis and Design* (This is **the** bible for anything antenna related).
  - Summary: Ever wonder how antennas in phones and radio telescopes work? TELE9782 explains these concepts starting from the fundamentals exposed in ELEC3115 (Electromagnetic Engineering). The course is fairly mathematically involved with topics covering antennas operation, design and tools like CST Studio simulations. Lectures are more reminiscent of tutorials with the expectation that students have read the chapters from the textbook beforehand and time will be spent solving sample problems. Assignments involve selecting an antenna design and researching the literature, simulating and identifying areas of possible improvement. The course leans more towards theory and is a broad introduction into antenna design ideal for those wanting to expand their understanding of telecommunication systems.
  - Industry: Companies developing radar include CEA Technologies, Rojone and RFI Technology. A lot of work is in defence or space communication systems. Companies may also purchase antenna off the shelf and knowledge may be helpful when building RF systems.
  - Research: Lots of research in microstrip technologies and miniaturisation.
  - Comments: Make sure you are familiar with ELEC3115 (Electromagnetic Engineering, 1st half) as it lays the foundation for all the work done. The extension of the 2nd part of ELEC3115 is ELEC4604 (RF Engineering).

6 Acknowledgements and Contributors

This project was started by myself Leo Poon and would not be possible without my fellow peers. Whether you contributed by discussing your course experiences with me or writing out sections, you have my greatest gratitude. If you would like to add an entry not listed here or update it, you can email me at *l.poon@student.unsw.edu.au*. The summary provided here is quite brief and if you have questions about the courses or career choices in EE, many of us older folk can be found in the SuperElec Discord. The following contributors (in no particular order) are listed below.

- Julian Keledjian - Extra thanks for assisting from the beginning and being my editor. He did all the layout work for this document and has an intense passion for LaTeX. If the guide reads like trash blame him.
- Kyu-Sang Kim - Extra thanks for hosting this on your Github.
- Kristjan Semmelweis
- Arthur Sze
- Hazeem Aldy
- Aaron Lucas
- Alfred Mak
- Leon Luo
- Jayden Moore
- Anonymous helpers