School of Electrical Engineering and Telecommunications

Term 3, 2020

Course Outline

TELE3118
Network Technologies

COURSE STAFF

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Consultations: You are encouraged to ask questions on the course material, during the allocated class times in the first instance, then in the online Moodle forum (so all students can benefit from the answer), and then via email. Lecturer consultation times will be advised during lectures. You are welcome to email the tutor or laboratory demonstrator, who can answer your questions on this course and can also provide you with consultation times. ALL email enquiries should be made from your student email address with "[TELE3118]" 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 be using the course webpage https://subjects.ee.unsw.edu.au/tele3118/. 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 4 hours of live and online lectures for the first 6 weeks, and 3 hours per week for the remaining 4 weeks. Lectures are recorded and available in Moodle. There is a 3-hour laboratory session per week, and a 1-hour tutorial per week. Class times and locations are available online http://classutil.unsw.edu.au/TELE_T3.html#TELE3118T3

	Days	Time	Location
Lectures	Monday (w1-10)	4pm - 6pm	Blackboard Collaborate
	Thursday (w1-6)	9am - 11am	Blackboard Collaborate
	Thursday (w7-10)	10am - 11am	Blackboard Collaborate
Tutorials	Wednesday (w1-10)	10am - 11am	Biosci G07
	Wednesday (w1-10)	11am - 12noon	Biosci G07
			Blackboard Collaborate
Labs	Thursday (w1-10)	9am - 12noon	ElecEng206
	Thursday (w1-10)	3pm - 6pm	ElecEng206
			Blackboard Collaborate

Context and Aims

This course aims to develop a fundamental understanding of the architecture of communication networks such as the Internet. It will introduce students to the layered communication protocol stack (referred to as the TCP/IP stack in the Internet context), and progressively work through the functions and technologies at the various layers. Topics covered will include the physical medium, medium access mechanisms, IP addressing and routing, TCP congestion control, and applications such as the web, streaming media and DNS.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1 (4 hours)	Physical Layer; Data Link Layer: Framing and Errors, MAC
Week 2 (4 hours)	Data Link Layer: Wireless and Ethernet; Switching
Week 3 (4 hours)	Network Layer Data Plane: Basics, Addressing; Routers
Week 4 (4 hours)	Network Layer Data Plane: Forwarding; IPv6, SDN
Week 5 (4 hours)	Network Layer Control Plane: IGP Routing; BGP Routing; SDN and SNMP; **Mid-Session Test (Friday 16 Oct, 3-5pm)**
Week 6 (4 hours)	Flexibility Week – Revision discussions and activities
Week 7 (3 hours)	Transport Layer: Basics, UDP and TCP
Week 8 (3 hours)	Transport Layer: TCP congestion control; TCP fairness
Week 9 (3 hours)	Application Layer: Basics, HTTP; SMTP, P2P
Week 10 (3 hours)	Application Layer: DNS and CDNs; Review

Indicative Laboratory Schedule

Period	Summary of Laboratory Program
Week 2-3	Lab 1: Cabling
Week 4	Lab 2: Switching
Week 5	Lab 3: IP and ICMP
Week 7	Lab 4: Routing
Week 8	Lab 5: TCP
Week 10	Lab 6: Mini-Project

Assessment

Weighting	Task	Due date
30%	Mid-session exam	During week 5
40%	Final exam	During Examinations Period
20%	Labs	During allocated lab session
10%	Project	Demonstration in week 10
Discretionary	Quizzes	Online and/or in-class quizzes

COVID-19

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

If you are required to self-isolate and/or need emotional or financial support, please contact the Nucleus: Student Hub.

If you are unable to complete an assessment, or attend a class with an attendance or participation requirement, please let your teacher know and apply for special consideration through the Special Consideration portal.

To advise the University of a positive COVID-19 test result or if you suspect you have COVID-19 and are being tested, please fill in this form.

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

COURSE DETAILS

Credits

This is a 6 UoC course and the expected workload is 15 hours per week throughout the 10-week term. It includes lectures, laboratories, and tutorials. Supervised labs are held 3 hours per week; however, you will be expected to work on the project outside of designated lab hours.

Relationship to Other Courses

This is a 3rd year undergraduate course in the School of Electrical Engineering and Telecommunications. It is a core course for students following a BE (Telecommunications) program and other combined degree programs, and an elective for the BE (Electrical) program.

Pre-requisites and Assumed Knowledge

The official pre-requisite for this course is ELEC2142 Embedded Systems Design. While that course provides useful background about operating systems and interfacing to hardware, which are both crucial for network technologies, that course is mainly a prerequisite because it has its own prerequisites including COMP1921 Computing 1B which develop programming skills that are crucial for network technologies.

Following Courses

This course provides an introduction to data networking, and establishes the foundation for subsequent courses such as TELE3119 “Trusted Networks” which covers the security aspects of data networks, TELE4123 “Telecomms Design Proficiency", and TELE4642 “Network Performance” which studies tools and techniques for analysing the performance of data networks. Postgraduate courses that delve deeper into these topics include TELE9751 Switching Systems Design (about the internal operation of network devices such as routers and switches), TELE9752 Network Operations and Control (about managing and running networks), GSOE9758 Network Systems Architecture, and TELE9756 Advanced Networking (about selected network research topics). The course is a pre-requisite for

- Trusted Networks - TELE3119
- Network Performance - TELE4642
- Telecomms Design Proficiency - TELE4123

Learning outcomes

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

1. Describe the role of layers in the architecture of a communication system
2. Evaluate medium access mechanisms suitable to different physical media
3. Design simple data networks by constructing appropriate IP addresses and routes
4. Analyse mechanisms for reliability and congestion-control in the Internet
5. Recognise the steps by which applications such as the web operate
6. Construct client-server applications that operate over the Internet

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
From the UNSW Course Handbook: https://www.handbook.unsw.edu.au/undergraduate/courses/2020/tele3118/?q=TELE3118

Network architectures in terms of topology, role (client/server, peer-to-peer), and layered specification. Packet and circuit switching. Physical characteristics of network transmission links. Medium access control protocols for wired links (e.g. Ethernet) and wireless links (e.g. 802.11). Protocols for error and flow control and their link layer application. Interconnection of networks using bridges, switches and routers. Routing techniques, including Dijkstra's algorithm, distance vector and link state routing. Addressing and naming. Network congestion control. End-to-end protocols for matching applications to networks, including TCP and UDP. Network applications, such as web (HTTP), email (SMTP, POP, IMAP), and streaming media (e.g.VOIP).

TEACHING STRATEGIES

Delivery Mode
The lectures for this course will include online lectures and discussions. Recorded versions of the lectures will be provided when possible, but do not substitute for live lectures, since the course continually evolves to stay updated with advances in network technology, and provides live discussions on topical issues in which students are encouraged to participate actively.

The tutorials will focus on problem solving, which will not only consolidate and apply the theory learnt in the lectures, but also provide an opportunity for reflection, critical thinking, and discussion.

The laboratory assignments and project will stress the applicability of the course material to the real world. In-lab experiments will provide first-hand observation of and experimentation with the technologies used in the Internet. The project will provide an opportunity to design and implement a real-world application that works over the Internet.

Learning in this Course
You are expected to attend lectures, tutorials, labs, and the mid-term exam 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, 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 online classes throughout the course.

Tutorial Classes
You should attempt all of your problem sheet questions in advance of attending the tutorial classes. The importance of adequate preparation prior to each tutorial cannot be overemphasized, as the effectiveness and usefulness of the tutorial depends to a large extent on this preparation. Group learning is encouraged. Answers for these questions will be discussed during the tutorial class and the tutor will cover the more complex questions in the tutorial class.

Laboratory Program
The laboratory schedule is deliberately designed to provide practical, hands-on exposure to the concepts conveyed in lectures soon after they are covered in class. You are required to attend laboratory from Week 2 to Week 10. Laboratory attendance WILL be recorded. While you are expected to attend the lab session that you are enrolled in, if you cannot then you may arrange with lab demonstrators to attend a different session of the same lab (if space permits), but unfortunately other catch-up labs cannot be offered after the scheduled lab session. When attending labs, make sure that you wear enclosed footwear (i.e. no thongs/sandals) since if you don't the lab demonstrators will have to ask you to leave the lab.

Laboratory Exemption
There is no laboratory exemption for this course. Regardless of whether equivalent labs have been completed in previous courses, all students enrolled in this course must take the labs. If, for medical reasons, (note that a valid medical certificate must be provided) you are unable to attend a lab, you will need to apply for a catch-up lab during another lab time, as agreed by the laboratory coordinator.

ASSESSMENT
The assessment scheme in this course reflects the intention to assess your learning progress through the term. Ongoing assessment occurs through the lab checkpoints (see lab manual) and the mid-term exam.

Laboratory Assessment
In-lab experiments will provide hands-on experience with networking technologies. You are required to prepare beforehand by reading the handouts posted on the course web-page. They will stress the applicability of the course material to the real world. They will provide first-hand observation of and experimentation with the technologies used in the Internet. There are 5 lab experiments, of which the best 4 you perform in will each contribute 5% towards your overall course mark. Marks for each lab session will be available to you by the next lab session.

Assessment marks will be awarded according to your preparation (completing set preparation exercises and correctness of these or readiness for the lab in terms of pre-reading), how much of the lab you were able to complete, your understanding of the experiments conducted during the lab, the quality of the code you write during your lab work, and your understanding of the topic covered by the lab.

Project
The project will provide you with the opportunity to design and demonstrate a real Internet application. You will be expected to work on your programming assignment outside of designated lab hours, either on your own computing equipment or using the undergraduate computer labs in the EET building, and you will have to demonstrate your working software during week 10. The project will be marked according to the degree to which it meets the specifications. The project must be "submitted" by demonstrating it operating and explaining the source code to markers in your allocated marking session, which will be stated on the course web-page.

Online/In-class Quizzes
Several quizzes may be held onine and/or in-class, and the credit for these quizzes is discretionary. Specifically, these quizzes will be looked at if you happen to be at the borderline between grades, and your performance in them may determine if you receive extra credit that improves your grade.

Examinations
The bulk (70%) of the assessment will take the form of two standard written examinations that will be run in Moodle. The mid-session exam, held in week 5 (**Fri 16 Oct, 3-5pm**) and covering topics covered in weeks 1 to 5, is intended to give you timely feedback about your individual performance. The final exam will provide a final test of competency and will cover all the topics taught in the course. Marks will be assigned according to the correctness of the responses.

Bonus for course improvement
Students are encouraged to propose realistic ways to improve the course, and may be rewarded for such proposals by receiving a bonus mark (that adds to the 100% potential marks from other assessment tasks) of up to 5%. Such contributions (be they questions, answers, comments, pointers to useful course material, etc.) must be made before the Final Exam.

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes					
Assessment	**1**	**2**	**3**	**4**	**5**	**6**
Laboratory practical assessments	✓	✓	✓	✓	✓	✓
Project	✓	-	-	-	✓	✓
Mid-term exam	✓	✓	✓	-	-	-
Final exam	✓	✓	✓	✓	✓	✓

Assessment requirements
Material submitted for assessment must:

1. Be submitted before the deadline. Late submissions will be penalised, potentially by receiving a mark of 0.
2. Be original work by the student and not involve plagiarism. Students who have been found to have plagiarised in a TELE3118 assessment item may have the maximum number of marks for that assessment item subtracted from their overall course mark, e.g. -10% if you have been found to have plagiarised in your project.
3. Be self-contained in that it can be fully understood independent of course materials (e.g. lecture notes)
4. Demonstrate skills and understanding of knowledge that are covered by the course.

Merely memorising course materials and repeating them as answers to written exam questions will likely not demonstrate understanding of the materials and such answers will often not be self-contained.

COURSE RESOURCES

Textbooks
The recommended book for this course is by James F. Kurose and Keith W. Ross, Computer Networking: A Top-Down Approach, Global edition (7e), Pearson, 2017.

As an additional reference we will also be using the book by Andrew S. Tanenbaum and David J. Wetherall, Computer Networks, 5th edition, Pearson, 2011.

OTHER MATTERS

Dates to note
Important dates are available at: https://student.unsw.edu.au/dates

Academic Honesty and Plagiarism
Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information to help you avoid plagiarism, see: https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

Student Responsibilities and Conduct
Students are expected to be familiar with and adhere to all UNSW policies (see https://student.unsw.edu.au/guide), and particular attention is drawn to the following:

Workload
It is expected that you will spend at least **15 hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both online 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://www.engineering.unsw.edu.au/electrical-engineering/resources and https://student.unsw.edu.au/guide.

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	✓