# TELE3118
# Network Technologies

Course Outline – Semester 1, 2017

Never Stand Still | Faculty of Engineering | School of Electrical Engineering and Telecommunications

## Course Staff


Course Convener: Prof. Vijay Sivaraman, MSEB room 749, vijay@unsw.edu.au
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**Consultations:** You are encouraged to ask questions on the course material, before or after the lecture class times in the first instance, rather than via email. Another opportunity to ask questions is during consultation times on Mondays from 5pm-6pm.

**Email**: You can contact the Course Convenor about course administration issues through email to vijay@unsw.edu.au if you include the phrase "TELE3118" in the subject line and your student number in the message body. Please do not ask technical questions about the content of this course through email.

**Keeping Informed:** Announcements may be made during classes, via email (to your student email address, e.g. z1234567@student.unsw.edu.au) and/or via the course web site. Please check these sources at least once per week. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

## Course Resources

**Web sites**: The course web page http://subjects.ee.unsw.edu.au/tele3118/ is the primary online resource for this course, directly hosting many resources (e.g. lecture slides and schedule) and linking to others. This course will does not currently plan to use Moodle.

### 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.

## Course Summary

### Contact Hours

The course consists of 3 hours of lectures, a 1-hour tutorial per fortnight, and a 3-hour laboratory session each fortnight. Class times and locations are available online https://my.unsw.edu.au/classutil/TELE_S1.html#TELE3118T1

## 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 and Lab Schedule

| Period | Topic | Lab |
|---|---|---|
| Week 1 | Introduction to Internet Technologies | |
| Week 2 | Data Link Layer: Framing, Error Control, MAC | Cabling |
| Week 3 | Data Link Layer: Ethernet, Wireless, Switching | |
| Week 4 | Network Layer Data Plane: Basics, Addressing | Switches |
| Week 5 | Network Layer Data Plane: Forwarding | |
| Week 6 | Network Layer Control Plane: Routing | IP and ICMP |
| Week 7 | **Mid-Session Test** and Sockets | |
| Week 8 | Transport Layer: Basics | Routing |
| Week 9 | Transport Layer: TCP | |
| Week 10 | Application Layer: Basics, HTTP | TCP |
| Week 11 | Application Layer: DNS, P2P | |
| Week 12 | Future Networks: SDN, IoT | Project presentations |
| Week 13 | Review | |

## Assessment

| Weighting | Task | Due date |
|---|---|---|
| 70% | Examinations | |
| 30% | Mid-session exam | During week 7 |
| 40% | Final exam | During Examinations Period |
| 20% | Labs | During allocated lab session |
| 10% | Project | Demonstration in week 13 |
| Discretionary | Quizzes | In class surprise-quizzes |

# Course Details

## Credits

This is a 6 Units of Credit (UOC) course. "The normal workload expectations of a student are approximately 25 hours per Semester for each UOC" [https://student.unsw.edu.au/uoc] or about 10–12 hours per week throughout the 13 week semester.

## 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
[http://www.handbook.unsw.edu.au/undergraduate/courses/2015/TELE3118.html]:

> 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 3-hours of face-to-face 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-semester 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 face-to-face 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 13. 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 semester. Ongoing assessment occurs through the lab checkpoints and the mid-semester 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 13. 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.

### In-class Quizzes

Several surprise quizzes may be held 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 closed-book examinations. The mid-session exam, held in week 7 and covering topics covered in weeks 1 to 6, 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-semester exam | ✓ | ✓ | ✓ | - | - | - | |
| Final exam | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |

## Assessment requirements

Material submitted for assessment must:

- Be submitted before the deadline. Late submissions will be penalised, potentially by receiving a mark of 0.
- Be original work by the student and not involve plagiarism - see below. 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.
- Be self-contained in that it can be fully understood independent of course materials (e.g. lecture notes)
- 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.

# Other Matters

## 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://my.unsw.edu.au/student/atoz/ABC.html), and particular attention is drawn to the following:

## Workload

It is expected that you will spend at least **ten to twelve hours per week** studying a 6 UoC course, from Week 1 until the final assessment, including both face-to-face classes and *independent, self-directed study*. In periods where you need to 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

UNSW has "special consideration" policies for "when illness or other circumstances interfere with your assessment performance." [https://student.unsw.edu.au/special-consideration] Pay particular attention to the need to **apply though myUNSW within 3 days of the date of the examination** for which you seek special consideration. You should only apply for special consideration for exceptionally severe/grave conditions, since you may not be granted it for moderate/mild conditions. Any alternate assessment given to recipients of special consideration may be conducted orally and will be no easier than the original assessment. Any supplementary final exam will likely be held in week 18 (6 weeks after the last week of session), and you should particularly consider this if you are planning to travel.

### Continual Course Improvement

Students are advised that the course is under constant revision in order to improve the learning outcomes of its students. Students are encouraged (in part by the potential for a bonus mark) to forward any feedback (positive or negative) on the course to the Lecturer. You can make anonymous comments through the MyExperience evaluation process. An example of the impact of student feedback is the introduction of recorded videos that can be used to revise certain topics covered in lectures, as requested by many TELE3118 students in earlier years.

### 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:
http://www.engineering.unsw.edu.au/electrical-engineering/policies-and-procedures
https://my.unsw.edu.au/student/atoz/ABC.html

## 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

This course contributes to the following UNSW Graduate Attributes:

- The skills involved in scholarly enquiry: This course develops an attitude towards keeping up to date with the latest methods and technology.

- An in-depth engagement with the disciplinary knowledge in its inter-disciplinary context: This course will help you appreciate the societal context and technological and market advances in other disciplines that have helped shape the Internet.
- The capacity for analytical and critical thinking and for creative problem solving: This course develops the ability to analyse and criticise the design decisions that have shaped the Internet, and to indulge in design problems outside the limits of principles and examples used in teaching.
- The ability to indulge in independent and reflective learning.
- The skills to appropriately locate, evaluate, and use relevant information.
- The capacity to contribute to and work within the international community.
- The skills required for collaborative and multi-disciplinary work.

# 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 | ✓ |