School of Electrical Engineering and Telecommunications

Term 3, 2019
Course Outline

TELE9782
Special Topics in Telecommunications
Antenna and Propagation

Course Staff

Course convener: Dr. Shaghik Atakaramians, Room # 414, Building G17
Email: s.atakaramians@unsw.edu.au

Moodle: https://moodle.telt.unsw.edu.au/course/view.php?id=44542

Active learning project student mentor: Syed Daniyal Ali Shah, daniyal.shah@unsw.edu.au

Consultations: You are encouraged to ask questions on the course material, after the face-to-face class times, rather than via email. If required, all email enquiries should be made from your student email address with TELE9782 in the subject line; otherwise they will not be answered.

Keeping Informed: Most announcements will be made via Moodle. 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 face-to-face session and an active learning project using CST. The face-to-face lectures will be in rm G03 G17 and the active learning project session will be in rm 108, G17 according to the following schedule:

	Day	Time and Location
Lectures	Wed 18/9	6 – 8 pm G03 (G17)
	Wed 25/9	6 – 8 pm G03 (G17) 8 – 9 pm 108 (G17)
	Wed 2/10	6 – 8 pm G03 (G17) 8 – 9 pm 108 (G17)
	Wed 9/10	6 – 8 pm G03 (G17) 8 – 9 pm 108 (G17)
	Wed 16/10	6 – 9 pm G03 (G17)
	Wed 23/10	6 – 8 pm G03 (G17) 8 – 9 pm 108 (G17)
	Wed 30/10	6 – 9 pm 108 (G17)
	Wed 6/11	6 – 8 pm G03 (G17) 8 – 9 pm 108 (G17)
	Wed 13/11	6 – 9 pm 108 (G17)
	Wed 20/11	6 – 8 pm G03 (G17)

Context and Aims

Context: This course's main objective is to introduce the fundamental principles of antenna theory and to apply them to the analysis and design of basic antenna including but not limited linear dipoles, loops, arrays, broadband antennas. Antenna technology has been an indispensable part of communications systems with still many challenges to be addressed for greater system performance and miniaturization. The course is heavily analytical and involves software simulations using CST Studio Suite and MATLAB.

Aims: The course will provide students with essential knowledge in the mathematical and numerical simulation techniques to analyse narrowband and broadband dipole antennas and beam forming using antenna arrays.

Topics covered comprise: Fundamental Parameters and Figure-of-Merit of Antennas, Radiation Integrals and Auxiliary Potential Functions, Linear Wire Antennas, Loop Antennas, Linear Array, Broadband Dipoles and Matching Techniques and an active learning project.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Fundamental Parameters and Figure-of-Merit of Antennas, CST ALP
Week 2	Radiation Integrals and Auxiliary Potential Functions, CST ALP
Week 3	Linear Wire Antennas, CST ALP
Week 4	Loop Antennas, CST ALP
Week 5	Mid-term exam and Guest speaker
Week 6	Linear Array, CST ALP
Week 7	CST ALP
Week 8	Broadband Dipoles and Matching Techniques, CST ALP
Week 9	CST ALP
Week 10	Review and problem solving

Assessment

In class participation (lectures) and online quizzes	10%
Active learning project (ALP)	25%
Mid-Semester Exam	25%
Final Exam	40%

Note: It is required to pass the final exam to pass the course.

Course Details

Credits

This is a 6 UoC course and the expected workload is 15 hours per week throughout the 10-week semester.

Relationship to Other Courses

The course is a fourth-year professional elective offered to students following a BE (TELE and ELEC) course at UNSW. The course gives the foundations for antenna and propagation.

Pre-requisites and Assumed Knowledge

The pre-requisite for the course is ELEC3115, Electromagnetic Engineering. It is further assumed that the students have good computer literacy and mathematical skills. Students who are not confident in their knowledge from Electromagnetic Engineering are strongly advised to revise Part B: Wave electromagnetics course materials as quickly as possible to avoid difficulties in this course. Students must have at least an average WAM of greater than 65 and basic knowledge of MATLAB.

Learning outcomes

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

1. Know the fundamental parameters and Figure-of-Merit of antennas
2. Calculate electric and magnetic field components of wire and loop antennas from radiation integrals and auxiliary potential functions
3. Design wire and loop antennas with specific required characterization (e.g. radiation and input resistance, directivity and beamwidth)
4. Design wire and loop antenna array with specific required beam pattern and directivity
5. Understand broadband dipoles and matching techniques
6. Design basic dipole and array antenna using CST

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 course consists of the following elements: face-to-face lectures, online activities, in-class discussions, and active learning project (ALP).

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

- Face-to-face Lectures
- In-class discussions, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding;
- Face-to-face mentoring sessions that will promote group work and enhance deeper learning of the concepts.
- ALP focuses on active, student-directed learning and gives you an authentic, real-world context for learning.
- Quizzes via online modules that enable active discussions.

Learning in this course

You are expected to attend all face-to-face sessions, APL sessions, and mid-semester exams in order to maximise learning. 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 encouraged. UNSW *assumes* that self-directed study of this kind is undertaken in addition to attending face-to-face sessions throughout the course.

Assessment

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. The assessment occurs through, class participation and quizzes, APL and the mid-semester and final exam.

Class participation and online quizzes

There will be five online quizzes on various topics. The class participation and online quizzes will be contributing to 10% towards the course. These quizzes will be via Moodle. The quizzes will aid understanding of the material.

Active Learning Project (ALP)

ALP is introduced in this course for you to gain knowledge and skills by investigating and responding to an engaging challenge in various topics of the course. The students will work in groups. The aim of ALP is to design an antenna array for beam forming using CST numerical software. The assessment towards the active learning project will be 25% towards the course. This will include a brief report submission which is due on Firday Week 10.

Mid-Semester Exam

The mid-session examination tests your general understanding of the course material, and is designed to give you feedback on your progress through the analytical components of the course. Questions may be drawn from any course material up to the end of week 4 (topics include up to Linear Arrays). Marks will be assigned according to the correctness of the responses. The test is of 75-minute duration, closed-book, held during **Week 5 Wednesday 18-17:15 hrs, rm G04** (EE&T building, G17 on the map). This assessment provides 25% contribution towards your course.

Final Exam

The exam in this course is a standard closed-book 2 hours written examination, covering all aspects of the course. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion.

Please note that you must pass the final exam in order to pass the course.

Relationship of Assessment Methods to Learning Outcomes

	Learning outcomes					
Assessment	**1**	**2**	**3**	**4**	**5**	**6**
APL	✓	-	✓	✓	✓	✓
Mid-semester exam	✓	✓	✓	-	-	-
Final exam	✓	-	✓	✓	✓	-

Course Resources

Textbooks

Prescribed textbook

- C. A. Balanis, *Antenna Theory : analysis and design*, 4th Edition, Wiley-Interscience, 2016.

Reference books

- W. L. Stutzman and G. A. Thiele, *Antenna Theory and design*, 3rd edition, Wiley, 2012.
- J. J. Carr, Practical Antenna Handbook, 4th Edition, MaGraw-Hill.

On-line resources

Moodle https://moodle.telt.unsw.edu.au/course/view.php?id=44542

Occasionally Moodle may be used to host quizzes. Information on this will be made available later.

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 http://www.lc.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 **12 to 15 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

You must submit all assignments and attend all examinations scheduled for your course. The assessment of applications for Special Consideration is now being managed centrally and the University has introduced a "fit to sit/submit" rule. You will no longer be required to take your original documentation to The Nucleus for verification. Instead, UNSW will conduct source checks on documentation for verification purposes. 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. If you sit an exam or submit an assignment, you are declaring yourself well enough to do so.

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 myExperience. You can also provide feedback to ELSOC who will raise your concerns at student focus group meetings.

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

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 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 ethical practitioners who are collaborative and effective team workers, through group activities, lab work and tutorials.

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	