School of Electrical Engineering and Telecommunications

Term 2, 2019
Course Outline

TELE9755
Microwave Theory and Circuits for Communications Systems

COURSE STAFF

Course Convener: Professor R. Ramer, Room EE&T 308, ror@unsw.edu.au

Tutor: Dr. K.Y. Chan, Room EE&T TBA, kyc@unsw.edu.au

Consultations: You are encouraged to ask questions on the course material, after the lecture class times in the first instance, rather than via email. Lecturer consultation times will be advised during lectures. You are welcome to email the tutor, 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 TELE9755 in the subject line; otherwise they will not be answered.

Lecturer consultation times: Wednesday, EE&T TBA.

Keeping Informed: Announcements may be made during classes, via email (to your student email address) and/or via online learning and teaching platforms – in this course, we will use Moodle https://moodle.telt.unsw.edu.au/login/index.php. Please note that you will be deemed to have received this information, so you should take careful note of all announcements.

COURSE SUMMARY

Contact Hours

The course consists of 3 hours: 2 hours of lectures, and 1-hour tutorial.

	Day	Time	Location
Lectures	Wednesday	13 – 16 (wk 1-10)	Myers Theatre

Context and Aims

Wireless communication is one of the fasted growing technology areas and is found in wireless systems like Global Positions Satellite (GPS) systems, Wireless Local Area Networks (WLANs), paging systems, Direct Broadcast Satellite (DBS) television, Radio Frequency Identification (RFID) systems, mobile phones, automobile industry, and IoT. These systems have the capability of providing global connectivity for voice, video, and data communications. Hence, there is enormous commercial interest in this technology and never enough supply of competent microwave engineers.

This course will look at the hardware aspects of wireless systems from a telecommunications engineer perspective covering both basic passive and active microwave components as parts of the microwave building blocks in telecommunication transceiver system. Theoretical background comprises brief recapitulation of models and transmission line principles and Smith charts, followed by mathematical representation of microwave circuits, analysis of multiport microwave networks, introduction to modern planar technologies, lumped vs. distributed planar circuits, and analysis of planar circuits. Passive and active components will be discussed.

Indicative Lecture Schedule

Period	Summary of Lecture Program
Week 1	Introduction and recapitulation
Week 2	Recapitulation of fundamental concepts cont.
Week 3	Theory background
Week 4	Theory background cont.
Week 5	Microwave technologies and components/ Mid-session test
Week 6	Microwave passive devices
Week 7	Microwave passive devices cont.
Week 8	Microwave passive devices cont.
Week 9	Microwave active devices
Week 10	Microwave active devices cont.

Assessment

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Ongoing assessment occurs through the mid-semester exam and the assignment.

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Mid-Semester Exam	20%
Assignment	20%
Final Exam (2 hours)	60%

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

This is a postgraduate course in the School of Electrical Engineering and Telecommunications. The course is offered to students enrolled in the postgraduate level in the School of EE&T at the University of New South Wales. The course gives the foundation for microwave engineering design principles. The course should be taken by students that plan to design overall communications systems.

Assumed Knowledge

It is essential that the students are familiar with circuit theory, basic analogue electronics and communication principles, before this course is attempted. Electromagnetic theory and circuit theory techniques are assumed background knowledge for this subject. It is further assumed that the students are familiar with circuit simulators, have good computer literacy, and that they are able to operate electronics equipment.

Following Courses

The course will provide essential basic understanding to attempt the postgraduate courses TELE 9344 Cellular and Mobile and Communications and TELE 4652 Mobile and Satellite Communications, which are core courses in Telecommunications and Master of Engineering Science post-graduate specialization coursework program, offered by the School.

Learning outcomes

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

1. Understand the limitations of conventional low frequency circuits;
2. Compare the currently available microwave technologies for applications;
3. Analyze microwave circuits;
4. Design microwave circuits.

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

The general flow of the course is applications, systems, components; applications of microwaves: (terrestrial and satellite communications, radar, remote sensing, wireless); system requirements for elements are to be analyzed; propagation modes (TEM, TE, TM, quasi-TEM), attenuation, dispersion, S-parameters are parts of general fundamentals; microwave technologies for various applications and the analysis and design of microwave circuit components are to be introduced.

TEACHING STRATEGIES

Delivery Mode

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

- Formal face-to-face lectures, which provide you with a focus on the core analytical material in the course, together with qualitative, alternative explanations to aid your understanding;
- Tutorials, which allow for exercises in problem solving and allow time for you to resolve problems in understanding of lecture material;
- Small quizzes (non-assessed) that provide with reflection on the topic.

Learning in this course

You are expected to attend all lectures, tutorials, and mid-semester exams in order to maximize learning. 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 your problem sheet questions. The importance of adequate preparation prior to each class 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. In addition, during the tutorial class, 1-2 new questions that are not in your notes may be provided by the tutor, for you to try in class. These questions and solutions may not be made available, so it is worthwhile for you to attend your tutorial classes to gain maximum benefit from this course.

ASSESSMENT

The assessment scheme in this course reflects the intention to assess your learning progress through the semester. Ongoing assessment occurs through the quiz and the mid-semester exam.

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 already covered in the course schedule. It may contain numerical and analytical questions. Marks will be assigned according to the correctness of the responses.
Mid-semester exam will be held in week 5, during the tutorial time. It will be one –hour long.

Assignment

The assignment allows self-directed study leading to the solution of partly structured problems. Marks will be assigned according to how completely and correctly the problems have been addressed, the quality of the written assignment and the understanding of the course material demonstrated by the report.

The assignment will be given in week 8. The assignment report will be due for submission at the end of the third hour, on Wednesday in Week 10. *Timely submissions will avoid penalties.*

Final Exam

The exam in this course is a standard closed-book 2-hour written examination, comprising five compulsory questions. University approved calculators are allowed. The examination tests analytical and critical thinking and general understanding of the course material in a controlled fashion. Questions may be drawn from any aspect of the course, unless specifically indicated otherwise by the lecturer. Marks will be assigned according to the correctness of the responses. *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**
Mid-semester exam	-	✓	✓	-
Assignment	✓	✓	✓	-
Final exam	-	✓	✓	✓

COURSE RESOURCES

Textbooks

Prescribed textbook

- D. Pozar – Microwave Engineering, John Wiley, 4th Ed. 2012.
- R. Collin – Foundations of Microwave Engineering, Mc Graw Hill, 2nd Ed 2006.

Reference books

- D. Pozar, Microwave an RF Design of Wireless Systems, John Wiley, 4rd Ed. 2013.
- R.S. Elliott, Guided Waves and Microwave Circuits, Prentice Hall, 1999.
- D. K. Cheng, Field and Wave Electromagnetics, Addison Wesley, 2nd Ed., 1992.
- A.S. Sedra and K.C. Smith, Microelectronic Circuits, Oxford University Press, 7th Ed., 2010.

On-line resources

Moodle

As a part of the teaching component, assessment marks will be made available via Moodle: https://moodle.telt.unsw.edu.au/login/index.php.

Mailing list

Announcements concerning course information will be given in the lectures and/or on Moodle and/or via email (which will be sent to your student email address).

OTHER MATTERS

Dates to note

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

Academic Honesty and Plagiarism

Plagiarism is the unacknowledged use of other people's work, including the copying of assignment works and laboratory results from other students. Plagiarism is considered a form of academic misconduct, and the University has very strict rules that include some severe penalties. For UNSW policies, penalties and information

to help you avoid plagiarism, see https://student.unsw.edu.au/plagiarism. To find out if you understand plagiarism correctly, try this short quiz: https://student.unsw.edu.au/plagiarism-quiz.

Student Responsibilities and Conduct

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

Workload

It is expected that you will spend at least **fifteen 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. You should seek assistance early if you suffer illness or misadventure which affects your course progress. All applications for special consideration must be **lodged online through myUNSW within 3 working days of the assessment**, not to course or school staff. For more detail, consult 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.

In 2017, a few students expressed interest in visiting the antenna range testing facilities and the Giga-Hertz laboratory from CSIRO. In response to this request, two visits to these facilities at CSIRO were organized to.in 2018.

Administrative Matters

On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights, and general expectations of students, please refer to the School and UNSW policies:
https://student.unsw.edu.au/guide
https://www.engineering.unsw.edu.au/electrical-engineering/resources

APPENDICES

Appendix A: Targeted Graduate Capabilities

Electrical Engineering and Telecommunications programs are designed to address the following targeted capabilities which were developed by the school in conjunction with the requirements of professional and industry bodies:

- The ability to apply knowledge of basic science and fundamental technologies;
- The skills to communicate effectively, not only with engineers but also with the wider community;
- The capability to undertake challenging analysis and design problems and find optimal solutions;
- Expertise in decomposing a problem into its constituent parts, and in defining the scope of each part;
- A working knowledge of how to locate required information and use information resources to their maximum advantage;
- Proficiency in developing and implementing project plans, investigating alternative solutions, and critically evaluating differing strategies;
- An understanding of the social, cultural and global responsibilities of the professional engineer;
- The ability to work effectively as an individual or in a team;
- An understanding of professional and ethical responsibilities;
- The ability to engage in lifelong independent and reflective learning.

Appendix B: UNSW Graduate Capabilities

The course delivery methods and course content directly or indirectly addresses a number of core UNSW graduate capabilities, as follows:

- Developing scholars who have a deep understanding of their discipline, through lectures and solution of analytical problems in tutorials and assessed by assignments and written examinations.
- Developing rigorous analysis, critique, and reflection, and ability to apply knowledge and skills to solving problems. These will be achieved by the laboratory experiments and interactive checkpoint assessments and lab exams during the labs.
- Developing capable independent and collaborative enquiry, through a series of tutorials spanning the duration of the course.

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	✓