TELE 9755

Microwave Theory and Circuits for Telecommunications Systems

COURSE INTRODUCTION – Session 2, 2010

Course Staff
Course convenor: Prof. R. Ramer, room EE 305, ror@unse.edu.au
Laboratory Demonstrators: Hamood Khawaja, khawajahamood@yahoo.com
                        King Yuk Chan, kinguk@gmail.com
                        Yi Yang,
Web CT assistant: Jiong An, 9385 4001, jiongan@ee.unsw.edu.au

Course Details

Credits
The course is a 6 UoC course; expected workload is 10-12 hours per week throughout the 12 week session.

Contact hours
The course consists of 3 hours of lectures per week.

Lectures: Wednesday 15-18, 224
Lab Sessions: Week 12 and/or Week 13, TBA, Room EE 322,
Consultation: Wednesdays 18-19, EE236
Students are encouraged to use the open consultation time rather than contact by email.

COURSE INFORMATION

Context and Aims
Wireless communication is one of the fastest 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. 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 form a telecommunications engineer perspective. The course will cover many of the microwave building block in a telecommunication transceiver system: basic passive and active microwave components, models, transmission line principles, Smith charts, mathematical representation of microwave circuits, analysis of multiport microwave
networks, introduction to modern planar technologies, lumped vs. distributed planar circuits, analysis of planar circuits, microwave couplers, filters, amplifiers, oscillators and mixers.

This course aims to convey to students an understanding of microwave engineering principles for both the design and analysis in a telecommunication system. Assumed knowledge of this course include electromagnetic theory background and understanding of circuit theory techniques.

Aims
The course aims to make the student familiar with microwave engineering theory and circuits principles that are essentials for the knowledge of the design of a larger telecommunications system.

Relations to other courses
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.

Pre-Requisites: It is essential that the students are familiar with circuit theory, basic analogue electronics and communication principles.

Assumed knowledge: It is further assumed that the students are familiar with SPICE-like circuit simulators, have good computer literacy and are able to operate electronics equipment.

Following Courses: The course will provide essential basic understanding to attempt the postgraduate course ELEC 9702 RF Integrated Circuits, TELE 9344 Cellular and Mobile and Communications, and TELE 4652 Mobile and Satellite Communications, which are core courses in the Microsystems and Microelectronics, Telecommunications and Master of Engineering Science post-graduate specialisation coursework program, offered by the School.

Learning Outcomes
After the successful completion of the course, the student will be able to
1. Analyse and design microwave circuits
2. Use modern CAD design techniques to simulate microwave circuits
3. Use modern instrumentation to measure the microwave circuit parameters
4. Understanding of the limitations of conventional low frequency circuit and microwave circuit analysis

The course delivery methods and course content address a number of core UNSW graduate attributes; they include:
1. The capacity for analytical and critical thinking and for creative problem-solving, which is addressed by the design task and tutorial exercises.
2. The ability to engage in independent and reflective learning, which is addressed by the design task.
3. Information literacy, which is addressed by the homework.
4. The skills of effective communication, which are addressed by the reports.
Please refer to [http://www.ltu.unsw.edu.au/content/userDocs/GradAttEng.pdf](http://www.ltu.unsw.edu.au/content/userDocs/GradAttEng.pdf) for more information about the graduate attributes.

**Teaching Strategies**
The course consists of the following elements: lectures, laboratory work, and home work.

**Lectures**
The lectures, delivered in the class, will cover a range of microwave topics. They will begin with a revision of basic RF topics like transmission line theory, Smith Charts. Noise and linearity principles, S-parameters will be taught as they are essential performance parameters for any RF system and its constituent functional blocks. The essential building blocks of a standard RF system will be considered and analysed. These include RF components such as matching networks, resonators, RF filters, RF amplifiers, oscillators and mixers.

**Laboratory work**
The laboratory work provides the student with opportunity to measure and characterize the microwave components and circuits using the network analyser and develop sufficient competency in utilizing equipment of this nature. Introductory simulation experiment will expose students to the state of the art CAD software for microwave design. All laboratory work must be recorded in lab Book and not in loose sheets of paper. The lab work will be marked by the demonstrator at the end of the lab session.

**Home work and Self-guided tutorials**
The lectures can only cover the course material to a certain depth; students must read the textbook and reflect on its content as preparation for the lectures to fully appreciate the course material. Students are encouraged to read the textbook and reference materials. Home preparation provides the student with quantitative understanding.

The self guided tutorials provide the student with in-depth quantitative understanding of microwave circuit analysis. The proposed problems take the student through all critical course topics and aim to exercise the students microwave circuit analysis skills. The students are strongly encouraged to complete all the proposed problems that are discussed in the class.

**Quiz and Assignment**
One quiz and one assignment will be set for this course. Assignments will allow the students to explore the subject in great depth and would consume more effort and time than the normal tutorial questions. Quiz will be held at mid session. The assignment will be given in the second half of the course. Deadline for the submission of assignment will be set during the course schedule.

**Assessment**
There are four components of the assessment in this course:
- Laboratory work: 20% overall weight
- Quiz and Assignment: 20% overall weight
- Final examination: 60% overall weight
Final examination: The exam in this course is a closed book 3 hours written examination. University approved calculators are allowed. The examination test analytical and critical thinking and general understanding of the course material in a controlled fashion. Assessment is a graded mark according the correct fraction of the answers to the exam questions.

Assignment: There is one quiz during the lecture time and one assignment held through the session, which are provided in order to give feedback on student performance and general understanding of the course material in a controlled fashion.

Laboratory work: Due various time/schedule constraints all the laboratory work is scheduled for the last weeks of classes (week 12 and/or week 13). Laboratory work must be documented in brief reports which are due at the end of each laboratory session. Reports should be submitted directly to the lab demonstrators. Assessment is grade only mark based on lab work and reports.

Laboratory Experiments:
L1: Voltage standing wave and impedance measurement
L2: GSM
L3: Satellite communication
L4: Antenna pattern
L5: (DEMO) Familiarisation with Vector Network Analyser Operation; Calibration. S-parameters measurement, ADS.

Resources for Students

Textbooks: Prescribed textbook
The following textbook is prescribed for the course:

Reference books
The following books are good additional resources for topics on microwave engineering:
Books covering assumed knowledge
The following books cover material which is assumed knowledge for the course

On-line Resources
Some additional on-line resources relevant to the course: course website:
http://subjects.ee.unsw.edu.au/tele9755
library resources: http://info.library.unsw.edu/web/services/teaching

CAD Resources
Students can access the CAD tools in room EE125 and after hours on the dual boot PCs in the School computer laboratory located in room EEG16.

Other Matters
Academic Honesty and Plagiarism
Plagiarism is the unacknowledged use of others peoples work, including the copying of assignment works and laboratory results form other students. Plagiarism is considered a serious offence by the University and severe penalties may apply. For more information on plagiarism, please refer to: http://www.lc.unsw.edu.au/plagiarism

Continual Course Improvement
Students are advised that the course is under constant revision in order to improve the learning outcomes of its students. Please forward any feedback on the course to the course convenor.

Administrative Matters
On issues and procedures regarding such matters as special needs, equity and diversity, occupational health and safety, enrolment, rights and general expectation of students, please refer to the School policies, see http://scoff.ee.unsw.edu.au/.