Course Objectives
Microwave Engineering introduces the student to RF/microwave analysis methods and design techniques. Scattering parameters are defined and used to characterize devices and system behavior. Passive and active devices commonly utilized in microwave subsystems are analyzed and studied. Design procedures are presented along with methods to evaluate device performance. The free space communication link is examined and equations developed to determine the link carrier-to-noise ratio performance factor. Microwave computer-aided-design (CAD) methods are introduced by means of laboratory exercises. Project work serves to develop student engineering design and report writing skills.

Co-requisites
ECE 3590 Electromagnetic Theory

Course Content
The following topics will be covered:
- An introduction to microwave engineering
- Transmission lines as circuit elements
- Smith chart analysis methods
- Impedance transforming and matching circuits
- Line and waveguide structures and associated components
- Power waves and the network scattering matrix
- Passive devices
- Two-port network signal transmission
- Active devices
- Communication link design

Projects
Two design projects are normally assigned each requiring the preparation and submission of a formal report. Late project submissions may be penalized at the rate 10% of project value per class day.

Accreditation Units
Mathematics: 0
Natural Science: 0
Complementary Studies: 0
Engineering Science: 50%
Engineering Design: 50%

Web Page
http://courses.ece.umanitoba.ca/ECE4290
The course Web Page contains solutions to problems from prior year tests and examinations extending back to 1996.

Textbook
Microwave Engineering: Notes for Course ECE 4290, Ernest Bridges. This textbook is available in PDF format from the course Web Page.
Other References
A reference list relevant to the course topics appears in the textbook at the end of the first chapter.

Evaluation Details
The final course grade is determined by the student’s performance on projects, laboratory assignments, mid-term test and final examination. Students must complete all projects and laboratory assignments in order to be eligible to receive a passing grade.

Mid-Term(s)
Tuesday, October 25, 2011, 6:00 pm to 8:00 pm. Location: TBA

Instructor
Prof. E. Bridges
Room: E3-413 EITC
Telephone: (204) 474-7245
Email: ebridges@ee.umanitoba.ca

Office Hours
1:00pm to 2:00pm on Tuesdays and Thursdays (or by appointment)

Teaching Assistants
TBA

Voluntary Withdrawal Date
Wednesday, November 16th, 2011.

Requirements/Regulations
- Attendance at lectures and laboratories is essential for successful completion of this course. Students must satisfy each evaluation component in the course to receive a final grade.
- It is the responsibility of each student to contact the instructor in a timely manner if he or she is uncertain about his or her standing in the course and about his or her potential for receiving a failing grade. Students should also familiarize themselves with Sections 4 and 6 of the Regulations dealing with incomplete term work, deferred examinations, attendance and withdrawal.
- No programmable devices or systems (such as calculators, PDAs, iPods, iPads, cell phones, wireless communication or data storage devices) are allowed in examinations unless approved by the course instructor.

Academic Integrity
Students are expected to conduct themselves in accordance with the highest ethical standards of the Profession of Engineering and evince academic integrity in all their pursuits and activities at the university. As such, in accordance with the General Academic Regulations and Requirements of the University of Manitoba, Section 7.1, students are reminded that plagiarism or any other form of cheating in examinations, assignments, laboratory reports or term tests is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating in examinations or term assignments is also subject to serious academic penalty.
Learning Outcomes (approximately 5 recommended)

1. Gain knowledge and understanding of microwave analysis methods.
2. Be able to apply analysis methods to determine circuit properties of passive/active microwave devices.
3. Know how to model and determine the performance characteristics of a microwave circuit or system using computer aided design methods.
4. Have knowledge of basic communication link design; signal power budget, noise evaluation and link carrier to noise ratio.
5. Have knowledge of how transmission and waveguide structures and how they are used as elements in impedance matching and filter circuits.

Expected Competency Level **

<table>
<thead>
<tr>
<th>Learning Outcome</th>
<th>Attribute*</th>
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<tr>
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</tbody>
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**Attributes:**
A1 A knowledge base for engineering
A2 Problem analysis
A3 Investigation
A4 Design
A5 Use of engineering tools
A6 Individual and team work
A7 Communication skills
A8 Professionalism
A9 Impact of engineering on society/environment
A10 Ethics and equity
A11 Economics and project management
A12 Life-long learning

**Competency Levels:**
1 - Knowledge (Able to recall information)
2 - Comprehension (Able to rephrase information)
3 - Application (Able to apply knowledge in a new situation)
4 - Analysis (Able to break problem into its components and establish relationships)
5 - Synthesis (Able to combine separate elements into whole)
6 - Evaluation (Able to judge of the worth of something)

Student Contact Time (Hrs)

Lectures: 3 hrs lecture/week × 13 weeks/term = 39 hrs
Laboratories: 3 hrs laboratory × 5 weeks = 15 hrs
Tutorials: 0 hr tutorial × 0 weeks = 0 hrs

Evaluation

<table>
<thead>
<tr>
<th>Component</th>
<th>Value (%)</th>
<th>Methods of Feedback *</th>
<th>Learning Outcomes Evaluated</th>
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<td>Assignments</td>
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<td>Final Examination</td>
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<td>S</td>
<td>1, 2, 3, 4, 5</td>
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* Methods of Feedback: F - *formative* (written comments and/or oral discussion), S - *summative* (number grades)