UVic Department of Electrical and Computer Engineering

# COURSE OUTLINE

## ELEC 404 – Microwaves and Fiber Optics

## Summer 2014


**Instructor:**

Prof. Thomas Darcie
Phone: 721-8686
E-mail: tdarcie@uvic.ca


**Office Hours:**

Days: By appointment
Time:
Location: EOW 443

**Lectures:**

A-Section: CRN 30293
Days: Mondays & Thursdays
Time: 1:00 - 2:20
Location: CLE A202

**Labs:** **Location: ELW A317**

| B-Sections | Day | Time |
|---|---|---|
| CRN 30xxx – B01 | Wed. | 2:30 – 5:20 |
| CRN 30xxx – B02 | Wed. | 2:30 – 5:20 |
| CRN 30xxx – B03 | Mon. | 3:30 – 6:20 |

**Required Text:**

Title: Microwave Engineering
Author: D.M. Pozar
Publisher: John Wiley & Sons
Year: 2012 (4th ed.)

**Optional Text:**

Title: Optical Fiber Communications
Author: G. Keiser
Publisher: McGraw-Hill
Year: 2011 (4th ed.)

Title: Laboratory Manual for ELEC 404 - Microwave and Fiber Optics (posted online)
Author: T. Darcie, P. Fedrigo, R. Vahldieck, J. Bornemann
Publisher: University of Victoria
Year: April 2011

**Assessment:**

| | | |
|---|---|---|
| Assignments: | 10% | |
| Labs | 20% | |
| Mid-term | 20% | Date: June 26, 2014 |
| Final | 50% | Date: TBD |

Notes:

- Failure to complete all laboratory requirements will result in a grade of N being awarded for the course.

**Due dates for assignments:**

Posted on course web site

The final grade obtained from the above marking scheme will be based on the following percentage-to-grade point conversion:

| Passing Grades | Grade Point Value | Percentage for Instructor Use Only | |
|---|---|---|---|
| A+<br>A<br>A- | 9<br>8<br>7 | 90 – 100<br>85 – 89<br>80 – 84 | |
| B+<br>B<br>B- | 6<br>5<br>4 | 77 – 79<br>73 – 76<br>70 – 72 | |
| C+<br>C | 3<br>2 | 65 – 69<br>60 – 64 | |
| D | 1 | 50 – 59 | |
| **Failing Grades** | **Grade Point Value** | **Percentage for Instructor Use Only** | **Description** |
| E | 0 | 35 - 49 | Fail, conditional supplemental exam.<br>(For undergraduate courses only) |
| F | 0 | 0 – 49 | Fail, no supplemental. |
| N | 0 | 0 – 49 | Did not write examination, Lab or otherwise complete course requirements by the end of term or session; no supplemental exam. |

The rules for supplemental examinations are found on page 80 of the current 2013/14 Undergraduate Calendar.

| Term in which E Grade Was Obtained | Application Deadline for Supplemental Exam | Supplemental Exam Date |
|---|---|---|
| First term of<br>Winter Session (Sept – Dec) | February 28 in the following term | First week of following May |
| Second term of<br>Winter Session (Jan – Apr) | June 30 in the following term | First week of following September |
| Summer Session<br>(May – Aug) | October 31 in the following term | First week of following January |

Deferred exams will normally be written at the start of the student's next academic term; i.e., approximately 4 months following the deferral of the exam.

Course Description

1. Course Objectives

To introduce students to microwave and fiber optic engineering, including transmission line theory, microwave network analysis, optical fiber, and related components and measurement principles.

2. Learning Outcomes: Upon completion of this course students should be able to:

- describe basic properties of transmission lines in terms of characteristic impedance, complex propagation constants, transmission and reflection coefficients,
- understand electromagnetic wave propagation in waveguides, including wave impedance, spatial structure of electric and magnetic fields, and mode cutoff condition,
- describe the basic operation of coupled lines in terms of even and odd mode impedances and coupling coefficient,
- describe networks of inter-connected microwave components and ports in terms of network analysis tools and in particular the scattering matrix,
- calculate power flow in transmission lines and waveguides,
- use a variety of techniques to optimize power flow or minimize reflections in transmission line systems and in particular become comfortable with the applications of the Smith Chart,
- calculate basic antenna parameters such as beam width, directivity, gain, radiation loss and resistance and calculate power link budget for a variety of wireless links,
- describe the noise temperature, noise figure, gain, and power available from a microwave amplifier,
- understand basic design and fabrication techniques and mode propagation properties for optical fiber,
- calculate propagation limitations in optical fiber resulting from attenuation and chromatic dispersion, and
- describe basic use of various optical waveguide devices including couplers, circulators, and fiber Bragg gratings in constructing a basic optical communication link.

3. Syllabus

| | Hours |
|---|---|
| **Introduction and Fundamentals** | 3 |
| **Microwave Engineering:** | |
| Transmission Line Theory | 4.5 |
| Waveguide theory | 4.5 |
| Couplers and Coupled Lines | 1.5 |
| Network Analysis | 3 |
| Smith Chart and Load Matching | 3 |
| Antennas | 1.5 |
| Impedance Matching and Tuning | 3 |
| Amplifier Fundamentals | 1.5 |
| **Optical Fiber Engineering:** | |
| Optical Fiber Communications | 1.5 |

| | |
|---|---|
| Modes and Propagation in Optical Fiber | 3 |
| Impairments in Optical Fiber | 1.5 |
| Optical Waveguide Devices | 1.5 |
| Sub Total | 33 |
| Test | 1.5 |
| Review | 1.5 |
| Total | 36 |

**Laboratory Experiments** (Each experiment is of 3 hours duration)

| | |
|---|---|
| Experiment 1 | Standing Waves and Impedance Measurements Using Slotted Line |
| Experiment 2 | Microwave Couplers and Network Analysis |
| Experiment 3 | Microwave Antennas |
| Experiment 4 | Basic Fiber Optic Measurements and Transmission |

**Note to Students:**

**Students who have issues with the conduct of the course should discuss them with the instructor first. If these discussions do not resolve the issue, then students should feel free to contact the ECE Chair by email or the ECE Chair's secretary to set up an appointment.**



**Accommodation of Religious Observance**
See http://web.uvic.ca/calendar2014/GI/GUPo.html

**Policy on Inclusivity and Diversity**
See http://web.uvic.ca/calendar2014/GI/GUPo.html

**Standards of Professional Behaviour**

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour at http://www.uvic.ca/engineering/current/undergrad/index.php#section0-25 which contains important information regarding conduct in courses, labs, and in the general use of facilities.

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult

http://web.uvic.ca/calendar2014/FACS/UnIn/UARe/PoAcI.html for the UVic policy on academic integrity.

**Plagiarism detection software may be used to aid the instructor and/or TA's in the review and grading of some or all of the work you submit.**