University of Manitoba | Price Faculty of Engineering
Department of Electrical and Computer Engineering

Course Outline

Instructor
- Prof. Arkady Major, P.Eng.
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Office Hours
- By appointment

Teaching Assistant
- Mohammad Reza
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Contact Hours
- 4 credit hours
- Lectures:
  3 hours x 13 weeks = 39 hours
- Laboratories:
  3 hours x 5 weeks = 15 hours

Prerequisites:
- ECE 3600 Physical Electronics

Course Website:
https://umanitoba.ca/umlearn

Important Dates

- **Term Test**
  November 3rd, 2020
  (in-class)
- **Voluntary Withdrawal Deadline**
  November 23rd, 2020
- **Thanksgiving Day**
  October 12th, 2020
  No classes or examinations
- **Remembrance Day**
  November 11th, 2020
  No classes or examinations
- **Fall Term Break**
  November 9th–13th, 2020
  No classes or examinations

ECE 4580 – Optoelectronics

Fall 2020

IMPORTANT NOTICE – In-Person Laboratories

This course will be delivered using online lectures and *in-person laboratories*. ***Students are required to pre-screen themselves*** before travelling to campus for their laboratory and must not attend the campus if they are experiencing any COVID-19 symptoms or if they have been in contact with someone who has tested positive for COVID-19. In addition, ***students must wear a face mask*** while attending the laboratory and in all common indoor spaces on campus, or whenever social distancing can not be maintained. For further information, please visit the *UofM COVID-19 Resources* website (https://umanitoba.ca/coronavirus/recovery).

Course Objectives

The course starts with an introduction to light and optics. Light sources of different types are discussed, including lasers and Light Emitting Diodes (LEDs). Light modulation and detection methods are also discussed. Finally the course covers fibreoptic systems including fibre optic communications.

Course Content

The following topics will be covered:

- Light: Properties, Vision, Radiometry and Photometry
- Optics: Mirrors, Lenses, Ray Tracing and Imaging
- Radiation Sources: Radiation Profiles, Gas Discharge, LEDs
- Lasers: Principles of Operation, Types of Lasers, Modes of Operation
- Laser Diodes: Principles of Operation, Structures, Main Characteristics
- Detectors: Thermal Detectors, Photodiodes, Sources of Noise
- Light Modulators: Electro-optics, Acousto-optics, Liquid Crystals
- Fibre Optics: Theory of Operation, Characteristics of Fibres
- Fibre Optic Communications

Textbook

Instructor course notes.

Other Resources

Fundamentals of Photonics, B.E.A. Saleh and M.C. Teich, Wiley, 2007.

Requirements and 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 the University's *General Academic Regulations*, as well as Section 3 of the Faculty of Engineering *Academic 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.
- Students should be aware that they have access to an extensive range of resources and support organizations. These include Academic Resources, Counselling, Advocacy and Accessibility Offices as well as documentation of key University policies e.g. Academic Integrity, Respectful Behaviour, Examinations and related matters.

Supplemental Information

Accreditation Details

Accreditation Units

- Mathematics: 0%
- Natural Science: 30%
- Complementary Studies: 0%
- Engineering Science: 70%
- Engineering Design: 0%

Graduate Attributes

KB: A knowledge base for engineering
PA: Problem analysis
IN: Investigation
DE: Design
ET: Use of engineering tools
IT: Individual and team work
CS: Communication skills
PR: Professionalism
IE: Impact of engineering on society/ environment
EE: Ethics and equity
EP: Economics and project management
LL: Life-long learning

Competency Levels

1 - Knowledge (Able to recall information)
2 - Comprehension (Ability to rephrase information)
3 - Application (Ability 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 a whole)
6 - Evaluation (Able to judge the worth of something)

Grading Scale

Letter	Mark
A+	95–100
A	85–94
B+	80–84
B	70–79
C+	65–69
C	55–64
D	45–54
F	< 45

Note: These boundaries represent a guide for the instructor and class alike. Provided that no individual student is disadvantaged, the instructor may vary any of these boundaries to ensure consistency of grading from year-to-year.

Learning Outcomes

1. Understand fundamental properties of light and operation principles of basic optical components.
2. Demonstrate a mastery of basic mechanisms of light generation (including lasers) through detailed understanding and analysis of operation principles, characteristics, design architectures and trade-offs of semiconductor lasers.
3. Understand and compare operation principles, characteristics, design architectures and trade-offs of optical detectors and modulators of light.
4. Understand basic system design of fibre optic communication link and fundamental theory of fibre optics.
5. Hands-on testing, measurement and development of optical systems in a range of areas spanning the course.

Expected Competency Levels

Outcome	KB	PA	IN	DE	ET	IT	CS	PR	IE	EE	EP	LL
1	3	2	2	2	3		2		1			1
2	3	2	2	2	3		3		1			1
3	4	3	3	3	3		3		1			1
4	4	3	3	3	3		3		1			1
5	2	2	3	3	3		3					1

Evaluation

The final course grade is determined by the student's performance on assignments, presentation, in laboratories, and on examinations. Students must complete all the laboratories in order to be eligible to receive a passing grade.

Component	Value (%)	Method of Feedback	Learning Outcomes Evaluated
Assignments	10	F, S	1, 2, 3, 4
Presentation	10	F, S	1, 2, 3, 4
Laboratories	10	F, S	1, 2, 3, 4, 5
Term Test	20	F, S	1, 2, 3
Final Examination	50	S	1, 2, 3, 4

* Method of Feedback: **F** - Formative (written comments and/or oral discussion), **S** - summative (numerical grade)

CEAB Graduate Attributes Assessed

KB.4 – Recalls and defines, and/or comprehends and applies, first principles and concepts in specialized engineering science.

IN.4 – Understands appropriate safe work procedures during experiments or laboratory exercises.

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* on *Academic Integrity*, students are reminded that plagiarism or any other form of cheating in examinations, term tests, assignments, projects, or laboratory reports is subject to serious academic penalty (e.g. suspension or expulsion from the faculty or university). A student found guilty of contributing to cheating by another student is also subject to serious academic penalty.

Copyright Notice

Retention of Student Work

Students are advised that copies of their work submitted in completing course requirements (i.e. assignments, laboratory reports, project reports, test papers, examination papers, etc.) may be retained by the instructor and/or the department for the purpose of student assessment and grading, and to support the ongoing accreditation of each Engineering program. This material shall be handled in accordance with the University's *Intellectual Property Policy* and the protection of privacy provisions of *The Freedom of Information and Protection of Privacy Act (Manitoba)*. Students who do not wish to have their work retained must inform the Head of Department, in writing, at their earliest opportunity.