University of Victoria Engineering

Faculty of Engineering
Department of Mechanical Engineering
COURSE OUTLINE

MECH 450F/401A/580 – Microfluidics for Biomedical and Energy Applications
Term – Summer 2017 (201705)

INSTRUCTORS

Instructor	Office Hours
Dr. Mohsen Akbari	Days: Tuesdays
Phone: 250-721-6038	Time: 11 am-12 pm
E-mail: makbari@uvic.ca	Location: EOW 533

List all prerequisites and co-requisites: None

LECTURE SCHEDULE

Section: A01	CRN: 30581	Days: M,Th	Time: 2:30pm-3:50pm	Location: CLE A307

ATTENDANCE

Students are expected to attend all classes in which they are enrolled. An academic unit may require a student to withdraw from a course if the student is registered in another course that occurs at the same time.

An instructor may refuse a student admission to a lecture, laboratory, online course discussion or learning activity, tutorial or other learning activity set out in the course outline because of lateness, misconduct, inattention or failure to meet the responsibilities of the course set out in the course outline. Students who neglect their academic work may be assigned a final grade of N or debarred from final examinations.

Students who do not attend classes must not assume that they have been dropped from a course by an academic unit or an instructor. Courses that are not formally dropped will be given a failing grade, students may be required to withdraw and will be required to pay the tuition fee for the course." UVic Calendar, (2015) http://web.uvic.ca/calendar2015-09/FACS/UnIn/UARe/Atte.html

TEACHING ASSISTANTS

A team of one teaching assistants (TAs) will manage the tutorial sessions, help deliver this course.

TA Name	E-mail
Bahram Mirani	bmirani@uvic.ca

TEXTBOOKS & ONLINE COURSE MATERIALS (MASTERING ENGINEERING)

Required Text	Optional Text
Title: *No required textbook*	-Nguyen, N-T, Wereley, S. T. (2002) Fundamentals and Applications of Microfluidics, Artech House. -Folch, A (2012) Introduction to BioMEMS, CRC Press.

COURSE OBJECTIVES

"Microfluidics for Biomedical and Energy Applications" is an interdisciplinary senior and graduate level course, which introduces the students to the design and development of miniaturized systems for a wide range of biomedical applications from medical diagnostics to drug discovery and regenerative medicine as well as energy applications from fluid sample analysis (e.g. oil analysis) to CO2 transport in microporous media). The main focus is to understand the fundamentals and basic concepts underlying the heat and mass transport in micro scales, microfabrication strategies, and flow control in microfluidic systems. This course will cover the following topics: 1) Transport phenomena in microscale; 2) Fundamentals of microfabrication

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techniques for microfluidic devices; 3) Flow control in microfluidic systems; 4) Recent advances in designing microscale diagnostics and analytical systems; 5) A brief overview of the applications of microfluidic systems in biology and the concept of organ-on-chip; and 6) A brief overview of the use of microscale technologies for energy applications. The course is highly interactive, emphasizing teamwork, student presentation, and class discussion.

LEARNING OUTCOMES: At the end of this course, students will be able to:

- Explain the scaling laws in microscales
- Understand the heat and mass transfer in microscales
- Understand and analyze the hydrodynamic of pressure –driven flows in microchannels
- Understand and analyze wettability, surface tension, and capillary flow in microchannels
- Understand and analyze flow through porous structures
- Understand and analyze electrokinetic flow in microchannels
- Explain different microfabrication strategies and their advantages and drawbacks.
- Describe flow control approaches in microfluidic systems
- Explain different applications of microfluidic systems for analytical chemistry and diagnostics
- Explain the applications of microfluidics in cell culture, three-dimensional tissue modeling, organs-on-chip, and disease modelling.
- Explain the use of microfluidic systems for energy applications

CONTENT OVERVIEW

The lectures will attempt to cover the following topics

MODULE	WEEK #	ASSIGNMENTS
Introduction	**05.01-05.05**	
Module 1	**05.08-05.12**	
Module 1/ 2	**05.15-05.19**	**Assignment #1 (05.15)** **Due: 05.25**
Module 2	**05.22-05.26**	
Module 2/3	**05.29-06.02**	**Assignment #2 (05.29)** **Due: 06.08**
Module 3	**06.05-06.09**	**Assignment #3** **(06.05)** **Due: 06.26**
Module 4	**06.12-06.16**	**Midterm**
Module 4	**06.19-06.23**	**Assignment #4** **(06.22)** **Due:07.06**
Module 5	**06.26-06.29**	

Module 5	**07.03-07.07**	**Assignment #5 (07.06) Due:07.13**
Module 6	**07.10-07.14**	**Assignment #6 (07.13) Due: 07.24**
Presentations	**07.17-07.21**	
Presentations	**07.24-07.28**	

Module #1: Transport phenomena in microscales

Module #2: Fabrication techniques for microfluidics

Module #3: Flow control in microfluidics

Module #4: Lab-on-chip

Module #5: Cells-on-chip

Module #6: Microfluidics for energy

ASSIGNMENTS

There are six written assignments after each module. The assignment include problem sets or summary of two recent papers on a special topic. Each student will submit the assignment on due dates by the end of the lecture.

PROJECT

There will be a major project on the following topics:

- Organ-On-Chip
- Microfluidic devices for drug discovery
- Tissue engineering and disease modeling
- Point of care diagnostics
- Microfluidics for CO2 management
- Microfluidics and optics for bioenergy
- Your own topic

Students will submit a 15-page report, give presentations in the class, provide feedback to their peers.

For the projects, undergraduate students will be evaluated as a group while the graduate students will be evaluated individually.

GRADING SCHEME

Assessment:	Weight	Date
Assignments	30%	See "ASSIGNMENTS" section above
Midterm	30%	
Project	40% (20% report+20% presentation)	
Presentation attendance and feedback (bonus)	5%	

GENERAL INFORMATION

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 Chair of the Department by email or the Chair's Secretary to set up an appointment.

Accommodation of Religious Observance (AC1210)
http://web.uvic.ca/calendar2015-09/GI/GUPo.html

Discrimination and Harassment Policy (GV0205)
http://web.uvic.ca/calendar2015-09/GI/GUPo.html

Faculty of Engineering, University of Victoria Standards for Professional Behaviour
"It is the responsibility of all members of the Faculty of Engineering, students, staff and faculty, to adhere to and promote standards of professional behaviour that support an effective learning environment that prepares graduates for careers as professionals…."

You are advised to read the Faculty of Engineering document Standards for Professional Behaviour which contains important information regarding conduct in courses, labs, and in the general use of facilities.
http://www.uvic.ca/engineering/current/undergrad/index.php#section0-23

Cheating, plagiarism and other forms of academic fraud are taken very seriously by both the University and the Department. You should consult the Undergraduate Calendar for the UVic policy on academic integrity.

Policy on Academic Integrity
http://web.uvic.ca/calendar2015-09/FACS/UnIn/UARe/PoAcI.html