# University Of California, Berkeley
# Department of Mechanical Engineering

## ME 167: Microscale Fluid Mechanics (3 units)

**Elective Course**

***Syllabus***

### CATALOG DESCRIPTION

Phenomena of physical, technological, and biological significance in flows of gases and liquids at the microscale. The course begins with familiar equations of Newtonian fluid mechanics, then proceeds to the study of essentially 1-D flows in confined geometries with the lubrication equations. Next is a study of the flow of thin films spreading under gravity or surface tension gradients. Lubrication theory of compressible gases leads to consideration of air bearings. Two- and 3-D flows are treated with Stokes' equations. Less familiar physical phenomena of significance and utility at the microscale are then considered: intermolecular forces in liquids, slip, diffusion and bubbles as active agents. A review of relevant aspects of electricity and magnetism precedes a study of electrowetting and electrokinetically driven liquid flows.

### COURSE PREREQUISITES

ME 105, ME 106, ME 109, Physics 7B or equivalent.

### TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

The course begins with familiar equations of Newtonian fluid mechanics. A first course in fluid mechanics like ME 106 is assumed.

### COURSE OBJECTIVES

Introduce the students to the special features of microscale flows.

### DESIRED COURSE OUTCOMES

The students should be able to formulate and solve elementary problems associated with the list of topics.

### TOPICS COVERED

The course begins with the study of essentially 1-D flows in confined geometries with the lubrication equations. Next is a study of the flow of thin films spreading under gravity or surface tension gradients. Lubrication theory of compressible gases leads to consideration

**TOPICS COVERED (Cont.)**

of air bearings. Two- and 3-D flows are treated with Stokes' equations. Less familiar physical phenomena of significance and utility at the microscale are then considered: intermolecular forces in liquids, slip, diffusion and bubbles as active agents. A review of relevant aspects of electricity and magnetism precedes a study of electrowetting and electrokinetically driven liquid flows.

**CLASS/LABORATORY SCHEDULE**

Three hours of lecture per week.

**CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT**

Computer aided analysis is used in the context of design in examples.

**RELATIONSHIP OF THE COURSE TO ABET PROGRAM OUTCOMES**

(a) an ability to apply knowledge of mathematics, science, and engineering
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(e) an ability to identify, formulate, and solve engineering problems
(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

**ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES**

Frequent homework, midterm and final exam.

**PERSON(S) WHO PREPARED THIS DESCRIPTION:** Andrew Szeri Feb. 26, 2006