

University Of California, Berkeley
Department of Mechanical Engineering

ME 262: Hydrodynamic Stability and Instability (3 units)

Graduate Course

Syllabus

CATALOG DESCRIPTION

Discussions of linear and nonlinear instabilities in a variety of fluid flows: thermal convection, Rayleigh-Taylor flows, shearing flows, plane and cylindrical Couette flow (i.e., centrifugal instability). Use of the Landau equation, bifurcation diagrams, and energy methods for nonlinear flows.

EXPANDED DESCRIPTION

The stability of flows that are common in engineering, atmospheric, geophysical, oceanographic and astrophysical settings will be examined. These flows include stratified and unstratified shear flows, pipe and channel flows, rotating flows, baroclinic flows, flows with currents and jets, magneto-hydrodynamic flows, and vortical flows. We examine thermal convection, centrifugal instabilities, Kelvin-Helmholtz instabilities, the magneto-resonance instability (MRI), and double diffusive instabilities. Discussion of stability begins with linear analysis and normal modes, continues through bifurcation diagrams and the use of symmetry, and finishes with small-amplitude expansions and other types of weakly nonlinear analyses, including the use of the Landau equation, elliptical instabilities and resonances.

COURSE PREREQUISITES

ME 260A or equivalents

TEXTBOOK(S) AND/OR OTHER REQUIRED MATERIAL

Drazin & Reid *Hydrodynamic Stability* and Downloads of published papers

COURSE OBJECTIVES

Understanding linear and weakly nonlinear analyses of the stability of flows and understanding their evolution when they become unstable.

DESIRED COURSE OUTCOMES

N/A

TOPICS COVERED

Linear stability analysis of most of the “classic flows”, bifurcation diagrams, symmetry, Landau equation, elliptical instability, weakly nonlinear perturbations, and resonances.

CLASS/LABORATORY SCHEDULE

Three hours of lecture per week

CONTRIBUTION OF THE COURSE TO MEETING THE PROFESSIONAL COMPONENT

Experience in producing reports of research projects

ASSESSMENT OF STUDENT PROGRESS TOWARD COURSE OBJECTIVES

Problem sets, Midterm and Final Project

PERSON(S) WHO PREPARED THIS DESCRIPTION

Philip S. Marcus
September 22, 2010

ABBREVIATED TRANSCRIPT TITLE (19 SPACES MAXIMUM): Hydro Stability

TIE CODE: LECS

GRADING: Letter

SEMESTER OFFERED: Spring

COURSES THAT WILL RESTRICT CREDIT: None

INSTRUCTORS: Marcus

DURATION OF COURSE: 14 Weeks

EST. TOTAL NUMBER OF REQUIRED HRS OF STUDENT WORK PER WEEK: 9

IS COURSE REPEATABLE FOR CREDIT? No

CROSSLIST: None