FLORIDA ATLANTIC UNIVERSITY™

Graduate Programs—NEW COURSE PROPOSAL[1]

UGPC APPROVAL ______
UFS APPROVAL ______
SCNS SUBMITTAL ______
CONFIRMED ______
BANNER POSTED ______
CATALOG ______

DEPARTMENT: Department of Ocean and Mechanical Engineering	**COLLEGE:** ENGINEERING AND COMPUTER SCIENCE

RECOMMENDED COURSE IDENTIFICATION:

PREFIX **EML** **COURSE NUMBER** 6716 **LAB CODE** (L or C) N/A

(*TO OBTAIN A COURSE NUMBER, CONTACT MJENNING@FAU.EDU*)

COMPLETE COURSE TITLE:

Advanced Fluid Dynamics

EFFECTIVE DATE

(first term course will be offered)

FALL 2017

CREDITS[2]**:** 3

TEXTBOOK INFORMATION:

Introduction to Fluid Mechanics, James A. Fay, MIT Press, 1998.

GRADING (*SELECT ONLY ONE GRADING OPTION*): **REGULAR** YES **SATISFACTORY/UNSATISFACTORY** ______

COURSE DESCRIPTION, NO MORE THAN THREE LINES:

A survey of fluid dynamics addresses the fundamental principles and their applications in a variety of engineering and science problems. Topics covered include dimensional analysis, kinematics, dynamics, inviscid flow, viscous flow, vorticity, boundary layer, turbulence, compressible flow, flow with gravity, and flow of industrial and natural processes.

PREREQUISITES *:	**COREQUISITES*:**	**REGISTRATION CONTROLS (MAJOR, COLLEGE, LEVEL)*:**
OME Graduate Standing, Undergraduate Fluid Mechanics or Permission of Instructor	**NONE**	**MAJOR**

* ***PREREQUISITES, COREQUISITES AND REGISTRATION CONTROLS WILL BE ENFORCED FOR ALL COURSE SECTIONS.***

MINIMUM QUALIFICATIONS NEEDED TO TEACH THIS COURSE:

Faculty contact, email and complete phone number:

Dr. Tsung-chow Su , Professor

Office Address:
Engineering West (EG-36), Room 180

Telephone Number: (561)297-3896
Email Address: su@fau.edu

Please consult and list departments that might be affected by the new course and attach comments.[3]

This course doesn't not affect any other department.

Approved by:	*Date:*	1. **Syllabus** must be attached; see guidelines for requirements: www.fau.edu/provost/files/course syllabus.2011.pdf
Department Chair:	1/6/15	
College Curriculum Chair:	9/10/16	
College Dean:		2. Review **Provost Memorandum: Definition of a Credit Hour** www.fau.edu/provost/files/Definition_Credit_Hour_Memo_2012.pdf
UGPC Chair:		
Graduate College Dean:		
UFS President:		3. **Consent** from affected departments (attach if necessary)
Provost:		

Email this form and syllabus to UGPC@fau.edu one week before the University Graduate Programs Committee meeting so that materials may be viewed on the UGPC website prior to the meeting.

1. Course title/number, number of credit hours

Advanced Fluid Dynamics EML 6716	3 credit hours

2. Course prerequisites, corequisites, and where the course fits in the program of study

- Prerequisites: OME Graduate Standing, Undergraduate Fluid Mechanics or Permission of Instructor

3. Course logistics

Class hours: TBA

For students in online sections, homeworks are administered through Blackboard and tests are administered through the Division of Engineering Student Services office. The course contains weekly homework set and two tests. The course does not have any laboratory experiment. This is a classroom lecture course. This course has no design content.

4. Instructor contact information

Instructor's name	Dr. Tsung-chow Su, Professor
Office address	Engineering West (EG-36) Bldg., Room 180
Office Hours	MW: 1.30-4.30 PM
Contact telephone number	561-297-3896
Email address	su@fau.edu

5. TA contact information

TA's name	TBD
Office address	
Office Hours	
Contact telephone number	
Email address	

6. Course description

A survey of fluid dynamics addresses the fundamental principles and their applications in a variety of engineering and science problems. Topics covered include dimensional analysis, kinematics, dynamics, inviscid flow, viscous flow, vorticity, boundary layer, turbulence, compressible flow, flow with gravity, and flow of industrial and natural processes.

7. Course objectives/student learning outcomes/program outcomes

Course objectives	This course introduces fluid dynamics to incoming graduate students and serves as a common core course for graduate students in mechanical engineering.
Student learning outcomes & relationship to ABET a-k objectives	1. The students will be familiar with the continuum approximation, the concept of stress and strain, and the modeling of the macroscopic world through the laws of conservation. 2. The students will learn basic formulations of fluid dynamics and various approximations and methods which will lead to useful solutions. 3. The students will know how to solve practical problems in fluid dynamics.

8. Course evaluation method

Homework	40%	*Note*: The minimum grade required to pass the course is C.
Mid-term Exam	30%	
Final Examination	30%	

9. Course grading scale

Grading Scale:
95 and above: "A", 90-95: "A-", 85-90: "B+", 80-85: "B", 75-80 : "B-", 70-75: "C+", 65-70: "C", 60-65: "C-", 55-60: "D+", 50-55: "D", 45-50: "D-", 45 and below: "F."

The final grade for the course will be the numerical average of grades assigned for all work in each of the categories listed above weighted according to the percentages shown.
The instructor reserves the right, in exceptional cases, to raise or lower the final numerically averaged course grade by 2.5% in cases where the instructor does not believe that the average is representative of the student's performance in the class. Normally, the student will receive the numerically-averaged letter grade for the course.

10. Policy on makeup tests, late work, and incompletes

Students are expected to attend all classes and complete homework assignments.
Any exam, or homework missed will be averaged as a zero. Make-ups will not be given except in the case of illness, or with the prior permission of the instructor.

An Incomplete, or an "I", will only be given out if a student, while carrying a passing average, becomes ill and is unable to complete the course on time. An "I" will not be given out to a student failing the course

11. Special course requirements

12. Classroom etiquette policy

University policy requires that in order to enhance and maintain a productive atmosphere for education, personal communication devices, such as cellular phones and laptops, are to be disabled in class sessions.

13. Disability policy statement

In compliance with the Americans with Disabilities Act (ADA), students who require special accommodations due to a disability to properly execute coursework must register with the Student Accessibility Services (SAS) located in Boca Raton campus, SU 133 (561) 297-3880 and follow all SAS procedures.

14. Honor code policy

Students at Florida Atlantic University are expected to maintain the highest ethical standards. Academic dishonesty is considered a serious breach of these ethical standards, because it interferes with the university mission to provide a high quality education in which no student enjoys unfair advantage over any other. Academic dishonesty is also destructive of the university community, which is grounded in a system of mutual trust and place high value on personal integrity and individual responsibility. Harsh penalties are associated with academic dishonesty. See University Regulation 4.001 at www.fau.edu/regulations/chapter4/4.001_Code_of_Academic_Integrity.pdf

15. Required texts/reading

Introduction to Fluid Mechanics, James A. Fay, MIT Press, 1998.

16. Supplementary/recommended readings

- http://ocw.mit.edu/courses/mechanical-engineering/2-25-advanced-fluid-mechanics-fall-2005/

17. Course topical outline, including dates for exams/quizzes, papers, completion of reading

Course Topics :

Week 1: Introduction and Requisite Mathematics:
The world of Fluid Mechanics; The Physics of Fluids; Dimensions and Units of Measurement; Vector Algebra and Calculus.

Week 2: Fluid Statics:
Forces on a Fluid Particle; Stress in a Fluid; Pressure in a Static Fluid; Pressure Forces on Solid Surfaces; Pressure Forces on Bodies Immersed in Fluids; Stratified Fluids; Surface Tension and Capillarity; Hydraulic Force Transmission.

Week 3: Conservation of Mass:
Kinematics of Fluid Flow; Control Volumes and Surfaces; Conservation of Mass; Conservation of Chemical Species; Two-Phase Flow; Measuring Volume and Volume Flow Rate.

Week 4: Inviscid Flow:
Criterion for Inviscid Flow; Acceleration of a Fluid Particle; Euler's Equation; Bernoulli's Equation; Euler's Equation in Streamline Coordinates; Inviscid Flow in Noninertial Reference Frames; Special Flows.

Week 5: Conservation of Momentum

Introduction; Reynolds' Transport Theorem; Linear Momentum; Applications of Linear Momentum Theorem; Propulsion; Wind Turbines; Wakes and Jets; Turbine Blades and Blade Rows; Horizontal Flow with a Free Surface; Angular Momentum; Applications of Angular Momentum Theorem; Centrifugal Compressors and Pumps; Axial Flow Turbines and Compressors; Propellers.

Week 6: Laminar Viscous Flow:
Introduction; Viscous Stress; The Viscous Force; The Navier-Stokes Equation of Motion; Applications of the Navier-Stokes Equation; Plane Couette Flow; Plane Poiseuille Flow; Combined Plane Couette and Poiseuille Flow; Circular Poiseuille Flow; Poiseuille Flow in Non-circular Tubes; Creeping (Stokes) Flow; Flow Through Porous Media.

Week 7: Laminar Viscous Flow:
Applications of the Navier-Stokes Equation, unsteady laminar flow; Laminar Boundary Layers; The Boundary Layer Approximation; The Boundary Layer on a Flat Plate; Boundary Layer at a Stagnation Point; Boundary Layer Separation.

Week 8: Mid-Term Review and Examination

Week 9: Turbulent Viscous Flow:
Introduction; Characteristics of Turbulent Flow; Kolmogoroff Microscale of Length, Time and Velocity; Turbulent Skin Friction and Drag; Simple Models of Turbulent Mean Flow.

Week 10: Conservation of Energy:
Introduction; Incompressible Viscous Flow; The First Law of Thermodynamics; The Second Law of Thermodynamics; Derivation of the Differential Form of the First Law.

Week 11: Dimensional Analysis and Modeling:
Introduction; Dimensional Analysis; The Principle of Dimensional Homogeneity; Dimensionless Form of Conservation Laws; Modeling; Similitude; Application of Modeling; Aerodynamic Drag of Road Vehicles; The Resistance of Ships.

Week 12: Irrotational Flow
Introduction; Vorticity; Circulation; Kelvin's Theorem and Irrotationality; The Stream Function for Incompressible Flow; Plane Irrotational Flows; Entrained Mass.

Week 13: Irrotational Flow:
Superposition of Elementary Flows; Flow past a Line Source; Flow past a Line Vortex; Kutta-Joukowski Theorem; Flow over a Circular Cylinder; Line Vortex and Sink; Axisymmetric Irrotational Flows; Superposition of Axisymmetric Flows; Flow past a sphere; Flow over Airfoils and Wings.

Week 14: Review

Homework problems will be assigned weekly on blackboard prior to classes. Approximately 6-10 problems based on problems from each of chapters 1-12 of the text book will be assigned. About 50% of the mid-term and final exam problems will be based on homework problems. In the mid-term and final exams the students will be allowed to use their textbooks.

Test Dates:
Midterm Exam: TBD
Final Exam: Follow University Final Examination Calendar.