NEW COURSE PROPOSAL

College: [Engineering and Computer Science] **Department: [Mechanical Engineering]**

Note: Use this form to request a single course that can be offered independently of any other course, lab or activity.

1. **Course information for Catalog Entry**
   Subject Abbreviation and Number: **[ME 593]**
   Course Title: **[Compressible Flow]**
   Units: **[3]** units
   Course Prerequisites: **[Background equivalent to a two semester undergraduate course sequence in fluid mechanics; enrollment for graduate students only]** *(if any)*
   Course Corequisites: **[ME 501A or ME 501B]** *(if any)*
   Recommended Preparatory Courses: **[ ]** *(if any)*

2. **Course Description for Printed Catalog:** *Notes:* If grading is NC/CR only, please state in course description. If a course numbered less than 500 is available for graduate credit, please state "Available for graduate credit in the catalog description."

   [Prerequisite: Background equivalent to a two semester undergraduate course sequence in fluid mechanics; enrollment for graduate students only. Corequisite: ME 501A or ME 501B. Fundamental treatment of compressible flows including generalized one-dimensional flows, normal and oblique shock waves, Prandtl-Meyer expansion waves, unsteady waves, linearized potential flow. Method of characteristics. Hypersonic flow, high temperature and low density effects. **]**

3. **Date of Proposed Implementation: (Semester/Year): [Fall] / [2016]** *Comments*

4. **Course Level**
   []Undergraduate Only **[X]**Graduate Only **[]**Graduate/Undergraduate

5. **Course Abbreviation "Short title" (maximum of 17 characters and spaces)**
   Short Title: **[C•O•M•P• •F•L•O•W• • • • • • •]**

6. **Basis of Grading:**
   []Credit/No Credit Only **[X]Letter Grade Only** **[]CR/NC or Letter Grade**

7. **Number of times a course may be taken:**
   [X] May be taken for credit for a total of **[1]** times, or for a maximum of **[3]** units
   [ ] Multiple enrollments are allowed within a semester

8. **C-Classification:** *(e.g., Lecture-discussion (C-4).)*
   [3] units @ **[C] [5]**

9. **Replaces Current Experimental Course?**
   [ ] YES **[X]** NO
   Replaces Course Number/Suffix:**[ ]**
   Previously offered **[ ]** times.

10. Proposed Course Uses: *(Check all that apply)*

[X]Own Program: **[X]**Major **[ ]**Minor **[X]**Masters **[ ]**Credential **[ ]**Other

[ ] Requirement or Elective in another Program
[ ] General Elective
[ ] General Education, Section **[ ]**
[ ] Meets GE Information Competence (IC) Requirement
[ ] Meets GE Writing Intensive (WI) Requirement
[ ] Community Service Learning (CS)
[ ] Cross-listed with: *(List courses)* **[ ]**

11. Justification for Request: *Course use in program, level, use in General Education, Credential, or other. Include information on overlap/duplication of courses within and outside of department or program. (Attach)*

12. Estimate of Impact on Resources within the Department, for other Departments and the University. *(Attach)*
(See Resource List)

13. Course Outline and Syllabus *(Attach) Include methods of evaluation, suggested texts, and selected bibliography.* Describe the difference in expectations of graduates and undergraduates for all 400 level courses that are offered to both.

14. Indicate which of the PROGRAM'S measurable Student Learning Outcomes are addressed in this course. *(Attach)*

15. Assessment of COURSE objectives *(Attach)*

A. Identify each of the course objectives and describe how the student performance will be assessed

(For numbers 14 and 15, see Course Alignment Matrix and the Course Objectives Chart)

16. If this is a General Education course, indicate how the General Education Measurable Student Learning Outcomes (from the appropriate section) are addressed in this course. *(Attach)*

17. Methods of Assessment for Measurable Student Learning Outcomes *(Attach)*

A. Assessment tools
B. Describe the procedure dept/program will use to ensure the faculty teaching the course will be involved in the assessment process (refer to the university's policy on assessment.)

18. Record of Consultation: *(Normally all consultation should be with a department chair or program coordinator.) If more space is needed attach statement and supporting memoranda.*

Date:	Dept/College:	Department Chair/ Program Coordinator	Concur (Y/N)
[3/5/2015]	[CECM/ECS]	[N. Dermendjian]	[Y]
[3/5/2015]	[CS/ECS]	[R. Covington]	[Y]
[3/5/2015]	[ECE/ECS]	[A. Amini]	[Y]
[3/5/2015]	[ME/ECS]	[H. Johari]	[Y]

[3/5/2015]	[MSEM/ECS]	[K. Chang]	[Y]
[ ]	[ ]	[ ]	[ ]

Consultation with the Oviatt Library is needed to ensure the availability of appropriate resources to support proposed course curriculum.

Collection Development Coordinator **Date**

Please send an email to: collection.development@csun.edu **[3/5/2015]**

19. Approvals:

Department Chair/Program Coordinator:	Hamid Johari	Date:	[3/5/2015]
College (Dean or Associate Dean):	Robert Ryan	Date:	[4/15/2015]
Educational Policies Committee:		Date:	[ ]
Graduate Studies Committee:		Date:	[ ]
Provost:		Date:	[ ]

11. Justification for Request:

The proposed course is a graduate level treatment of compressible flow with emphasis on the development of fundamentals of steady and unsteady compressible flow in subsonic and supersonic regimes. There are a number of applications in aerospace and mechanical engineering that require knowledge and usage of compressible flow. The Mechanical Engineering department does not offer any graduate courses on this topic, and only a limited introduction to this subject is presented in a senior elective course ME 490. Moreover, the increased graduate enrollment in the department requires offering additional courses not only in the mechanical design but also in the thermal-fluids area. Thus, we are requesting the addition of this new fundamental course to the graduate curriculum in the Mechanical Engineering department.

12. Estimated Impact on Resources within the Department, for other Departments and the University:

One of the full-time faculty members in the Mechanical Engineering department has expertise in this area, and he will be assigned to teach this new graduate level course as part of his normal assignment. This course will be offered once every other year so students interested in compressible flow will be able to enroll in this course during their MSME program. No special laboratory or software package is needed for this course; the textbook includes access to the relevant software packages. The increased enrollment in the graduate program within the department justifies the addition of this new course. Not only does this new course provide student with knowledge in an area previously not covered in the graduate curriculum, but it also helps to relieve the strong demand for graduate level courses.

13. Course Outline and Syllabus:

ME 593 Compressible Flow

Prerequisite: Background equivalent to a two semester undergraduate course sequence in fluid mechanics; enrollment for graduate students only; Corequisite: ME 501A or ME 501B.

Textbook: Introduction to Compressible Fluid Flow – P.H. Oosthuizen and W.E. Carscallen; CRC Press, Second Edition, 2013; ISBN: 978-1439877913 (Required)

References:

Modern Compressible Flow - J.D. Anderson; McGraw Hill, Third Edition, 2003
Compressible Fluid Flow - M.A. Saad; Prentice Hall, Second Edition, 1993
Compressible-Fluid Dynamics – P.A. Thompson; McGraw-Hill, 1984

Course Content: The topics to be covered along with the time allotted are listed below:

Week	Topics
1	Introduction and motivation, review of basic thermodynamic concepts, equations of motion, continuity, and Bernoulli's equation
2	Conservation equations of inviscid flow in integral form; mass, momentum, and energy equations
3	1-D compressible flow, normal shock relations and the Hugoniot equation
4	Oblique shock waves, wedge in supersonic flow, detached shock waves
5	Mach waves, Prandtl-Meyer expansion waves, wave-boundary interactions
6	Quasi 1-D flow in nozzles and diffusers, wave reflection from free boundaries
7	Differential form of conservation equations for inviscid flow
8	Unsteady waves, moving normal shock waves, shock tube equations
9	Irrotational flow and velocity potential equations
10	Linearized small disturbance potential flow equation (subsonic and supersonic), pressure coefficient in linearized flow, critical Mach number
11	Method of characteristics for irrotational 2-D flows, introduction to numerical methods
12	Hypersonic flow and Newtonian theory
13	High temperature and low density effects

One week for the two midterm exams, and one week for review and catch-up.

Course Objectives:

A. Obtain a thorough understanding of the fundamentals of 1-D compressible flow.

B. Analyze problems involving steady and unsteady compression and expansion waves.

C. Apply the principles of linearized potential flow.

Grading: There will be quizzes, two exams and one final exam in addition to the homework assignments. The breakdown of the final grade is as follows:

Assignment	% of final grade
Quizzes	20%
Exam 1	25%
Exam 2	25%
Final	30%

Homework: Homework problems will be assigned approximately once a week and they are due in the class the following week. No late homework will be accepted.

Course Policies: Attendance is mandatory for all classes. Please bring your textbook to class. For help on homework problems, you should have tried the problem on your own first.

14. Indicate which of the Program's Measurable Student Learning Outcomes are addressed in this course:

Demonstration of MSME (Thermal-Fluid Emphasis) Program Outcomes in course
1. Have a firm understanding of the physical principles which govern the behavior of fluid flow and energy transfer.
2. Be able to solve complex thermal-fluids problems using both analytical and computational methods.

15. Assessment of COURSE objectives

The three course objectives listed in the course outline are assessed through the homework and examinations in addition to the project. The alignment of the course objectives and the student assessment tools is shown in the table below.

Course Objectives	Assessments of Student Performance
1. Obtain a thorough understanding of the fundamentals of 1-D compressible flow.	Quizzes, examinations and homework assignments
2. Analyze problems involving steady and unsteady compression and expansion waves.	Quizzes, examinations and homework assignments
3. Apply the principles of linearized potential flow.	Quizzes, examinations and homework assignments

16. Not Applicable

17. Methods of Assessment for Measurable Student Learning Outcomes:

A. Assessment Tools

Homework assignments, quizzes, and examinations.

COURSE ALIGNMENT MATRIX

Assess how well ____ME 593____ contributes to the program's student learning outcomes by rating each course objective for that course with an I, P or D.

I=introduced (basic level of proficiency is expected)
P=practiced (proficient/intermediate level of proficiency is expected)
D=demonstrated (highest level/most advanced level of proficiency is expected)

Course Objectives	Student Learning Outcome 1 Have a firm understanding of the physical principles which govern the behavior of fluid flow and energy transfer	Student Learning Outcome 2 Be able to solve complex thermal-fluids problems using both analytical and computational methods
1. Obtain a thorough understanding of the fundamentals of 1-D compressible flow.	D	D
2. Analyze problems involving steady and unsteady compression and expansion waves.	D	D
3. Apply the principles of linearized potential flow.	P	P

B) Describe the procedure dept/program will use to ensure the faculty teaching the course will be involved in the assessment process

The ME Department has developed a Course Evaluation Form which is used by all full-time and part-time faculty members to evaluate program outcomes and course objectives. All mechanical engineering courses are evaluated according to a defined schedule. The form template is attached.

Mechanical Engineering - Course Evaluation Form

Course Number: **Instructor:** **Semester/year:**

The purpose of this is form is to document the achievement of course objectives and program outcomes in the courses that you instruct. Answers to the questions below should cite supporting evidence from your own observations, student performance on assignments and examinations, and other feedback.

☐ **First time course taught by this instructor** ☐ **Course taught previously**

Course prerequisite(s) _____ _____ _____

- **Were the students adequately prepared by prerequisite courses?** **Yes** ☐ **No** ☐

- Were changes implemented since the last time this course was taught? **Yes** ☐ **No** ☐

If Yes, what changes were made since the last time this course was taught? Did these changes improve the course?

Changes made since last time	*Effects of change*

- Are changes called for the next time this course is taught? **Yes** ☐ **No** ☐

If Yes, what changes should be made the next time this course is taught?

Changes recommended for next time	*Purpose of changes*

Most useful comments from students:

Achievement of Course Objectives/Demonstration of Program Outcomes

Did the students demonstrate achievement of the course objectives and program outcomes specific to this course? In the table below, rate achievement of objectives/outcomes using evidence from direct assessment of student work, student surveys, etc.

If sampling, please indicate the approximate percent of the class sampled:
Use assessment rubrics for determining program outcome assessment

Course Objectives/Program Outcomes *List Course Objectives first, followed by Program Outcomes*	*Means of Direct Assessment by Instructor—what evidence was used for your assessment?*	*Instructor's Direct Outcome Assessment* *4=Excellent to 0=Poor*	*Improved (yes/no/??) compared to last year*