APPLICATION FOR NEW COURSE

1. Submitted by College of: Engineering
   Date: April 5, 2005
   Department/Division offering course: Mechanical Engineering

2. Proposed designation and Bulletin description of this course
   a. Prefix and Number: ME 692
   b. Title: CFD II - Compressible Flows
      *NOTE: If the title is longer than 24 characters (including spaces), write
      A sensible title (not exceeding 24 characters) for use on transcripts

   c. Lecture/Discussion hours per week: 3
   d. Laboratory hours per week: 0
   e. Studio hours per week: 3
   f. Credits: 3

   g. Course description:
      See: attached.

   h. Prerequisites (if any):
      ME 531 and ME 691

   i. May be repeated to a maximum of: 0
      (if applicable)

4. To be cross-listed as: n/a

5. Prefix and Number: Signature, Chairman, cross-listing department
   Effective Date: Fall 2005
   (semester and year)

6. Course to be offered: ☐ Fall ☐ Spring ☐ Summer

7. Will the course be offered each year?
   (Explain if not annually):
   ☐ Yes ☐ No
   This course will be offered every other year because it is an optional third course for the Ph.D. qualifying exam.

8. Why is this course needed?
   This course has become a standard course of the Thermo-fluids area and it has been offered in many universities
   as a core course.

9. a. By whom will the course be taught? Departmental Faculty

   b. Are facilities for teaching the course now available?
      If not, what plans have been made for providing them?
      ☐ Yes ☐ No

   ________________________________
   Nov 15, 2005
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10. What enrollment may be reasonably anticipated?  _____

11. Will this course serve students in the Department primarily?  
   ☑ Yes ☐ No
   Will it be of service to a significant number of students outside the Department?  
   ☑ Yes ☐ No
   Students from chemical, civil, mining, and biomedical engineering will also take this course.

12. Will the course serve as a University Studies Program course?  
   ☐ Yes ☑ No
   If yes, under what Area?  

13. Check the category most applicable to this course
   ☑ traditional; offered in corresponding departments elsewhere;
   ☐ relatively new, now being widely established
   ☐ not yet to be found in many (or any) other universities

14. Is this course applicable to the requirements for at least one degree or certificate at the 
   University of Kentucky?  
   ☑ Yes ☐ No

15. Is this course part of a proposed new program?  
   If yes, which?  
   ☐ Yes ☑ No

16. Will adding this course change the degree requirements in one or more programs?*  
   If yes, explain the change(s) below

17. Attach a list of the major teaching objectives of the proposed course and outline and/or reference list to be used.

18. If the course is a 100-200 level course, please submit evidence (e.g., correspondence) that the Community College System has 
   been consulted.  

19. If the course is 400G or 500 level, include syllabi or course statement showing differentiation for undergraduate and graduate 
   students in assignments, grading criteria, and grading scales.  

Within the Department, who should be contacted for further information about the proposed course?

Name  George Huang  Phone Extension  257-6336, ext. 80640

*NOTE: Approval of this course will constitute approval of the program change unless other program modifications are proposed.
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Signatures of Approval:

[Signature]

Department Chair

[Signature]

Dean of the College

Approved at Department of Mechanical Engineering Faculty Meeting of April 20, 2005. Vote: unanimous.

*Undergraduate Council

Date

*University Studies

Date

*Graduate Council

Date

*Academic Council for the Medical Center

Date

*Senate Council (Chair)

Date of Notice to University Senate

*If applicable, as provided by the Rules of the University Senate

ACTION OTHER THAN APPROVAL
University of Kentucky
Department of Mechanical Engineering
ME692 – Computational Fluid Dynamics II

Fall semester, 2003
RGAN room 202
Monday and Wednesday 5:00-6:15pm

Instructor: Professor George Huang
161 RGAN
Phone: 257-6336 ext 80640
Email: ghuang@engr.uky.edu

Office Hours: Mon. & Wed. 3:00pm-5:00pm
I will turn on MSN Messenger during the office hours. My MSN ID is
uk_mel@msn.com.

Prerequisites: ME531 & ME691 CFD I. You need to get an approval from me to take
the course should you not take ME531 and ME691.

Course Description:
In this second course, we shall focus on the solution of the compressible Navier-Stokes
equations. The Van-Leer’s and Roe’s approaches will be discussed to derive the
discretization equations. Modern shock capturing schemes, such as FCT, TVD and ENO
will be introduced. The solution techniques such as ADI, DDADI and line-relaxation will
be used to solve the system of equations. Multi-grid acceleration techniques will be
introduced to speed up the rate of convergence. Finally, the parallelization of CFD
codes using shared and distributed computers will be discussed.

Text:
No text is available to cover the materials to be presented in the course. Students have to
keep a good and neat course note. Handouts will be distributed as needed.

Anticipated Outcomes:
(1) Develop and apply appropriate forms of momentum, heat and mass conservation
laws for high speed flows,
(2) Master the numerical solution of compressible Navier Stokes equations
(3) Use of high order shock capturing schemes
(4) Understand modern algorithms for the solution of gas dynamic equations
(5) Write FORTRAN95 CFD programs to solve practical flow problems
(6) Understand PC cluster hardware
(7) Use MPI to write parallel codes for fluid dynamics applications
Projects:

There will be 4 homework projects and all projects will be considered comprehensive. The students have to derive all basic governing equations, write FORTRAN90 programs, plot results using TECPLOT and submit the final report using Word. Students will be assigned in class to give a presentation of their projects using PowerPoint.

Grading Policy:

There will be 4 projects with 15% each. You may submit an incomplete project to get partial credits. Mid term and final exam will be 20% each.

85-100       A
75-84        B
65-74        C
55-64        D
below        E

Material covered:

1. Governing equations for compressible flows
2. Classification of flows
   a. Perfect gas
   b. Reynolds-averaged equations
   c. Thin-shear-layer approximations
   d. Elliptic equations
   e. Parabolic equations
   f. Hyperbolic equations
3. Discretization of compressible equations in a finite volume
   a. Discretization of Euler equations
   b. Transformation of the conservative variables to Riemann variables
   c. Upwind Schemes for Euler equations
   d. High order schemes
   c. Flux vector splitting and Roe’s averaging method
4. Solvers
   a. Block tridiagonal solvers
   b. ADI
   c. DDADI
   d. Multigrid techniques
5. Shock capturing
   a. Upwind scheme
   b. High order scheme
   c. FCT, TVD, ENO and WEND
6. Treatment of boundary conditions
7. Parallel processing – Hardware and software implementations.