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 691 _______________________________

   b. Title* CFD I - Incompressible 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 _______________________________

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

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

   Prefix and Number _______________________________

   Signature, Chairman, cross-listing department _______________________________

5. 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 _______________________________

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 _______________________________

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10. What enrollment may be reasonably anticipated? 10

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

If so, explain.

Students from chemical, civil, mining, and biomedical engineering will also take this course.

Will the course serve as a University Studies Program course? □ Yes □ No

If yes, under what Area?

12. 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

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

14. Is this course part of a proposed new program: If yes, which? □ Yes □ No

15. Will adding this course change the degree requirements in one or more programs?* □ Yes □ No

If yes, explain the change(s) below

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

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

18. 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. □

19. 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:

Department Chair

Dean of the College

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

*Undergraduate Council

*University Studies

*Graduate Council

*Academic Council for the Medical Center

*Senate Council (Chair)

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

Date of Notice to University Senate

ACTION OTHER THAN APPROVAL

Rev 8/02
University of Kentucky
Department of Mechanical Engineering
ME691 – Computational Fluid Dynamics I

Fall semester, 2005
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_me1@msn.com.

Prerequisites: ME531. You need to get an approval from me to take the course should
you not take ME531.

Course Description:

In this course, we will cover a control-volume CFD approach for the conservation of
momentum, heat and mass transfer. The emphasis will be on the discretization of the
transport equations in general coordinates and its application in both structured and
unstructured grid arrangements. Modern numerical schemes and pressure solution
algorithms will also be covered. An introduction of turbulence modeling will be
provided. At the end of the lecture, the students not only are able to understand the
basics of commercial software but also will be able to write a general coordinate code for
fluid flow, heat and mass transfer applications.

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. Familiar with UK’s UNIX operating system
2. Develop and apply appropriate forms of momentum, heat and mass conservation
   laws to various practical design situations.
3. Good knowledge of basics of CFD as used in commercial software
4. Skillful in using FORTRAN90 to write CFD codes
5. Use TECPLLOT to present results and draw important conclusions from the results
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 TECPLLOT 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

Training:

UNIX: (1) http://darkstar.ucd.ie/~timosh/help/unix2.html
      (2) http://www.acns.fsu.edu/docs/unix_index.html/
      (3) http://www.comet.ucar.edu/sac/hphelp.html

Tecplot: (1) http://www.esc.uiuc.edu/computers/tecpot.html
         (2) http://www.amtec.com/Service_pages/tecpot_doc.html
         (3) http://www.msi.umn.edu/software/tecpot/tutorial/getting-started.html

FORTRAN 90: (1) http://www.fortran.com/fortran/tutorials.html
            (2) http://www.nsc.liu.se/~boe/fort77to90/f77to90.html
            (3) http://www.man.ac.uk/hpc/teclo/courses/Fortran90/F90course.html

Material covered:

1. Governing equations in conservative forms
   a. Continuity equations
   b. Momentum equations
   c. Energy equations
2. General coordinates in 2- and 3-D
3. Discretization of governing equations in general coordinates
   a. Diffusion (conduction) terms
   b. Convection terms
   c. Source terms
   d. Inhomogeneous materials
   e. Low and high order schemes
i. Upwind differencing scheme
ii. Central differencing scheme
iii. QUICK
f. Boundary conditions

4. Implicit and explicit solution methods
   a. Runge Kutta
   b. Point approaches
   c. Line solvers
   d. LU decompositions

5. Pressure Correction methods
   a. Projection method
   b. SIMPLE
   c. PISO
   d. SIMPLER

6. Unsteady flow simulations
   a. Treatments of time-derivative terms
   b. 1st order vs. high order
      i. Upwind
      ii. ADI
      iii. Crank-Nicolson
      iv. 2nd order three-point backward

7. Turbulence models
   a. Zero, one and two equation models
   b. Reynolds and algebraic stress transport models
   c. DES, LES and DNS