UK

UNIVERSITY OF KENTUCKY

To: Kaveh Tagavi
        University Senate Council

From: Jeannine Blackwell, Dean
        The Graduate School

Date: January 19, 2007

At its meeting on January 18, 2007 the Graduate Council approved the proposal for the Graduate Certificate in Computational Fluid Dynamics.

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UNIVERSITY OF KENTUCKY

October 25, 2006

MEMORANDUM

TO: Dr. Jeannine Blackwell
        Graduate Council

FROM: Dr. Donn Hancher, Associate Dean

Below is an item for consideration by the Graduate Council. The corresponding proposal can be viewed at:

http://www.engr.uky.edu/proposed_changes/pending/

	Type	Effective Date
Graduate Certificate in Computational Fluid Dynamics	New	Spring 2007

We appreciate your consideration of this request.

An Equal Opportunity University

January 23, 2006

TO: Rosa Hicks, Engineering Student Records

FROM: Dr. Eric Grulke, Associate Dean for Research and Graduate Studies

SUBJECT: Graduate Certificate in Computational Fluid Dynamics

Attached is a proposal submitted by Dr. James McDonough, mechanical engineering, to create a Graduate Certificate in Computational Fluid Dynamics in the College of Engineering. The program will be available to all graduate students in Engineering and the Mathematical, Physical and Biological Sciences at the University of Kentucky.

The proposed certificate program will be a minimum of 12 credit hours in length and represents a collaborative effort between the Department of Mechanical Engineering and various other departments within the College of Engineering and the College of Arts and Sciences at UK.

Dr. McDonough will be the Director of this graduate certificate. Associates will be drawn from numerous departments reflecting the interdisciplinary nature of this endeavor. Additional details on the certificate can be found on the attached.

This proposal has been reviewed by the College of Engineering's Graduate Studies Team and was approved unanimously. I concur with their decision and ask that you approve this request.

_____   _____
Dean of College   Date of notice to faculty

Proposal for Graduate Certificate in Computational Fluid Dynamics

Purpose. This proposal is for the establishment of a Graduate Certificate in Computational Fluid Dynamics (CFD) available, in principle, to all graduate students in Engineering and the Mathematical, Physical and Biological Sciences at the University of Kentucky. It will be a minimum of 12 units in length and represents a collaborative effort between the Department of Mechanical Engineering and various other departments within the College of Engineering and the College of Arts and Sciences at UK.

Background. Computational fluid dynamics is by now a generally recognized subdiscipline of fluid dynamics, complementing (and now often supplanting) use of theory and experimentation in the analysis of fluid behavior from sub-micro scales to intergalactic cosmological scales. CFD is highly interdisciplinary, as hinted by the accompanying figure, and due to this it can be approached for study from a number of different directions; correspondingly, its potential applications are essentially unlimited. Examples that are currently of very high interest include biological flows (*e.g.*, air in respiratory systems and blood in circulatory systems of animals), flows in porous media (*e.g.*, remediation of contaminated ground water, extraction of oil from marginal deposits), and combusting flows (*e.g.*, higher energy conversion efficiencies, lower pollutant production). Thus, competency in the use of CFD is becoming critical to the advance of science and technology in the 21st Century.
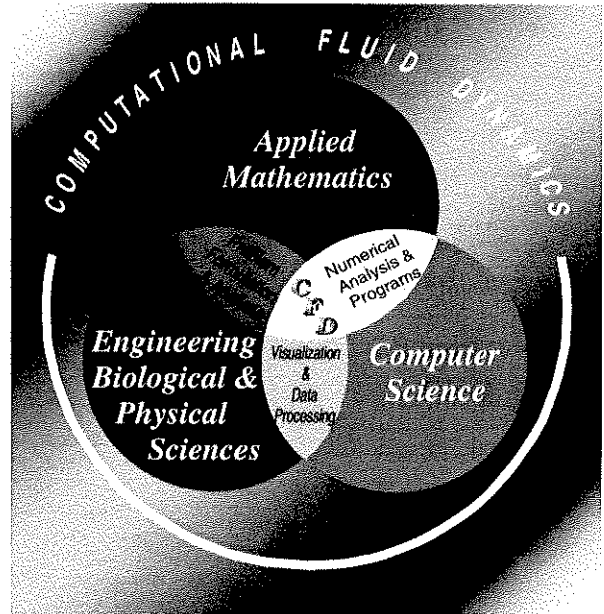
It is of interest to further note that the term "computational fluid dynamics" actually originated at the University of Kentucky, appearing in the title of a book written by a visiting researcher in Mechanical Engineering, P. Roache, in 1971, and which now is considered a classic reference. Yet, to this day, UK has no formal program in this very important field. This proposed Graduate Certificate represents an attempt to at least minimally address this shortcoming.

Director. The Director of the Graduate Certificate in CFD will be Professor J. M. McDonough of the Department of Mechanical Engineering, who also holds a secondary appointment in the Department of Mathematics. Dr. McDonough has performed analyses via CFD since the mid 1970s, initially in an industrial setting, and has been teaching CFD and related courses since 1980—first at UCLA and then, beginning in 1990, at UK. He is well qualified to make decisions regarding qualifications of applicants for the CFD Graduate Certificate and to advise them on appropriate courses of study.

Associates. Associates will be drawn from numerous departments reflecting the interdisciplinary nature of this endeavor. At a minimum, the list of Associates will be comprised of: Prof. Tate Tsang (Chemical and Materials Engineering), Prof. Scott Yost (Civil Engineering), Prof. Craig Douglas (Computer Science, with secondary appointment in Mechanical Engineering), Prof. Zhongwei Shen and Prof. Qiang Ye (Mathematics), Prof. George Huang and Prof. Raymond LeBeau (Mechanical Engineering), and Prof. Isaac Shlosman (Physics and Astronomy). While this list of associates must not be viewed as permanent,

it should be clear that the ability to present a broad spectrum of interdisciplinary CFD-related courses is easily attainable.

Admission Requirements. Admission to eligibilty for a Graduate Certificate in CFD follows the same minimum requirements as apply to admission to the Graduate School of UK. In particular, any student currently accepted, or enrolled, in the Graduate School in graduate student, post-baccalaureate, or university scholar status will be considered for admission.

Graduate Certificate Requirements (General). As required by the Graduate School, a student must maintain a minimum GPA of 3.0 in the set of courses required for completion of the Graduate Certificate. In addition, a grade of C will be permitted only in fewer than one half of the total units a student wishes to apply toward the certificate, and no more than one half of the certificate units may be satisfied with 4XXG and/or 500-level courses.

Course Requirements. Course work applied to satisfy the minimum 12 unit requirement will be selected from three categories: *i*) basic mathematics/numerical analysis, *ii*) specific CFD and CFD-related courses and *iii*) independent studies and "Topics" courses in closely related fields. A minimum of <u>one</u> course must be selected from category *i*), and a minimum of <u>two</u> courses must come from the second category. <u>One</u> course will be permitted from category *iii*) but is not required. Lists of courses in each of these categories follow.

Math/Numerical Analysis	*CFD/CFD-Related*	*Topics/Indep. Studies*
MA/CS/EGR 537 MA 625 ME 690	ME 691 ME 692 ME 69X*	ME 599 ME 699 ME 780
MA 471G MA 481G MA 483G MA 522 MA 622 MA 633	ME 530 ME 531 ME 631 ME 634	Analogous courses from other departments

* We note that the course ME69X is a more fundamental incompressible CFD course appropriate mainly for doctoral students with superior mathematics backgrounds. This has previously been taught as a ME 699 Topics course but will be submitted for regular course status with the course number and title ME 693, Mathematical & Algorithmic Foundations of Incompressible CFD.

Courses shown above the dashed line in the table are to be viewed as the core courses of the CFD Graduate Certificate curriculum, and most students, especially those from Mechanical Engineering, would be expected to construct their course sequence mainly from these with the help of their graduate advisor and the CFD Certificate Director. On the other hand, because of the interdisciplinary nature of CFD, students from outside of Engineering may wish to apply a somewhat different curriculum toward receiving a certificate. For example, a student from Mathematics might find it worthwhile to take ME 531, a basic fluid dynamics course emphasizing analysis of viscous incompressible flows, before taking either ME 691

or ME 693, the corresponding CFD courses. Similarly, a student from astrophysics might benefit by taking ME 530 (gas dynamics) before enrolling in the compressible CFD course ME 692.

Finally, we note that the purpose of the individual study and topics courses is to address two main issues. First, there are specific recognized deficiencies in our current CFD curriculum. Specific examples of this are lack of courses in which so-called "grid generation" is taught (although a minimal amount of this is covered in ME 690), and similarly no courses in which use of commercial CFD codes, as widely employed world wide in industry, is specifically taught. But at present, we believe these subjects can be handled in independent studies and topics courses.

Award of Certificate. When a student enrolled in the UK Graduate School has successfully completed the last required course for the CFD Graduate Certificate and has satisfied the above-stated GPA requirements, the Director shall send a completed, signed Graduate Certificate Completion Form to the Dean of the Graduate School verifying that the student has fulfilled all requirements for the certificate and requesting award thereof. The Graduate School shall then issue the student's certificate and officially notify the University Registrar of award of the certificate for posting to the student's permanent transcript.

ARTS AND SCIENCES
EDUCATIONAL POLICY COMMITTEE
INVESTIGATOR REPORT

INVESTIGATING AREA: **Natural & Math. Sci.**   COURSE, MAJOR, DEGREE or **PROGRAM**: **Graduate certificate in computational fluid dynamics** _____ .

DATE FOR EPC REVIEW: **3/6/07**   CATEGORY: **NEW**, CHANGE, DROP

INSTRUCTIONS: This completed form will accompany the course application to the Graduate/Undergraduate Council(s) in order to avoid needless repetition of investigation. The following questions are included as an outline only. Be as specific and as brief as possible. If the investigation was routine, please indicate this. The term "course" is used to indicate one course, a series of courses or a program, whichever is in order. Return the form to **Leonidas Bachas Associate Dean, 275 Patterson Office Tower** for forwarding to the Council(s). ATTACH SUPPLEMENT IF NEEDED.

1. List any modifications made in the course proposal as submitted originally and why. **No changes were made.**

2. If no modifications were made, review considerations that arose during the investigation and the resolutions. **This graduate certificate involves only Mathematics in A&S and its impact on math was considered slight.**

3. List contacts with program units on the proposal and the considerations discussed therein. **Dr Zhongwei Shen, Mathematics, one of the participants in the program, shared the opinion that the program is worthwhile and will not affect department of Mathematics unduly.**

4. Additional information as needed. **None**

5. A&S **Area Coordinator** Recommendation:

    APPROVE, APPROVE WITH RESERVATION, OR DISAPPROVE

6. A&S **Education Policy Committee** Recommendation:

    APPROVE, APPROVE WITH RESERVATION, OR DISAPPROVE

7. _____   Date: **3/07/07**
    A&S Educational Policy Committee, **Phil Bonner**

File: \InvestigatorRpt

UNIVERSITY SENATE ROUTING LOG

Proposal Title: Graduate Certificate in Computational Fluid Dynamics

Name/email/phone for proposal contact:

James M. McDonough / jmmcd@uky.edu / 7-6336 x80657

Instruction: To facilitate the processing of this proposal please identify the groups or individuals reviewing the proposal, identify a contact person for each entry, provide the consequences of the review (specifically, approval, rejection, no decision and vote outcome, if any) and please attach a copy of any report or memorandum developed with comments on this proposal.

Reviewed by: (Chairs, Directors, Faculty Groups, Faculty Councils, Committees, etc)	Contact person Name (phone/email)	Consequences of Review:	Date of Proposal Review	Review Summary Attached? (yes or no)
Mechanical Engineering Dept Faculty	Dr. Keith Rouch (krouch@engr.uky.edu)	Approved	09/21/05	No
College of Engineering Graduate Studies Team	Dr. Eric Grulke (egrulke@engr.uky.edu)	Approved	09/14/06	Yes
Mathematics Dept. Faculty	Dr. David Leep (chair@ms.uky.edu)	Approved	04/21/06	Yes No
College of Arts & Sciences	Phil Berger	Approved	03/07/07	No
Graduate Council	Dr. Peter Hislop (hislop@ms.uky.edu)	Approved (unanimously)	01/19/07	Yes

From:	Robert B. Grossman [robert.grossman@uky.edu]
Sent:	Friday, April 20, 2007 1:23 PM
To:	Brothers, Sheila C
Subject:	Re: Grad Cert in CFD-Routing Log Received

The APC approves the proposal unanimously.

Good afternoon, Bob! Please find attached a new version of the proposal for a new graduate certificate in computational fluid dynamics. The routing information is on the last two pages of the proposal.

The updated proposal is also available at http://www.uky.edu/USC/New/AcadProgramsComm.htm.

If I can get this from you by April 20, it can get approved this semester. (That assumes, obviously, that the cmte approves it.)

Sheila

Sheila Brothers

Office of the Senate Council

Administrative Coordinator

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sheila.brothers@uky.edu

http://www.uky.edu/USC/New

Content-Type: application/octet-stream;
name="Computational Fluid Dynamics New Grad Cert_Complete.pdf"
Content-Description: Computational Fluid Dynamics New Grad Cert_Complete.pdf
Content-Disposition: attachment;
    filename="Computational Fluid Dynamics New Grad Cert_Complete.pdf"

Attachment converted: CP-339 iMac:Computational Fluid #2307E8.pdf (PDF /prvw)
(002307E8)