FORMAT 1
Submit original with signatures + 3 copies

TRIAL COURSE OR NEW COURSE PROPOSAL

SUBMITTED BY:

Department	Mechanical Engineering	College/School	College of Engineering & Mines
Prepared by	Debendra K. Das	Phone	907-474-6094
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See http://www.uaf.edu/uafgov/faculty/cd/cdman.html for a complete description of the rules governing curriculum & course changes.

1. ACTION DESIRED (check one):	Trial Course		New Course	X		
2. COURSE IDENTIFICATION:	Dept	ME	Course #	F443/ F643	No. of Credits	3
Justify upper/lower division status & number of credits:	Materials to be covered in this course are beyond the first level courses in fluid mechanics and heat transfer. The course content will be of the standard intended for the senior and graduate level students. Students taking this course for graduate credits will be required to do additional project and home work as explained under the section on JUSTIFICATION.					
3. PROPOSED COURSE TITLE:	Fluid Mechanics and Heat Transfer Characteristics of Nanofluids					
4. CROSS LISTED? YES/NO	NO	If yes, Dept:		Course #		
(Requires approval of both departments and deans involved. Add lines at end of form for such signatures.)						
5. STACKED? YES/NO	YES	If yes, Dept.	Mechanical Engineering	Course #	F443/ F643	
6. FREQUENCY OF OFFERING:	As demand warrants					
	(Every or Alternate) Fall, Spring, Summer -- or As Demand Warrants					
7. SEMESTER & YEAR OF FIRST OFFERING (if approved)	Fall 2011					

8. COURSE FORMAT:

NOTE: Course hours may not be compressed into fewer than three days per credit. Any course compressed into fewer than six weeks must be approved by the college or school's curriculum council. Furthermore, any core course compressed to less than six weeks must be approved by the core review committee.

COURSE FORMAT: (check one)		*1*		*2*		*3*		*4*		*5*	X *6 weeks to full semester*
OTHER FORMAT (specify)											
Mode of delivery (specify lecture, field trips, labs, etc)	Lecture										

9. CONTACT HOURS PER WEEK:	3	LECTURE hours/weeks		LAB hours /week		PRACTICUM hours /week

Note: # of credits are based on contact hours. 800 minutes of lecture=1 credit. 2400 minutes of lab in a science course=1 credit. 1600 minutes in non-science lab=1 credit. 2400-4800 minutes of practicum=1 credit. 2400-8000 minutes of internship=1 credit. This must match with the syllabus. See http://www.uaf.edu/uafgov/faculty/cd/credits.html for more information on number of credits.

OTHER HOURS (specify type)	Office hours 3. For questions and answers plus discussions on homeworks

10. COMPLETE CATALOG DESCRIPTION including dept., number, title and credits (50 words or less, if possible):

ME F443/F643 Fluid Mechanics and Heat Transfer Characteristics of Nanofluids

3 Credits

Description of nanofluids, nanostructured materials and dispersion in base fluids. Thermophysical properties: density, viscosity, thermal conductivity and specific heat. Theoretical equations and empirical correlations for properties. Principles of measurements of properties. Fluid dynamic losses and pumping power required for nanofluid flow in heat transfer systems. Experimental methods of determining the convective heat transfer coefficient of nanofluids. Practical application to heat exchangers in industries. Nanofluids flows in mini and microchannel.

11. *COURSE CLASSIFICATIONS:* (undergraduate courses only. Use approved criteria found on Page 10 & 17 of the manual. If justification is needed, attach on separate sheet.)

H = Humanities		N = Natural Science		S = Social Sciences	

Will this course be used to fulfill a requirement for the baccalaureate core? YES [ ] NO [X]

IF YES, check which core requirements it could be used to fulfill:

O = Oral Intensive, Format 6		W = Writing Intensive, Format 7		Natural Science, Format 8	

12. *COURSE REPEATABILITY:*

Is this course repeatable for credit? YES [ ] NO [X]

Justification: Indicate why the course can be repeated (for example, the course follows a different theme each time).

How many times may the course be repeated for credit? [ ] TIMES

If the course can be repeated with variable credit, what is the maximum number of credit hours that may be earned for this course? [ ] CREDITS

13. *GRADING SYSTEM:*

LETTER: [X] PASS/FAIL: [ ]

RESTRICTIONS ON ENROLLMENT (if any)

14. *PREREQUISITES*: ES 341 and ME 441 or their equivalent from other universities; or the permission of the instructor. For ME F643, graduate standing, For ME F443, senior standing

These will be *required* before the student is allowed to enroll in the course.

RECOMMENDED:

Classes, etc. that student is strongly encouraged to complete prior to this course.

15. *SPECIAL RESTRICTIONS, CONDITIONS*: None

16. *PROPOSED COURSE FEES*: $0

Has a memo been submitted through your dean to the Provost & VCAS for fee approval? Yes/No

17. *PREVIOUS HISTORY*

Has the course been offered as special topics or trial course previously? Yes/No: Yes

If yes, give semester, year, course #, etc.: Spring 2009,ME F493/F693(special topics) Fall 2004 and Sp. 2008 ME 697 (Indep. Study)

18. *ESTIMATED IMPACT*

WHAT IMPACT, IF ANY, WILL THIS HAVE ON BUDGET, FACILITIES/SPACE, FACULTY, ETC.

Impacts on budget, facility and space are minimal. Impact on the faculty, teaching this new subject matter will be beneficial. With the growth of nanotechnology, other faculty members may be interested in teaching the course and be involved in the research in this area in the future

19. *LIBRARY COLLECTIONS*

Have you contacted the library collection development officer (ffklj@uaf.edu, 474-6695) with regard to the adequacy of library/media collections, equipment, and services available for the proposed course? If so, give date of contact and

resolution. If not, explain why not.

No		Yes	X	I have contacted Karen Jensen of our library over the past 5 years ordering many books on this subject. Currently we have over 20 references on this topic that will be more than sufficient for this course.

20. IMPACTS ON PROGRAMS/DEPTS

What programs/departments will be affected by this proposed action?
Include information on the Programs/Departments contacted (e.g., email, memo)

This proposed course will have a positive impact on the Mechanical Engineering program in the arena of teaching and research. It will expose the students to a new area, which promises vast advancement in the future. Our recently introduced, 5-years fast track MS program students will have the opportunity to perform MS thesis research in this new area.

21. POSITIVE AND NEGATIVE IMPACTS

*Please specify **positive and negative** impacts on other courses, programs and departments resulting from the proposed action.*

The positive impact to the mechanical engineering department expressed under Item 20 may someday spread to Petroleum Engineering (e.g. enhanced viscosity of drilling mud), Alaska Space Grant projects (e.g. cooling of electronic circuits) , and fluid flow applications in civil, environmental, geological and mining engineering (e.g. in solutions of environmental problems). Wherever, there are fluid flows, nanofluids may find applications in those areas to improve the performance of engineering systems and find engineering solutions.

No negative impact is envisioned.

JUSTIFICATION FOR ACTION REQUESTED

The purpose of the department and campus-wide curriculum committees is to scrutinize course change and new course applications to make sure that the quality of UAF education is not lowered as a result of the proposed change. Please address this in your response. This section needs to be self-explanatory. Use as much space as needed to fully justify the proposed course.

Nanotechnology is rapidly evolving and is a desirable area of study for our students for their future careers and jobs. The innovative energy, electronics, aerospace, defense and security industries plus the federal labs in US Dept. of Defense, US Dept. of Energy, NASA are looking for trained engineers in this field. This course will provide the foundation needed for the students to pursue careers in such organizations. Introducing this course keeps our university in par with other US universities who are now teaching courses on nanoscience and nanotechnology. The quality of UAF education will be enriched by introducing this timely subject. Research emphasis in this area is growing. Therefore, our seniors and graduate students trained in this area will enhance the research capability at UAF.

The students taking this course for graduate credit (F643) will be required to devote a higher level of effort and performance in comparison to those who are taking it for the undergraduate credits (F443). For graduate credits, the students will be required to complete a project based upon their independent research on a topic in the area of nanoscience or nanotechnology. This topic should be their own selection or one suggested by the instructor. They will be required to submit a project report and make an oral presentation in the last week of the class. Additionally, more involved homework problems requiring some research and thought provoking analysis will be assigned for graduate (F643) credits.

APPROVALS:

Signature, Chair, Program/Department of:	Mechanical Engineering	Date 2/18/2011
Signature, Chair, College/School Curriculu Council for:	CEM	Date 2/18/11
Signature, Dean, College/School of:	CEM	Date 2/22/11
Signature of Provost (if applicable)		Date

Offerings above the level of approved programs must be approved in advance by the Provost.

ALL SIGNATURES MUST BE OBTAINED PRIOR TO SUBMISSION TO THE GOVERNANCE OFFICE

Signature, Chair, UAF Faculty Senate Curriculum Review Committee	Date

ADDITIONAL SIGNATURES: (If required)

Signature, Chair, Program/Department of:		Date
Signature, Chair, College/School Curriculu Council for:		Date
Signature, Dean, College/School of:		Date

ATTACH COMPLETE SYLLABUS (as part of this application).
Note: syllabus must follow the guidelines discussed in the Faculty Senate Guide http://www.uaf.edu/uafgov/faculty/cd/syllabus.html.
The department and campus wide curriculum committees will review the syllabus to ensure that each of the items listed below are included. If items are missing or unclear, the proposed course change will be denied.

SYLLABUS CHECKLIST FOR ALL UAF COURSES
During the first week of class, instructors will distribute a course syllabus. Although modifications may be made throughout the semester, this document will contain the following information (as applicable to the discipline):

1. **Course information:**
   ❑Title, ❑ number, ❑credits, ❑prerequisites, ❑ location, ❑ meeting time (make sure that contact hours are in line with credits).
2. **Instructor (and if applicable, Teaching Assistant) information:**
   ❑ Name, ❑ office location, ❑ office hours, ❑ telephone, ❑ email address.
3. **Course readings/materials:**
   ❑ Course textbook title, ❑ author, ❑ edition/publisher.
   ❑ Supplementary readings (indicate whether ❑ required or ❑ recommended) and
   ❑ any supplies required.
4. **Course description:**
   ❑ Content of the course and how it fits into the broader curriculum;
   ❑ Expected proficiencies required to undertake the course, if applicable.
   ❑ Inclusion of catalog description is *strongly* recommended, and
   ❑ Description in syllabus must be consistent with catalog course description.
5. ❑ **Course Goals (general) and ❑ Student Learning Outcomes (more specific)**
6. **Instructional methods:**
   ❑ Describe the teaching techniques (eg: lecture, case study, small group discussion, private instruction, studio instruction, values clarification, games, journal writing, use of Blackboard, audio/video conferencing, etc.).
7. **Course calendar:**
   ❑ A schedule of class topics and assignments must be included. Be specific so that it is clear that the instructor has thought this through and will not be making it up on the fly (e.g. it is not adequate to say ''lab''. Instead, give each lab a title that describes its content). You may call the outline Tentative or Work in Progress to allow for modifications during the semester.
8. **Course policies:**
   ❑ Specify course rules, including your policies on attendance, tardiness, class participation, make-up exams, and plagiarism/academic integrity.
9. **Evaluation:**
   ❑ Specify how students will be evaluated, ❑ what factors will be included, ❑ their relative value, and
   ❑ how they will be tabulated into grades (on a curve, absolute scores, etc.)
10. **Support Services:**
    ❑ Describe the student support services such as tutoring (local and/or regional) appropriate for the course.
11. **Disabilities Services:**
    The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials.
    ❑ State that you will work with the Office of Disabilities Services (203 WHIT, 474-7043) to provide reasonable accommodation to students with disabilities.''

SYLLABUS-ME F443/F643 – FLUID MECHANICS AND HEAT TRANSFER CHARACTERISTICS OF NANOFLUIDS, FALL 2011

Department: Mechanical Engineering; 3 credits
Prerequisites: ES 341 and ME 441 or their equivalent from other universities; or the permission of the instructor
Class Room: Duckering XXX
Contact hours: XXXXX, three hours lecture per week
Office hours: XXXXX, three hours per week
Instructor: Dr. Deben K. Das, Duckering 327, Telephone No. 474-6094; dkdas@alaska.edu

Course Textbook: Microscale and Nanoscale Heat Transfer (2008) by C. Sobhan and G. Peterson, CRC Press
Additional References:
(1) Fluid Mechanics by F. M. White, 5th Edition, McGraw-Hill
(2) Heat Transfer by A. Bejan 2nd Edition, John Wiley
(3) Handbook of Nanostructured Materials and Nanotechnology Vol. I and II, by H.S. Nalwa, American Scientific Publishers
(4) Springer Handbook of Nanotechnology by Bharat Bhushan, Springer-Verlag Publication
(5) Journals of Nanoscience and Nanotechnology
(6) Papers from selected journals given as class handouts

Catalog Description: Description of nanofluids, nanostructured materials, dispersion in base fluids, thermophysical properties: density, viscosity, thermal conductivity and specific heat. Measurement principles, theoretical relations and empirical correlations. Fluid dynamic losses and pumping power requirement for nanofluid flow in heat transfer systems. Experimental methods of determining the convective heat transfer coefficient of nanofluids. Application to heat transfer devices.

WEEK	TOPIC
1	Introduction to nanofluids, nanostructured materials, base fluids, dispersion, sonication and stable suspension. Various types of nanofluids. volumetric concentration.
2	Thermophysical properties: Density; principles of measurement and apparatus. Theoretical equations and new empirical correlations to determine the density of different nanofluids.
3	Viscosity: principles of measurement and apparatus. Andrade's and other theoretical equations and new empirical correlations to determine the viscosity of different nanofluids. Effect of volumetric concentration and temperature. Effect of subzero temperature on nanofluid viscosity.

WEEK	TOPIC
4	Thermal conductivity: principles of measurement and apparatus. Hamilton-Crosser and other theoretical equations and new empirical correlations to determine the thermal conductivity of different nanofluids. Effect of volumetric concentration and temperature. Effect of Brownian motion on enhancing the thermal conductivity.
5	Specific heat: principles of measurement and apparatus. Buongeorno's thermal equilibrium equation and other theoretical equations and new empirical correlations to determine the specific heat of different nanofluids. Effect of volumetric concentration and temperature.
6	Combined effects of thermophysical properties of nanofluids on the thermal diffusivity, the Prandtl number, the Reynolds number and the Nusselt number. Basic understanding of their effects on frictional loss and heat transfer.
7	Review of materials covered thus far. **MID-TERM EXAM** **(Based upon the materials covered in the first half of the course)**
8	Mid-Term Exam solution discussions. Convective heat transfer: Single-phase fluid equations, laminar flow, entry length and fully developed friction factor and heat transfer coefficient. Graetz number effect in the entry region. Correlations for friction factor and Nusselt number for nanofluids.
9	Turbulent flow: Single phase fluid fully developed flow Dittus-Boelter and Glienilski equations. Blasius and other turbulent friction factor correlations. Their comparison with nanofluids data. New correlations for turbulent friction factor and Nusselt number for nanofluids.
10	Principles of measurement and apparatus for the nanofluid convective heat transfer coefficient. Recent empirical relations for convection coefficient of various types of nanofluids. Effect of particle Peclet number. Effect of volumetric concentration.
11	Application of nanofluids to various types of industrial heat exchangers. Heating capacity, mass flow, heat exchanger surface area, LMTD and pumping power for nanofluids versus conventional heat transfer fluids.
12	Application to building heating and cooling Comparison of nanofluids performance with glycol solution in hydronic coils.

13 Application to automobile radiators. Comparison of the performance of nanofluids under arctic and sub-arctic temperatures with glycol solutions. Introduction to electronic cooling in microchannels with nanofluids.

14 Review of materials covered in the second half of the course. Individual project presentations and discussions.

15 On university schedule date **FINAL EXAM**

COURSE RULES:

Exam attendance is mandatory and must be taken when scheduled. All exams are open-book and open-note type exams. Two to three problems as homework will be assigned in each class. There will be short and long problems for homeworks. Those students taking the course for undergraduate credit (F443) will only solve the short problems. The short homework problems will require straight forward substitution into formulas leading to simple numerical answers. Those students taking the course for graduate credits (F643) will be assigned additional homework problems in addition to the short problems. The long problems will require detailed analysis, plotting and discussion of results. Homework will be collected once a week. Late homework will carry a score reduction of 20% per day.

Project: The students taking this course for graduate credit (F643) will be required to devote a higher level of effort and performance in comparison to those who are taking it for the undergraduate credits (F443). For graduate credits, the students must complete a project based upon their independent research on a topic of their choice in the area of nanoscience/nanotechnology. They will be required to submit a project report and make an oral presentation in the last week of the class. Those students who are taking the course for the undergraduate credit will write a short report on a simple project and would not be required to make any presentations.

GRADING CRITERIA:

Homework	20%
Project	15%
Mid-Term Exam	30%
Final Exam	35%

SCORE:	GRADE:
97-100	A^+
93-96	A
90-92	A^-

87-89	B^+
83-86	B
80-82	B^-
77-79	C^+
73-76	C
70-72	C^-
67-69	D^+
63-66	D
60-62	D^-
Below 60	F

ABET CRITERIA FOR ME F443

The students taking the course for the undergraduate credit will learn the following skills, which are a part of the ABET requirements.

(i) an ability to apply knowledge of mathematics, science, and engineering
(ii) an ability to design a system, component, or process to meet desired needs.
(iii) an ability to identify, formulate, and solve engineering problems
(iv) an ability to communicate effectively
(v) a knowledge of contemporary issues
(vi) northern issues

Disabilities Services

The Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. The instructor will work with the Office of Disabilities Services (208 WHIT, 474-5655) to provide reasonable accommodation to students with disabilities. Contact: Mary Matthews, Disability Services, fnmkm@uaf.edu, x5655.