

ME F494: Shape and Structure of Mechanical Systems
3 credits
Spring 2018

Instructor Dr. Sunwoo Kim
Phone: 474-6096
E-mail: swkim@alaska.edu
Office hours: Tue 3:30~4:30 pm, Wed 1~2 pm, or by appointment
Office: Duckering 323

Time Tues/Thurs 11:30 am - 1:00 pm, Duckering 341

Pre-reqs ES 331, ES 341, and ES 346

Course description

Optimization of flow configuration by minimizing the flow resistance in mechanical and energy systems. Introduction to the concepts of entropy minimization and constructal law. Applications to engineering problems in solid mechanics, fluid mechanics, and heat transfer.

Textbook (Required)

Adrian Bejan, *Shape and Structure, from Engineering to Nature*, Cambridge University Press, 2000. (ISBN: 978-0521793889)

Recommended reading materials

A. Bejan and S Lorente, *Design with Constructal Theory*, Wiley, 2008. (ISBN: 978-0471998167)

Website

UAF Blackboard will be used for course announcements, lecture notes, and supplementary learning materials.

Course objectives

To bring together the principles of solid mechanics, fluid mechanics, heat transfer, and thermodynamics, and use them to generate and discover optimal configurations (shapes, structures) for mechanical or energy flow systems.

To show how the flow configuration emerges from the constructal law of maximization of flow access in time, subject to global constraints, when the flow system is endowed with freedom to morph.

Students learning outcomes

To be able to apply the principles of solid mechanics, fluid mechanics, heat transfer and thermodynamics to describe the function of flow systems.

To be able to integrate the various aspects of flow system operation to establish the connection between system global performance and system configuration.

To be able to select the configuration that leads to the maximum performance.

To be able to identify a flow system not discussed in the classroom and to analyze it according to the aforementioned outcomes.

Instruction methods

This course is primarily lecture based. The projector and screen may be used to display course materials. The lecture notes that are to be projected will be available for downloading from Blackboard prior to lectures in classroom. The instructor will also use the whiteboard. Taking notes is recommended.

Tentative Course schedule

Week	Topic	Textbook	HW Deadline	Term paper Deadline
1 (1/16,18)	Objective, constraints, configuration	CH. 1		
2 (1/23,25)	Imperfection of flow systems	CH. 1		
3 (1/30, 2/1)	Optimization of mechanical structure	CH. 2	HW1	
4 (2/6,8)	Optimization of thermal structure	CH. 3	HW2	
5 (2/13,15)	Tree-shape heat flow structure	CH. 4	HW3	
6 (2/20,22)	Exam 1 and review			
7 (2/27,3/1)	Optimization of flow structure	CH. 5		
8 (3/6,8)	Flow structure in power systems	CH. 9	HW4	
9 (3/13,15)	Spring break		HW5	Topic selection (3/16)
10 (3/20,22)	Multi-objective structure	CH. 8		
11 (3/27,29)	Exam 2 & review		HW6	
12 (4/3,5)	Structure in time	CH. 10		
13 (4/10,12)	Flow in transportation	CH. 11	HW7	Full paper (4/13)
14 (4/17,19)	Constructal designs in non-engineering		HW8	
15 (4/24,26)	Term paper presentations	CH. 11	HW9	Presentations (4/24)
16	Exam 3			

Grading

Final composite score to be based on:

Exams 1, 2, 3:	50 points
HW assignments:	20 points
Term paper/presentation:	30 points
Total:	100 points

Absolute scores will be used in grading with the following scale:

87 – 100: A's, 77 – 86.9: B's, 67 – 76.9: C's, 57 – 66.9: D's, < 56.9: F

In addition, a grade of F will be given for:

- earning less than 40% (16 points) in Exams 1 and 2,
- earning less than 50% (15 points) in HW sets,
- earning less than 50% (15 points) in Term Paper/Presentation
- missing classes more than 10 times*, or
- receiving an F in any submission due to plagiarism

*Tardiness or early leaving more than 15 mins and less than 45 mins is considered a 0.5 days missing. More than 45 mins tardiness or early leaving is considered a 1 day missing.

Homework (HW)

A homework set will be in general two to four problems taken or revised from the textbook example problems. Homework is due at beginning of Thursday class in week stated in the schedule. No late homework will be accepted or graded. Homework should represent students' individual effort.

Exams

There will be three exams through the semester. Each exam will cover all materials discussed in classroom. Students must take exams when scheduled. No make-up exam will be given unless the instructor is provided with a written explanation ahead of time and approves it.

Term Paper and Presentation

Term paper and presentation are to evaluate the last student learning outcome described above. Students will choose a flow structure in engineering or any man-made system. Then, discover the function of the flow system and apply the constructal law to provide maximum flow access, subject to the system global constraints.

Students will submit a statement of topic selection (2 pages maximum) to the instructor by March 16. The instructor will inform them whether the topic is appropriate within 7 days. The next is term paper (8 pages maximum) due Apr. 13. A term paper contains 1) general description of the flow system, 2) description of the global constraints and 3) final results (design, performance improvements). Presentation will take place in the week of Apr. 24.

Class policy

Students are responsible for all material covered in class. The work submitted for grading should represent their individual effort. The course requires students to respect UAF policies on ethics and professionalism. The professor reserves the right to adjust final grades up or down based on a student's course participation.

Plagiarism:

Plagiarism is one of the most serious violations of academic integrity, and if I find that you have submitted assignment that is largely written by another person or lifted from the Internet (or any other source) you will receive an F for the assignment. If the source of plagiarism is a classmate's work, both the original and the copy will have an F for the work. And, an F due to plagiarism will result in an F for the course. Please consult the Student Code of Conduct in the University of Alaska Fairbanks 2017-2018 Catalog for the University's policies concerning the serious consequences of plagiarism, cheating, and other violations of academic integrity, as well as your right to due process. The following is part of Student Code of Conduct (<http://catalog.uaf.edu/academics-regulations/students-rights-responsibilities/>):

"Students will not collaborate on any quizzes, in-class exams, or take-home exams that will contribute to their grade in a course, unless permission is granted by the instructor of the course. Only those materials permitted by the instructor may be used to assist in quizzes and examinations.

Students will not represent the work of others as their own. A student will attribute the source of information not original with himself or herself (direct quotes or paraphrases) in compositions, theses and other reports. No work submitted for one course may be submitted for credit in another course without the explicit approval of both instructors."

Disabilities

UAF is committed to equal opportunity for students with disabilities. You are encouraged to contact the coordinator of Disability Services (Mary Matthews) at the Center for Health & Counseling. They can be reached by phone at 474-5655, TTY 474-1827, and on the web at <http://www.uaf.edu/disability/>. See section on "Disability Services" on the University Catalog (<http://catalog.uaf.edu/services/disability-services/>). If you have any kind of learning disability, no matter how unimportant you think it might be, you must tell me about it. I am willing to work with you to help you succeed, but I need to know that some things are difficult for you. Don't be shy, and don't hesitate to call me, or come and talk to me in my office, or send me an email.

Student Support Services

- Contact the Elmer E. Rasmuson Library at UAF reference desk for help with research. <http://library.uaf.edu> or 907-474-7481
- UAF Help Desk. Go to <http://www.alaska.edu/oit/> to see about current network outages and news. Reach the Help Desk at: e-mail at helpdesk@alaska.edu or phone: 450-8300 (in the Fairbanks area) or 1-800-478-8226 (outside of Fairbanks)
- UAF eLearning Student Services helps students with registration and course schedules, provides information about lessons and student records, assists with the examination process, and answers general questions. Our Academic Advisor can help students communicate with instructors, locate helpful resources, and maximize their distance learning experience. Contact the UAF eLearning Student Services staff at 907-479-3444 or toll free 1-800-277-8060 or contact staff directly – for directory listing see: <http://elearning.uaf.edu/contact>
- Title IX See <http://www.uaf.edu/oec/civil-rights/aa-eo/> University of Alaska Board of Regents have clearly stated in BOR Policy that discrimination, harassment and violence will not be tolerated on any campus of the University of Alaska If you believe you are experiencing discrimination or any form of harassment including sexual harassment/misconduct/assault, you are encouraged to report that behavior. If you report to a faculty member or any university employee, they must notify the UAF Title IX Coordinator about the basic facts of the incident. Your choices for reporting include: 1) You may access confidential counseling by contacting the UAF Health & Counseling Center at 474-7043; 2) You may access support and file a Title IX report by contacting the UAF Title IX Coordinator at 474-6600; 3) You may file a criminal complaint by contacting the University Police Department at 474-7721.
- UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: www.alaska.edu/nondiscrimination.
- Your instructor follows the University of Alaska Fairbanks Incomplete Grade Policy: “The letter “I” (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the student’s control, such as sickness, he or she has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an “I” grade.”
- Effective communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication’s Speaking Center (Phone 907-474-5470, email speak@uaf.edu) and the UAF English’s Department’s Writing Center (Phone 907-474-5314, location Gruening 8th floor).