BSE 4125-4126 Comprehensive Design Project (2 semesters)
   CRN: 88702, Tuesday 3:30-4:45 pm, 108 Seitz
   CRN: 81441, Thursday 3:30-4:45 pm, 108 Seitz
   [Note: additional times arranged with faculty advisors]

Instructor: *W. Cully Hession*, Professor, BSE, 204 Seitz Hall; 231-9480; chession@vt.edu
   Office hours: 2:30-3:30 Tuesday, Wednesday, Thursday (204 Seitz)

Course Prerequisites: BSE 3334 **OR** BSE 3524
Completion of 96 credit hours & Overall GPA of 2.0 or better

Catalogue Description: Identify and develop an engineering design project using the team approach; use literature resources to define project objectives and approach; present project proposal in a professionally written and oral manner; examine engineering ethics, professionalism, and contemporary issues.

Course Overview: This course sequence is the capstone design experience for students in Biological Systems Engineering. Engineering design is defined as "the process of devising a system, component, or process to meet desired needs. It is a decision-making process (often iterative), in which the basic sciences, mathematics, and the engineering sciences are applied to convert resources optimally to meet these stated needs" (ABET, 2010). The comprehensive design project provides you the opportunity to solve a **real-world** biological systems engineering problem using the science and engineering skills that you have developed during the last 3-4 years as an engineering student. The completed design project can also be used to demonstrate your professional engineering design, communications, and team-work skills to potential employers. Almost all work done in this course sequence will be team work and you will have the opportunity to develop your team leadership and/or team membership skills.

This is **not a lecture course**, although we will have short presentations/discussions on topics such as: the engineering design process, team working skills, engineering communications, engineering ethics and professionalism, globalization, safety, environmentally conscious design and manufacturing, life-long learning, engineering economics, and professional registration. This course is designed to meet ABET "Criterion 5. Curriculum", a component of which requires: *Students must be prepared for engineering practice through a curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating appropriate engineering standards and multiple realistic constraints.*

Course Learning Objectives: Upon successful completion of this course, you will be able to:
- Describe the fundamental components or steps in the engineering design process, (a,c)*
- Develop effective team approaches for engineering solutions, (c,d)
- Efficiently use literature resources to prepare a preliminary engineering design proposal, (e)
- Present engineering project plans in a professional manner using written and multimedia technologies, (g)
- Demonstrate an understanding of the importance of ethics, professionalism, globalization, safety, and environmentally conscious design and manufacturing in a professional engineering career, and (c,h,j)
- Apply appropriate and accepted planning strategies to open-ended design projects and maintain accurate project records and project schedule. (d,k)

ABET criteria applicable to individual learning objectives:
  (a) an ability to apply knowledge of mathematics, science, and engineering
  (b) an ability to design and conduct experiments, as well as to analyze and interpret data
  (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
  (d) an ability to function on multidisciplinary teams
  (e) an ability to identify, formulate, and solve engineering problems
  (f) an understanding of professional and ethical responsibility
  (g) an ability to communicate effectively
  (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
  (i) a recognition of the need for, and an ability to engage in life-long learning
  (j) a knowledge of contemporary issues
  (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

Design Project: *What makes a good design project?* Not cookbook (should be open-ended), involves design and/or new concept application. Typically, design projects have many different solutions. Your challenge is to identify feasible solutions for your client and to then develop a final detailed design for the solution preferred by your client. This is not a research project, where you are trying to answer a scientific question. It is a solution to a ***site-specific problem*** that can be solved using engineering principles. Site specific means that your design must be for a specific watershed, factory, client, etc. The usual steps in the engineering design process are: 1) Identify the problem; 2) Identify criteria and constraints; 3) Brainstorm possible solutions; 4) Explore most feasible solutions; 5) Select one or more feasible solutions for more in-depth design; 6) Build/test models or prototypes; and 7) Refine the most feasible design.

Safety: Your safety in the execution of your project is our highest priority. Therefore, you must consult with your faculty advisor, professional mentor, and the person in charge of any laboratory/construction facilities (if applicable) on safety rules and procedures. If you observe a safety violation, report it immediately to your advisor **or** the person in charge of the laboratory **and** the instructors.

Learning Philosophy: This course is discussion and teamwork-based, which means that we will minimize lectures so there is more time for you to work on your projects as a team, for class discussion, project management and other learning methods. Education research indicates that lecturing is generally the least effective way of learning. Discussions, hands-on activities, reading, use of audio-visual material, and repetition have been found to be much more effective in transmitting knowledge and increasing long-term memory of course material. There will be some reading assignments before class. To be successful in this course, you must be disciplined and organized enough to complete all required reading assignments before they are discussed in class. If students do not read the material before class, quizzes may need to be added to the course schedule.

Professionalism: Group learning, creativity, discussion, and teamwork require trust, personal exposure and the taking of risks. Other people may not agree with your ideas or may even consider them "crazy" but sometimes so called crazy ideas are the best solution and/or they spark another idea by someone else that is a viable solution. Creativity and risk taking are integral parts of this course and we will be

respectful of other people's ideas.

Engineering Calculations: All submitted engineering calculations will be done using appropriate software (e.g., MS Excel, MatLab, etc.) and submitted as appropriate software files. Your calculations must be thoroughly documented with all equations and variables defined so that it is easy for team members and reviewers to review your work. If you are not comfortable with MS Excel or other software packages, please start self-tutorials available at Lynda: http://lynda.vt.edu/

Collaborative Writing: Almost all assignments will be team writing assignments and all members of the team are expected to contribute to writing and review of the assignment before it is submitted for grading. Written assignments shall be developed with MS Word in "Track Changes" mode OR within MS OneNote so that you will learn how to use collaborative writing techniques and I can identify the individual contributions of individual team members with respect to writing and reviewing.

Course Notebook: Each team is expected to keep a project notebook that documents all design project work and activities. The notebook shall be maintained as a Microsoft OneNote document. Training on the use of OneNote is available on Lynda at: http://lynda.vt.edu

Final Design Report and Student Design Competitions: All comprehensive design project teams will be expected to submit their final design report formatted for one of the national student engineering design competitions. The details of the design competition entered will determine the format (and length) of the final design report. Additional design details and requirements not required for the design competition may be required as separate appendices. A list will be provided on our course site.

Text: This course does not require a textbook. Students are expected to identify and use the appropriate reference materials necessary for the completion of their design project

Grading: The entire class involves group work. Grades will be determined based on input from course instructor, faculty advisors, industry advisors, as well as your peers and some outside reviewers.

Grading Scale:

A 93-100	B+ 87-89	C+ 77-79	D+ 67-69	F < 60
A- 90-92	B 83-86	C 73-76	D 63-66	
	B- 80-82	C- 70-72	D- 60-62	

Assignments: This is a team-based course and students are expected to develop their team working skills. The team is responsible for almost all assignments and all assignments are due by the time and date indicated on the assignment. Late assignments will be assessed a penalty of 20% the first day and 20% per day thereafter.

Honor Code: The Undergraduate Honor Code pledge that each member of the university community agrees to abide by states:
> *"As a Hokie, I will conduct myself with honor and integrity at all times. I will not lie, cheat, or steal, nor will I accept the actions of those who do."*

Students enrolled in this course are responsible for abiding by the Honor Code. A student who has doubts about how the Honor Code applies to any assignment is responsible for obtaining specific guidance from the course instructor before submitting the assignment for evaluation. Ignorance of the

rules does not exclude any member of the University community from the requirements and expectations of the Honor Code. For additional information about the Honor Code, please visit: https://www.honorsystem.vt.edu/

All assignments submitted shall be considered "graded work" and all aspects of your coursework are covered by the Honor Code. All projects and homework assignments are to be completed individually unless otherwise specified.

Commission of any of the following acts shall constitute academic misconduct. This listing is not, however, exclusive of other acts that may reasonably be said to constitute academic misconduct. Clarification is provided for each definition with some examples of prohibited behaviors in the Undergraduate Honor Code Manual located at https://www.honorsystem.vt.edu/

- CHEATING: Cheating includes the intentional use of unauthorized materials, information, notes, study aids or other devices or materials in any academic exercise, or attempts thereof.
- PLAGIARISM: Plagiarism includes the copying of the language, structure, programming, computer code, ideas, and/or thoughts of another and passing off the same as one's own original work, or attempts thereof.
- FALSIFICATION: Falsification includes the statement of any untruth, either verbally or in writing, with respect to any element of one's academic work, or attempts thereof.
- FABRICATION: Fabrication includes making up data and results, and recording or reporting them, or submitting fabricated documents, or attempts thereof.
- MULTIPLE SUBMISSION: Multiple submission involves the submission for credit—without authorization of the instructor receiving the work—of substantial portions of any work (including oral reports) previously submitted for credit at any academic institution, or attempts thereof.
- COMPLICITY: Complicity includes intentionally helping another to engage in an act of academic misconduct, or attempts thereof.
- VIOLATION OF UNIVERSITY, COLLEGE, DEPARTMENTAL, PROGRAM, COURSE, OR FACULTY RULES: The violation of any University, College, Departmental, Program, Course, or Faculty Rules relating to academic matters that may lead to an unfair academic advantage by the student violating the rule(s).

If you have questions or are unclear about what constitutes academic misconduct on an assignment, please speak with me. I take the Honor Code very seriously in this course. The normal sanction I will recommend for a violation of the Honor Code is an F* sanction as your final course grade. The F represents failure in the course. The "*" is intended to identify a student who has failed to uphold the values of academic integrity at Virginia Tech. A student who receives a sanction of F* as their final course grade shall have it documented on their transcript with the notation "FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION." You would be required to complete an education program administered by the Honor System in order to have the "*" and notation "FAILURE DUE TO ACADEMIC HONOR CODE VIOLATION" removed from your transcript. The "F" however would be permanently on your transcript."

Virginia Tech's Principles of Community:
Virginia Tech is a public land-grant university, committed to teaching and learning, research, and outreach to the Commonwealth of Virginia, the nation, and the world community. Learning from the experiences that shape Virginia Tech as an institution, we acknowledge those aspects of our legacy that

reflected bias and exclusion. Therefore, we adopt and practice the following principles as fundamental to our on-going efforts to increase access and inclusion and to create a community that nurtures learning and growth for all of its members:

- We affirm the inherent dignity and value of every person and strive to maintain a climate for work and learning based on mutual respect and understanding.
- We affirm the right of each person to express thoughts and opinions freely. We encourage open expression within a climate of civility, sensitivity, and mutual respect.
- We affirm the value of human diversity because it enriches our lives and the University. We acknowledge and respect our differences while affirming our common humanity.
- We reject all forms of prejudice and discrimination, including those based on age, color, disability, gender, national origin, political affiliation, race, religion, sexual orientation, and veteran status. We take individual and collective responsibility for helping to eliminate bias and discrimination and for increasing our own understanding of these issues through education, training, and interaction with others.
- We pledge our collective commitment to these principles in the spirit of the Virginia Tech motto of Ut Prosim (That I May Serve).

Religious Holidays: If any required assignments conflict with a religious holiday that you observe, **you must** notify me in writing during the first week of classes so that I can reschedule to an alternate day. http://www.registrar.vt.edu/dates_deadlines/religious_ethnic/index.html

Disability Statement: If you need adaptations or accommodations because of a disability (learning disability, attention deficit disorder, psychological, physical, etc.), if you have emergency medical information to share with me, or if you need special arrangements in case the building must be evacuated, please make an appointment with me as soon as possible. More information on services available for students with disabilities is available at: http://www.ssd.vt.edu/.

Additional Sources of Student Support: For consultations or to report a distressed student, call:

- Dean of Students Office (for all student concerns) 231-3787
- Cook Counseling Center (for psychological concerns) 231-6557
- Services for Students with Disabilities (for academic accommodations) 231- 0858
- Campus Alcohol Abuse Prevention Center (for substance abuse issues) 231-2233
- Judicial Affairs (for violations of Student Code of Conduct) 231-3790
- Virginia Tech Women's Center (for cases of sexual assault or gender issues) 231-7806
- Residence Life (for concerns about on-campus students) 231-6205
- H1N1 Influenza Guidelines: http://www.emergency.vt.edu/guides/health/flu.html
- Emergency Preparedness: http://www.emergency.vt.edu/