ENGR 4020 / GSVS 3559 (1-3 credits)
DESIGN THINKING II

Formal description of the course
A multidisciplinary design thinking course; the primary objective is to provide students with a realistic and rigorous advanced design experience reflective of contemporary professional practice. Key course attributes include the multidisciplinary composition of design teams, emphasis on aspects of modern practice, and realistic problems and client-stakeholders. A disciplined design thinking process is followed that incorporates the important activities of contextual analysis, proof of concept prototyping, design verification, and project management and scheduling.

An operational description of the Spring 2019 course
This course guides students through the latter stages of the design thinking process as shown in Figure 1.

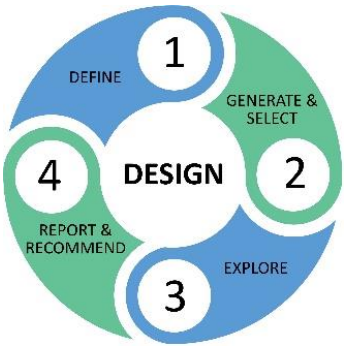

Fig. 1: The design thinking process

In spring 2019, students will have the opportunity to join one of three design teams working. The projects for the Spring will focus upon:

a) Reducing household food waste by developing an accessible and effective method of tracking individual purchasing and consumption habits, and
b) Developing an accessible clean electricity solution for rural communities in India.
c) Developing a music-therapy solution that reduces stress and anxiety in college students.

During the Fall 2018 semester, students selected these three challenge spaces, defined them in depth, stated critical solution requirements, and identified a most promising solution which will be the focus of design efforts this spring.

This semester, design team efforts will focus upon developing the identified solutions:

EXPLORE the most promising solution (11 weeks)
Having selected a “most promising” concept, teams implement plans for multiple physical and analytical (i.e., simulation-based) prototypes. Planned prototypes and related experiments must assess the ability of the selected concept to achieve some functional requirements specified in the GENERATE & SELECT stage. Depending upon the composition of teams, some team members may also explore additional, critical societal issues that could influence the success of these new concepts.

REPORT & RECOMMEND (4 weeks)
Having assessed their design during the EXPLORE stage, students now discuss the implications of their results for future design solution development. The discussion should directly connect design requirements with prototyping and testing results. Recommendations will be based upon the promise demonstrated by the test results and any project-related societal considerations.

Assessment & Measurement

Design Reports (65%) Oral and Poster Presentations (10%) Teamwork (25%)

The grading rubrics used to assess the two major design assignments of GSVS 3559 are as follows:

EXPLORE

Prototype, identified and developed: Prototypes have been introduced, placed in a context of disciplinary principles, planned, clearly and fully explained in text and drawings, and constructed with enough detail to assure that useful, objective data on high priority design requirement(s) can be collected; important solution attributes that need evaluation are accurately built into prototypes. Prototyping plans have been reviewed by one or more subject matter experts. Documented feedback has been incorporated.

Did you offer: (1 Poor to 5 Excellent)

- Sufficient background commentary to understand the disciplinary foundations of your efforts?
- A clear, comprehensive description of final prototype design(s)? Could others reproduce your work based on the information given in your report?
- Evidence of how the prototype design(s) will make possible valid, rigorous testing and / or mathematical modeling that can be confidently compared against measurable design requirements? Assertions of rigor could be supported by reference to testing standards and to accepted scientific concepts found in the literature.
- A summary of prototype review, as given by one or more subject matter experts?

Prototype, experimental procedure: The prototype testing plan addresses one or more high priority design requirements by effectively describing the conduct of tests (physical and / or mathematical modeling) intended to generate data useful for evaluation of solution concept viability; the testing plan is logical and well-developed; if relevant testing standards are available in the literature, they have been followed; the testing form and plan have been confirmed by one or more subject matter experts as likely to yield objective data regarding the effectiveness of the design.

Did you offer: (1 Poor to 5 Excellent)

- Easy to read, step-by-step testing procedure(s)?
- Evidence that the plan focuses on gaining objective and measurable testing data for evaluating design concept viability against one or more of highest priority requirements?
- Evidence that technically-competent subject matter experts agree with your prototyping efforts?

Prototype, testing & results analysis and presentation: Through conduct of tests of high priority requirements, the team demonstrates an understanding of testing procedures, including the gathering and analysis of resultant data. The analysis of the effectiveness with which the design meets stated goals includes a consistently detailed explanation of the data from each portion of the testing; the testing activity is supported by pictures, graphs, charts and other visuals; the analysis includes a summary of implications of collected data relative to a decision to proceed with the design and address the challenge. One or more subject matter experts have reviewed analysis and provided documented feedback.

Did you offer: (1 Poor to 5 Excellent)

- Evidence of testing procedure understanding, including:
    - The gathering, presentation, and analysis of data.
    - Pictures, graphs, charts and other visuals to provide a complete record of testing.
    - Evaluation of the extent to which the qualitative data collected allows assessment of design requirements.
    - A summary discussion of the broader implications of the data.
- Evidence that one or more subject matter experts reviewed and provided feedback?

Design for manufacture: The selected solution concept has been presented and described clearly and in detail – in text and images; perspective, assembly, and engineering drawings convey understanding about the dimensions of physical solutions; software wireframes, code and / or wiring diagrams define digital design elements; text, flowchart, and step-by-step operation instructions convey the understanding necessary to move the design towards production. A subject matter expert has reviewed the design and provided documented feedback.

Did you offer: (1 Poor to 5 Excellent)

- A verbal description of your design that allows others to understand its purpose and essential design features and to implement your design solution?
- A comprehensive set of drawings of your physical design solution that would enable fabrication?
- A complete copy of software wireframes, wiring diagrams, or computer code developed for the design solution?

REPORT & RECOMMEND

Report, the design process: The report is delivered in a highly professional manner. Its language and visual materials are appropriate for an executive team that expects to see a quality presentation and desires to understand and pass judgment after quick, high-level review. The project's testing and results were succinctly presented; relevant extra-functional considerations (e.g. cost, values) were considered in addition to core functional requirements; all were commented upon;

Did you offer:

- A compelling explanation for why this challenge space is significant?
- A structured, believable generate and select process?
- A well-illustrated, cleanly articulated description of the solution that you developed and explored throughout the course?
- A project summary that shows a command and use of discipline appropriate principles to design, develop, and analyze your solution concept?

Recommend, next steps: The report provides an easily identified judgment about design viability – the capacity of the proposed solution to address the challenge. The judgment is clearly stated and supported with credible evidence. The project designers included consistently detailed and salient recommendations regarding the conduct of the same or similar projects in the future; recommendations include caveats as warranted and specific ways the project could be improved with consistently detailed plans for the implementation of those improvements.

Did you offer:

- A succinct design viability statement?
- A prioritized list of obstacles to transitioning the solution design into actual use, supported by a subject matter expert review?
- Evidence that the obstacles can be addressed in a realistic and sustainable way when recommending to move forward.
- Is the judgment supported by a subject matter expert review?
- Recommendations regarding the conduct of the same or similar project in the future should someone choose to repeat or continue your work?
- Recommendations on how the project could be improved with consistently detailed plans for the implementation of those improvements?

Appendix: The designers provided consistently clear, insightful, and comprehensive reflection upon each step in the design process as undertaken during the year; the reflection(s) included a

substantive summary of lessons learned that would be clearly useful to others attempting the same or similar projects.

Did you offer:

- Comments about the utility of the different steps in the design thinking process?
- Prioritized recommendations to others redoing this project where you would suggest more focus and effort?
- Justification for why these recommendations might have led to a better result?

Late policy

All graded assignments in ENGR 1559 / GSVS 2050 will have specific due dates and times listed in the weekly handouts provided by your instructor. Untimed assignments may be turned in up to 72 hours after the assigned due date and time. When such assignments are turned in late (by any amount of time), a 15% grade penalty will be assessed. After a student misses the 72 hour "late submission" window, assignments may be turned in at any time before the official end of the semester, receiving a 50% grade penalty.

Course grade scale

A+	> 97%	**B+**	87 – 90%	**C+**	77 – 80%	**D+**	67 – 70%
A	93 – 97%	**B**	83 – 87%	**C**	73 – 77%	**D**	63 – 67%
A-	90 – 93%	**B-**	80 – 83%	**C-**	70 – 73%	**D-**	60 – 63%

F <60%

LEARNING COMMUNITY INTERACTION & ENGAGEMENT

Individual student engagement

Your success in this course will depend on *your* individual efforts and on *our* ability to work together to build a cooperative learning environment. Questions and sharing of beliefs, opinions, and feelings are strongly encouraged. In order to maximize our learning, we will need to create a safe community in which we will feel comfortable sharing thoughts and ideas even when those thoughts and ideas are not in full agreement with the thoughts of others in the course. Achieving a safe learning environment requires practice and effort. It will require each of us to behave professionally and respectfully at all times, and to adhere to our course norms. As you learn in this course and learn about your classmates, you are encouraged to respect and appreciate differences.

Learning community values

Meaningful and courteous dialogue is expected in this course. Healthy dialogue will require a degree of respectful understanding and a willingness to listen to all course participants. You may not agree with another person's point-of-view, or you may already understand a concept and feel frustrated with the pace of class discussion at times. Give others a chance to contribute and learn. Encourage one another politely. Seek to understand and appreciate the ideas of others. Learn from one another. Be patient and encouraging as we *all* seek to advance our knowledge of important sustainable energy system concepts. Since every student is entitled to full participation in this course without interruption, all students are expected to come to class sessions prepared and on time. You are always expected to refrain from undertaking any activities that might be considered disruptive.

Class schedule and time commitment

This course is a 1 - 3 credit hour course at the University of Virginia. Students should understand that the U.S. federal government mandates a certain *minimum* student workload for each credit hour earned while in college. By the federal definition, a credit hour is an amount of work that reasonably approximates *not less than* one hour of classroom or direct faculty instruction and a minimum of two hours of out of class student work each week for approximately fifteen weeks for one semester hour of credit, or the equivalent amount of work over a different amount of time. Students who spend less than the minimum should have no expectation of passing the course.

Use of email
Your instructor will seek to minimize the number of course related messages sent to you by email. Still, email messages to the class and to individual students will be necessary from time-to-time. Your instructor expects that you will check your university email account at least one time each day, Monday – Friday during the semester. If an email includes a specific request for a response, it is your instructor's expectation that you will respond in no more than two business days from the time that the email was *sent* to you (not from the time that you read the email). Failure to read and respond to emails from your instructor in a timely manner (as defined above) will have a negative impact upon your class participation grade.

Respect and safety
Your instructor is committed to supporting and encouraging students, staff, and faculty to take responsibility for safety on our campus. If you or someone you know experience stalking, partner violence, or sexual assault, please remember that you (or he or she) is not alone. If for any reason you do not feel safe in class, on grounds, or in your personal life, then please do not hesitate to contact your instructor or the Student Health Center. Counseling and Psychological Services (CAPS) is available for all students. Call 434-243-5150 (or 434-972-7004 after hours and weekend) to get started and to schedule an appointment. Call Madison House's HELP Line at 434-295-8255, if you prefer to speak anonymously and confidentially. If you or someone you know is struggling with gender, sexual, or domestic violence, there are many community and University of Virginia resources available to help you. The Office of the Dean of Students, Sexual Assault Resource Agency (SARA), Shelter for Help in Emergency (SHE), and the UVA Women's Center are excellent resources for both men and women. Contact the Director of Sexual and Domestic Violence Services at 434-982-2774.

Special Needs
It is the policy of the University of Virginia to accommodate students with disabilities in accordance with federal and state laws. Any student with a disability who needs accommodation (e.g., in arrangements for seating, extended time for examinations, or note-taking, etc.), should contact the Student Disability Access Center (SDAC) and provide them with appropriate medical or psychological documentation of his/her condition. Once accommodations are approved, it is the student's responsibility to follow up with the instructor about logistics and implementation of accommodations. Accommodations for test taking should be arranged at least 14 business days in advance of the date of the test(s). Students with disabilities are encouraged to contact the SDAC*:* 434-243-5180/Voice, 434-465-6579/Video Phone, 434-243-5188/Fax. Further policies and statements are available at www.virginia.edu/studenthealth/sdac/sdac.html

Honor code
The University of Virginia relies upon and cherishes its community of trust. Your instructor firmly endorses, upholds, and embraces the University of Virginia's Honor principle that students will not lie, cheat, or steal, and we expect all students to take responsibility for the System and the privileges that it provides. I recognize that even one Honor infraction can destroy an exemplary reputation that has taken years to build. Acting in a manner consistent with the principles of Honor will benefit every member of the community both while enrolled in this course and in the future.

If you have questions about the Honor System or would like to report suspicions of an Honor offense, please contact your instructor. For more information on the UVA Honor System, please visit the following web resource: http://www.virginia.edu/honor/