

Advanced Independent Engineering Research & Design (.5 credit, 1 Sem)

Course Syllabus

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Course Description

This is a hands-on course serves as a capstone course within the Engineering Design curriculum sequence. The purpose of the course is to provide direct application of the skills and knowledge learned in prerequisite courses to real-world problems. Students will develop solutions to problems that will require use of multiple technologies and various levels of expertise in CAD, manufacturing, additive manufacturing, etc. Students use Computer-Aided Drafting (CAD) software to assist in designing solutions to specific problems selected by teams of students. This course tests time management and team skills which are valuable assets in post-secondary and the work force. Benchmark assessments are used to track individual student progress.

Course Prerequisites

Introduction to Engineering & Design, Engineering & Design

Course Content

This course will consist of the following units of study:

1. Introduction to Engineering & Design
2. Problem Identification
3. Explore: Research and Development
4. Design: The Decision Process
5. Create: Building the Prototype
6. Test: Methods of Evaluation
7. Communication: Juried Presentation & Redesign

Course Objectives

The student will demonstrate the ability to answer in detail the following essential questions:

- When are expository and technical writing styles applicable to engineering notebook?
- When is the creation of a problem statement important in preparation to design and develop solutions to a problem?
- What processes may determine if problems need innovations or newly-developed solutions?
- What are the factors that influence design decisions?
- How do engineers communicate the design solution to others?
- How does the design phase transition into building a product?
- How is an engineer's testing procedure different from a scientist's use of the scientific?
- How do engineers present their design solutions and prototypes to potential users?
- Has the research and development of a product or system been successful?
- What are the post-graduation and/or career options that apply to the course content?

Class Expectations

1. Three Key Ideas...
 - a. Character Over Comfort
 - b. Team Over Self
 - c. Be Uncommon
2. Specific Rules
 - a. Show Character, Be On Time, Be Mentally Present
 - b. Hall Passes
 - c. One person out of FAB Lab at a time – with instructor permission. Instructor reserves the right to revoke pass privilege if they feel they are being abused.
3. Consequences

- a. All school policies are enforced
- b. Mobile phones and Media Players can be used but only when they directly relate to course activities.

Course Materials

Access to Duluth Google Drive

Evaluation Process

A final average of 60% or better is required to be awarded course credit. Throughout the length of this course, students may be evaluated on the basis of, but not limited to:

- Formative Assessment, such as writing prompts, journals, and portfolios
- Summative Assessments, such as quizzes, tests, and final examinations
- Performance Assessments, such as projects and presentations
- Technology-based applications, such as electronic portfolios, Web Quests, and podcasting
- Class participation
- Homework

Students must submit project proposals, project products, and project summaries/presentations for assessment.

- Project proposal as informal oral presentations/discussions where specific criteria will be shared.
- Project product is the finished project
- Project Summaries/Presentation Forms – presentations are completed for every other project, with forms submitted for the other half of projects
- Final Project - The last four (4) weeks of the course will be reserved for the final project, which will need to incorporate at least three or more engineering processes and pieces of equipment.

All assignments and assessments will be scored on a 10-point scale

- A (10/10) – Exemplary
- B (8.5/10) – Proficient
- C (7.5/10) – Developing
- D (6.5/10) – Basic
- F (5/10) – An attempt has been made, but the work does not meet basic criteria
- M – Missing assignments, projects, and final projects turn into “0’s” at the end of the semester if not attempt is made to complete the assignment
- Late work will earn the highest grade of “Developing” based on quality work

Assignment/Benchmark Project Grading Rubric (15 points)

10 – Exemplary, 8.5 – Proficient, 7.5 – Developing, 6.0 – Basic, 0 - Incomplete

- The product is fully complete
- The product demonstrates the skills needed to successfully use the machine/software
- The product is free of any flaws (cracks, rips, bubbles, gaps, scaling issues, etc) or requiring ancillary support (glue, etc)
- One of the 10 point parameters are not true
- Two of the 10 point parameters are not true
- Three of the 10 point parameters are not true
- Did not attempt

Benchmark Project Summary Grading Rubric (15 points)

10 – Exemplary, 8.5 – Proficient, 7.5 – Developing, 6.0 – Basic, 0 - Incomplete

- All appropriate pictures are included and annotated
- All questions are answered
- The reflection is very thorough and meaningful
- Each answer fully explains all appropriate aspects of the question
- A minimum of 5 sentences are used per question OR presentation is 3.5 minutes or more
- All appropriate pictures are included and annotated
- All questions are answered
- The reflection is very thorough and meaningful
- Each answer fully explains all appropriate aspects of the question
- A minimum of 3-4 sentences are used per question OR presentation is 2-3 minutes or more
- One of the Proficient parameters are not true
- Two of the Proficient parameters are not true
- Did not attempt

Safety Guidelines

1. Conduct yourself in a responsible manner at all times.
2. Follow all written and verbal instructions carefully. If you do not understand a verbal or written direction be sure to ask for assistance.
3. Never work alone in the FAB Lab. You must always be supervised by the FAB Lab instructor or lab supervisor.
4. When in the FAB Lab outside of normal class times do not use any equipment unless your assignment/project proposal has been approved and you have checked in with the instructor or lab supervisor.
5. Do not eat food or drink beverages in the FAB Lab. Liquid and food particles can disrupt equipment efficiency.
6. Only work on assignment/projects that have been approved by instructor. Unauthorized projects are strictly prohibited. Nothing viewed as a potential weapon will be approved.
7. Carefully read through the tutorials to re-familiarize yourself with the equipment before using it and continue to refer back to it while you are using it.
8. Never fool around in the FAB Lab, some examples are running, throwing things, and pulling pranks.
9. Work areas should be kept clean at all times. Only FAB Lab equipment should be on the counters and the counters should be cleaned when the activity is completed.
10. Keep all walkways clear by keeping your possessions in designated areas.
11. Know the locations and operating procedures of all safety equipment: eye wash station, fire extinguisher, and telephone
12. If a chemical splash's in your eyes, notify your instructor immediately and utilize the eye wash station for at least 20 minutes.
13. Be fully alert and use extreme caution at all times while working with the equipment. Know exactly what and who is around you when working with the equipment.
14. Equipment must be monitored by the students at all times. You must stay at the station until instructed otherwise.
15. Wear eye protection any time the Mill, Laser cutter, CNC Plasma, or CNC Router are used.
16. Dress properly; long hair, dangling jewelry and loose or baggy clothing are a hazard when using some equipment. Shoes must always be worn while in the FAB Lab. Lab coats should be worn while in the FAB Lab.
17. Report any accident or injury to the instructor or lab supervisor immediately no matter how minor you may think it is.
18. Ask the instructor if you are unsure of how to use a piece of equipment.