Introduction to Engineering Design (IED) 2023-24

Teacher: To Be Determined

Other Engineering Teacher at ROHS: April Moon april.moon@redoakisd.org
Ms. Moon's Tutoring Hours: 4:10-4:30

4 TALONS OF THE HAWK

ACADEMICALLY PREPARED	OPEN TO CHALLENGES OF LEARNING	FAIR, RESPECTFUL, & WELL ROUNDED	LEAVE A LEGACY
• 1% better every day • Love & Accountability	• GRIT- Growth, Resilience, Integrity, Tenacity	• REACH- Respect, Encourage, Appreciate, Communicate, Honor	• We Before Me (Service)

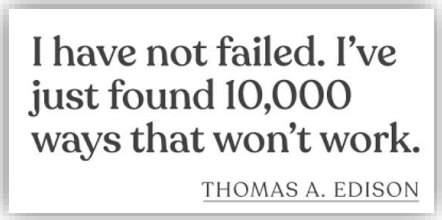
Suggested Supplies (stays with students)

- Pencils and a White Magic Rub Eraser
- Map Pencils ("Twistables" preferred)
- Glue Stick

* Some portfolio and project supplies (i.e. - presentation boards) may be required throughout the year.
* Ms. Moon will provide engineering journals for each student, which will primarily stay in the classroom.

Class Culture

The culture / environment in IED is *student centered* – where the teacher facilitates lessons, and students individually drive their own learning through exploration, creative and critical thinking, collaboration, and carrying out the steps of the engineering design process.



Course Description

Introduction to Engineering Design (IED) is a foundational course in Project Lead The Way's (PLTW) Engineering pathway.

In IED, students explore engineering tools and use the engineering design process to solve problems. Utilizing the activity-project-problem-based (APB) teaching and learning pedagogy, students progress from completing structured activities to solving open-ended projects and problems that require them to plan, document, communicate, and develop other professional skills. Through both individual and collaborative team activities, projects, and problems, students apply systems thinking and consider various aspects of engineering design including material selection, human-centered design, manufacturability, assimilability, and sustainability.

PLTW IED students develop skills in technical representation and documentation, especially through 3D computer modeling using a Computer Aided Design (CAD) application. As part of the design process, students produce precise 3D-printed engineering prototypes using an additive manufacturing process. Student-developed testing protocols drive decision-making and iterative design improvements, and computational methods are applied to inform design by developing algorithms, performing statistical analyses, and developing mathematical models. Students build competency in professional engineering practices including project management, peer review, and environmental impact analysis as part of a collaborative design team. Ethical issues related to product development are also presented.

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The most important goal in IED is to enable students to discover the wonderment of Science, Technology, Engineering, and Mathematics (STEM) and to help students build confidence in understanding/improving the world around them.

Course Outline (Subject to Change)

Unit 1 Design and Problem Solving	Unit 2 Assembly Design	Unit 3 Thoughtful Product Design	Unit 4 Making Things Move
Design Basics *Visualization and Solid Modeling* *CAD Fundamentals* *Product Improvement*	*Put it Together* *Take it Apart* *A Material World* *Fix It*	*Responsible Design More Than Parts Lesson* *Solve a Problem*	*You've Got to Move It* *May the Force Be With You* *Automating Motion Lesson* *Make It Move*

Course Resume

CAD and Drafting Experience

• Create and/or modify 3D solid computer models of complex parts • Create 3D solid computer models of part assemblies • Create technical CAD drawings of complex parts and assemblies from 3D solid models • Animate a 3D CAD assembly model to accurately simulate mechanical motion • Create hand drawn isometric sketches • Identify errors and omission in technical sketches and drawings

Design Process Experience

• Design a mechanical product/system to solve a problem using an engineering design process • Document in detail the engineering design process used to create a mechanical solution to a problem • Develop user-driven, specific and measurable design requirements to specify a successful design or problem solution • Create a detailed and comprehensive design brief • Brainstorm/recommend improvements to a mechanical consumer product based on reverse engineering • Design, develop and implement a testing protocol to test at least one aspect of an engineering solution or design • Produce a technical presentation to communicate a solution to a mechanical problem or product design • Work collaboratively on a design team to design a solution to a problem

Computational and Analytical Skills

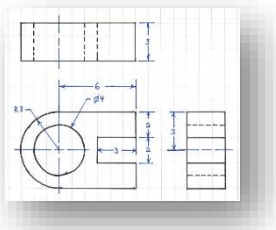
• Use a spreadsheet application to find a trend line (mathematical model) to represent data and interpret the model within the context of the data using grade appropriate mathematics • Use appropriate techniques to optimize a design or problem solution • Collect and analyze data to make predictions and inform engineering decisions • Perform precision measurement using common engineering tools • Use material properties to help identify an unknown material • Choose and justify material choice for a design or solution • Determine a mathematical equation that describes a relationship between two quantities and use it to define parametric relationships in CAD • Describe a mechanical system with respect to its structure, behavior and function • Optimize the structure and/or function of a mechanical system • Identify frictional forces in a mechanism and revise the design to reduce friction to improve function and/ or efficiency • Use computer, mathematical and physical representations to model behaviors of a mechanical system or process and communicate thinking. Describe the purpose and limitations of each model. • Design an electromechanical system to control motion and automate a device • Use Hooke's Law to determine the behavior of a spring

Professional Skills

• Team collaboration • Project management • Problem-solving • Communication skills • Presentation skills • Technical writing • Ethical practice • Global perspective

Tools and Software

• Microsoft Office (Excel, Word, PowerPoint) or similar • 3D solid modeling software - Autodesk Fusion 360 (or other 3D solid modeling application) • Dial calipers • 3D prototype • Mechanical prototyping equipment



Course Knowledge

Careers

• Engineering disciplines • STEM careers related to course content • Professional ethics

Design Process

• Define the problem – design brief • Generate concepts – brainstorming and decision matrices • Develop a solution – technical drawing • Construct and test a prototype • Evaluate a solution • Present a solution • Product life cycle • Design teams

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Technical Sketching and Drawing
• Isometric views • Orthographic projections • Alternate views - sectional views and detail views • Working drawings

Measurement
• Linear measurement • Unit conversion • Precision and Accuracy • Dimensioning • Tolerance • Physical property analysis

Statistics
• Measures of central tendency • Measures of variation • Box plots • Histograms • Normal Distribution • Inferential Reasoning

Modeling in Engineering
• Graphical modeling • Mathematical modeling • Computer 3D solid modeling • Physical modeling and prototyping

Classroom Rules

1. Safety is our first priority! Therefore, all lab rules must be strictly followed. Students must be signed off to use tools and equipment, and an engineering instructor must be present when tools are used!
2. Respect Others and Respect Property:
   - Treat others with respect as outlined in your class's Social Contract.
   - Please dispose of trash whether it is yours or not.
   - Please ensure all supplies / tools are put up in their designated 'home' neatly.
   - Please do not disturb items around or in my desk, and my teacher laptop is strictly off limits.
3. Eye contact is important, both with me and your classmates. Therefore, for the duration of class, all hair must be kept away from your eyes.
4. Computers will be used for academic purposes during designated times only. Proper electronic etiquette will be followed when others are speaking and no online games are ever allowed in the engineering lab (except the ones the teachers is using for instructional purposes)!
5. Please dispose of food packages in the trashcan OUTSIDE the classroom.

"Freedom and responsibility go hand in hand!"

Classroom Procedures

1. Everyone must participate. This is the only way our class will reach its full potential as a team.
2. Respect others even when it requires *intentional* effort. We will work as a team in my class.
3. Units must be shown, and the process steps used to arrive at all solutions must be neatly recorded.
4. Your journal should be your first resource for questions. Your second resource is your team.
5. All students will honor their commitment to the class's Social Contract (norms generated by students in each of my classes during the second week of school).

Course Structure and Assessments

It is important that you take thorough hand-written notes in their engineering journals since your notes will be their main source of information (not a textbook), and it is vital that you come to class prepared - with all required supplies and a focus on learning. Periodically, I will conduct unannounced evaluations of your engineering journals.

We will explore engineering through exciting activities and projects that will allow a deeper understanding of the concepts being learned. For major projects, a detailed design brief, grading rubric, and the project's due date will be supplied upfront so that expectations are clear. All projects will incorporate criteria related to creativity, proper documentation, accurate computations / content connections, evidence of the student's journey through the engineering design process (proof of concept), effective teamwork, proper project management, a final

presentation, and metacognition. Projects will be assessed using a rubric and will carry the weight of at least one test grade. Peer evaluations and progress checks may also factor in to a student's project grades.

Traditional quizzes/tests, live performance evaluations, and metacognition activities will also factor into the students' grade.

Note: Units must be shown ALWAYS, and the process steps used to arrive at solutions must be neatly recorded. Oftentimes, the process steps are graded at a heavier weight than the final answers.

Grading Policy

Mandated by District:
Daily Grades 40% [25% Classwork and 15% Homework/Other]
and Major Grades 60% [Tests and Major Projects]

Canvas: Some assignments will be given on Canvas, but the gradebook/Skyward is the source of final grades.

Late "Daily Grade" Work: If a student fails to meet the due date/time, then the student has until the next class period to turn in their assignment. Students will be assessed a penalty of 15 points for every school day that an assignment is late. If the work is still not submitted after the third late day, the assignment is recorded as a zero.

Late "Major Grade" Work: 1st day late maximum penalty of 25 points, 2nd day late maximum penalty of 50 points, 3rd day late grade of 0.

Retests: A retest grade will max out at 70. (Retesting will not include semester or final exams.) The retest must be taken within five school days of the original test grade being provided to the student unless there are extenuating circumstances approved by the classroom teacher and/or campus administrator.

Academic Dishonesty: Academic dishonesty includes cheating or copying the work of another student, unapproved use of technology including cell phones, plagiarism, and unauthorized communication between students during an examination. Consequences for academic dishonesty: Grade of zero, Referral, Student reflection assignment, and Teacher contacts parents. *Upon the teacher's discretion, an alternative exam/assessment (for a max grade of a 70) may be assigned.

Absences

If possible, work missed due to absences should be picked up and attempted before returning to class so the student better connects with the new lessons. When a student has excused absences for one or more days and has not had sufficient time to make up the work (ordinarily one day for each day of absence), more time may be allowed under extenuating circumstances.

Any project work that spans two weeks or longer should be turned in the day it is due. If a student is absent on that day, they must turn it in early, email it to me by their scheduled presentation time, or find a way to transport their project to school by their scheduled presentation time. This is especially important if the project is a team-based assignment.

Students that are absent for school related or pre-scheduled activities/events on the day an assignment is due are required to turn in the assignment prior to the absence for the event.

*** This syllabus may slightly change once the IED teacher is identified. ***