Engineering and Fabrication Course Outline

In this course, students learn the engineering design process to gain skills in engineering and fabrication. It utilizes content aligned to both an OSHA Safety Certification as well as the Associate CAD Certification of the teacher's choice. This course utilizes project-based learning to lead students through the process of designing and fabricating mechanisms that can complete the task of picking up an object and transferring it to another location in two stages. They learn how to increase automation skills with the use of belts and sprockets, along with conveyor systems. The course ends with a class competition to determine which teams' mechanisms perform the best.

Lesson	Learning Objectives	Time
Engineering Design Process, Teamwork, and Project Management	a) Students will be tasked with an engineering challenge such as designing a mechanism to pick up an object that involves two stages and initial contact with the object and then transfer the object to another location. b) Students will learn about working collaboratively in teams through the Engineering Design Process and Project Management. c) Students will develop design criteria and constraints for their challenge. d) Students will document their processes and project management with an engineering notebook.	5 hours
Safety and Fabrication Techniques	a) Students will understand the safety requirements for working in a robotics lab including proper PPE and electrical safety. b) As part of the certification needed students will pass a skills test for using the equipment. Example tasks include: 1) Cut a 3” X 3” square out of plywood using a jig saw, miter saw, or table saw. 2) Properly drill holes in a piece of aluminum using a drill press to match a motor mount diagram. 3) Properly operate a miter saw or band saw to cut a specific length of aluminum stock. c) Students will practice safety operation techniques when working with tools and the robot including robot power off when making changes, ensuring safe storage of stored power (air pressure, springs, etc.). d) Students will document their processes and project management with an engineering notebook.	10 hours
Prototyping and Experimentation	a) Students will discover ideas for their design through prototyping and experimentation. b) Students will fabricate a quick prototype to learn more about their design idea created in the Engineering Design Process Lesson. c) Students will evaluate prototypes based upon their criteria and constraints for solving the problem.	5 hours
Getting Software and Training Materials	a) Scroll through the CAD sponsorship page of your desired CAD Program. Click on the account set-up and fill out the form. Explore the resources for team onboarding. b) Access training materials and learn the basics of CAD through Solid Professor and Fundamentals.	5 hours
Sketching	a) Identify parts in your design that need to be sketched. b) Review needed training tutorials to assist you in the process.	10 hours

	c) Sketch one part that was fabricated in your prototyping process.	
Part Modeling	a) Identify parts in your design that would use part modeling skills. b) Review needed training tutorials to assist you in the process. c) Document your tasks in your Learning Portfolio. d) Utilize *FIRST* specific example to apply part modeling example. e) Learn about manufacturing your designs and bringing them to a reality with lessons utilizing manufacturing technology such as 3D printers and laser cutters. f) Identify skills used in the parts that apply to the CAD Associate Exam and complete the self-assessment to document your skills.	10 hours
Testing and Improving Prototypes	a) Students will use their part modeling techniques to design custom parts that can be fabricated to improve the design of their prototype. b) They should include additional fabrication techniques that utilize their CAD skills such as 3D printing, CNC Milling, or Laser Cutting.	10 hours
Assembly	a) Review the tutorials for creating assemblies. b) Utilize the Learning Portfolio Template to set up your learning documentation. c) Utilize the tutorials to learn how to work with and manage assemblies while assembling components. d) Identify skills used in the assemblies and parts that apply to the Associate Certification Exam (starting assembly, inserting components, move components, mate components, create complex mate connectors, use different mates, explode bill of materials, work with sub-assemblies) and complete the self-assessment to document your skills.	10 hours
Increasing Automation	a) Students will prototype options for the transfer of the object from the beginning prototype to another location with an arm or conveyor system through learning about different types of machines and mechanisms. b) Students should use information from testing of their prototypes to develop a CAD model of their automated design. c) Students will learn about using conveyor systems, gear ratios, pitch, determining belt/chain length, and choosing the proper actuator for a design. d) Students will continue to improve fabrication skills and automation skills for efficient robot operation through assembling and testing of their design.	10 hours
Final Testing and Automation Challenge	a) Students will test and make improvements to their automated machine through using project sprints to improve project management and accomplishments. b) Students will create a project sprint to finish remaining tasks before their final class challenge. c) Students will develop communication and presentation skills by developing a presentation of their final design decisions and engineering design process. d) Students will compare their designs and accomplishments with a class presentation and challenge to determine who developed the best design.	10 hours