Energy, Power, and Transportation Goals and Objectives

Unit 1 Review of Prerequisite Skills

Goal Students will apply skills taught in prerequisite courses to practicum coursework.

Objectives Students will be able to:

1. Outline (or diagram) and explain the steps of the design process.
2. Describe how mathematics and science topics fit into the design process.
3. Identify types of lines that make up a working drawing.
4. Perform computer-based research, using advanced search techniques.
5. Enter research citations into EPT online database.
6. Format presentation visual aids using an EPT workstation.
7. Present research results to peers.

Unit 2 Electrathon Specifications & Human Factors

Goal Students will include investigate information regarding Electrathon specifications as well as human factors considerations to design a concept model of an Electrathon class vehicle.

Objectives Students will be able to:

Describe requirements and design considerations for Electrathon class vehicles.
Summarize human factors that play into Electrathon vehicle design.
Build a shared knowledge base about Electrathon vehicles, including specification details, design considerations, and library and online resources.
Describe desirable features for our Electrathon vehicle.

Unit 3 Vehicle Aerodynamics

Goal Students will investigate the design of a road vehicle by constructing models and making careful measurements of aerodynamic quantities.

Objectives Students will be able to:

Identify and describe forces acting on a moving road vehicle.
Describe how drag and lift affect vehicle performance.
Determine drag coefficient by measuring drag vs. wind speed for a sphere.
Determine drag coefficient by measuring drag vs. wind speed for scale models of concept Electrathon vehicles.

Unit 4 Introduction to Materials

Goal Students will develop an expertise in the weight, strength, and cost of candidate materials. Students will also study the frame design consideration of road vehicles.

Objectives Students will be able to:

Describe how materials are characterized in terms of their strength and weight.
Research materials used by other Electrathon teams via the Internet and assemble a knowledge base of this information.
Determine the specific weight of candidate frame materials.
Develop a spreadsheet capable of estimating the cost and weight of an Electrathon concept vehicle given a set of specifications.
Develop a two-view working drawing of a frame capable of support an Electrathon Concept Car.
Determine the materials required to construct an scale model of an Electrathon concept vehicle frame.
Construct a scale model of an Electrathon concept vehicle frame.
Determine a cost and weight estimate for an Electrathon concept vehicle.

Unit 5 Computer analysis

Goals Students will analyze each their designs using a SolidWorks software. Before evaluating their cars, they will investigate how computer modeling can contribute to the design process.

Students will view and summarize the SolidWorks video tutorials showing how to simulate a wind tunnel test and a stress test.

Objectives Students will be able to:

Complete a tutorial on how to navigate SW software. Summarize the steps used to develop a computer-based model.
Explore the relative importance of various design factors for their Electrathon concept cars.
Predict details of the performance of their Electrathon concept vehicles based on a computer model.
Explore, understand, and enhance the computer model.

Goal

Objectives: Students will be able to:

Identify the parts that make up the SolidWorks window and describe their function
Navigate SW pull-down menus
Display and reorganize docked and floating toolbars.
Enter commands using the keyboard and toolbars
Draw two-dimensional views of holes, cylinders, and rounded and polygonal features
Recreate curved objects such as circles, arcs, ellipses, an donuts
Create rectangles and regular polygons
Describe several methods of entering x, y coordinates
Locate points and draw objects using the Cartesian coordinate system
Apply the absolute, relative, polar, polar tracking, and direct distance methods of entering coordinates.
Complete SW tutorials: Basic part, assembly, 3 view drawing, weldments, lofts, etc.

Unit 7 Laboratory Safety Plan Development

Goal Students will survey shop safety practices of local research facilities and develop their own safety plan for the laboratory.

Objectives Students will be able to:

Describe safety programs currently in place at local research labs, including APL, Allied Signal, BGE, and Northrop Grumman.
Describe the necessary features of an EV lab safety plan, including: battery handling and storage, machine tool safety, hazardous waste safety, and chemical safety.
Describe implementation procedures for a successful EV lab safety program.
Develop and implement a safety program in the EPT Laboratory.

Unit 8 Concept Presentation & Evaluation

Goal Student concept teams will present and defend their concept cars. The class as a whole, along with other stakeholders such as sponsors, will evaluate all concept cars in

which evaluates each concept car in light of Electrathon specifications and original class goals.

Objectives Students will be able to:

Present concept cars to stakeholders, justifying design features in light of specifications.
Explain how an attribute table is constructed.
Assemble an attribute table comparing student concept cars.
Arrive at consensus regarding which car design the class will adopt and complete.

Unit 9 Project Planning & Management

Goal Students will hear guest speakers describe key elements of project management strategies from local technical laboratories. After a role-playing exercise illustrating the benefits of careful project management, students will write their own management plan and present this plan to project stakeholders.

Objectives Students will be able to:

Describe the need for project management.
Develop an organizational chart for the construction of our electric vehicle.
Discuss the qualities that an effective leader and an effective team member should possess.
Identify team leaders for the development phase of our project.

Unit 10 Voltage in Mechanical Systems

Goal

Objectives: Students will be able to:

Differentiate between AC and DC current
Identify the most common source of DC voltage
Describe the sequence for connecting a DC circuit in series that will cause the voltages to be added
Identify three components of a circuit, giving their symbols, including a source, conductor, and load.
Describe how frequency and hertz relate to AC current
Briefly describe how voltage can be considered a force like quantity.
Name at least 3 types of voltmeters
Briefly describe a situation that requires a technician to measure

Unit 11 Work in Electrical Systems

Goal

Objectives Students will be able to:

WORK = VOLTAGE X ELECTRICAL CHARGE MOVED

Identify the effects of work done in electrical systems.
Identify workplace applications where work occurs in electrical systems.
Explain how efficiency relates to input work and output work in an Electrical System

Unit 12 Subsystem Design, Construction, and Testing

Goal Students will work in subsystem teams to finalize designs, simulate, and then fabricate vehicle subsystems. Each team will be responsible for presenting seminars on their progress and meeting integration deadlines.

Objectives Students will be able to:

List milestones that must be met within their subsystem team.
Schedule subsystem milestones.
Make working drawings of subsystem designs.
Research possible design solutions and record findings.
Document daily progress using a laboratory record.
Integrate team results with the progress of other subsystems teams.
Communicate team progress to project team by giving weekly seminars.
Research vendors for needed materials and acquire technical information about needed materials.
Expedite the purchasing process for needed materials.
Communicate subsystem team progress to laboratory visitors.

Unit 13 Battery Theory & Operation

Goal Students should understand the behavior of lead acid batteries and the subsequent ramifications for optimizing performance and handling them safely.

Objectives Students will be able to:

Describe the chemical reactions within lead-acid and nickel-hydride batteries.

Compare strengths and weaknesses of various exotic batteries.

Assess state of charge of a lead-acid battery using a hydrometer, a load resistor.

Monitor battery-charging process using a data acquisition system connected to a computer.

Unit 14 Vehicle Suspension, Steering, & Control

Goal Students will investigate principles of automotive steering and suspension. Students responsible for the design of the EV prototype's frame will refine original plans

Objectives Students will be able to:

Identify and explain components of a typical automotive suspension system.

Identify and explain components of a typical automotive steering system, including all steering angles.

Design EV prototype frame with correct steering geometry.

Unit 15 Advanced Fabrication

Goals Students will design a fixture system to facilitate accurate construction of an Electrathon vehicle frame. Using, either their designs or instructor designs, students will fabricate a fixture system that will allow precise positioning of frame tubing for welding.

Discuss procedures for constructing a usable EV prototype frame from straight tubing.

Objectives Students will be able to:

Explain the need for jigs and fixture for precise welding.

Explain the specifications for EPT frame fixture system.

Draw a frame fixture element that meets specifications.

Weld a piece of angle-steel or aluminum to a flat base using proper MIG welding techniques.

Manufacture a sufficient number of frame fixture elements to allow for future frame construction.

Unit 16 Work in Mechanical Systems
Students will:

Define work done by a force in a mechanical system
Explain the relationship between work, force, and distance moved.
Identify the effects of work done by force in a mechanical system.
Solve work problems, given force and distance information in English and SI units.
Explain how efficiency relates to input work and output work.
Define work done by torque in a mechanical system.
Explain the relationship of work, torque, and radian distance moved.
Define radian measure of angles
Solve work problems given torque, angle information in English and SI units.

Unit 17 Data Acquisition and Vehicle Testing

Goal Students will optimize the performance of the vehicle by conducting a series of drive tests and collecting data on car performance using a mobile data acquisition system.

Objectives Students will be able to:

1. Describe the components of a data acquisition system.
2. Explain principles behind Electrathon vehicle measurements.
3. Design and construct a buss to measure current, power, speed, and range for our Electrathon vehicle using a data acquisition device and a laptop computer.
4. Perform road trials to benchmark current vehicle design.
5. Analyze and data base information collected from each trial.
6. Optimize subsystems based on vehicle test results.
7. Communicate testing techniques and test results to an appropriate audience.

Unit 18 Force in Mechanical Systems

Goal

Objectives Students will be able to:

1. Define concept of Force in Mechanical Systems
2. Describe results of balanced and unbalanced forces
3. Name the units of force in SI and English Measuring systems
4. Define and understand scalar, vector, weight, mass, and torque
5. Determine the resultant force given 2 or more vectors
6. Solve Force, lever, and torque problems

Unit 19 Rate in Mechanical Systems
Goal

Objectives Students will:

1. Describe what is meant by rate in general.
2. Describe rate in mechanical, fluid, electrical, and thermal systems.
3. Identify appropriate SI and English units for rate in all four energy systems
4. Distinguish between Linear motion and rotational motion
5. Use the equation v=l/t to describe a linear rate or speed (v) as the distance (l) an object travels along a line in a unit of time (t).
6. Use the equation, $v_{av} = (v_1 + v_2)/2$, to calculate the average speed and average velocity when given two linear speeds.
7. Describe linear acceleration (a) as linear speed (v) per unit time by using the equation, $a = (v_f - v_i)/t$.
8. Describe an angular rate or speed (ω) as annular distance (θ) traveled per unit time (t) using the equation, $\omega = \theta/t$.
9. Use the equation, $\alpha = (\omega_f - \omega_I)/t$, to describe an angular acceleration (α) as angular speed (ω) per unit time (t).

Unit 20 Vehicle Display and Project Video Segment

Goal Students will be display and demonstrate the Electrathon vehicle at various end of term functions. A presentation will be prepared by in order to share their design process and engineering features of their vehicle.

Objectives Students will be able to:

1. Describe guidelines for communicating technical results to an audience.
2. Communicate their design process and results in a display format.
3. Communicate their design process and results in a video segment.