SYSTEMS MANAGEMENT SOLUTIONS G/T
ESSENTIAL CURRICULUM

Unit I: Introduction to Systems Engineering

Goal: The student will demonstrate the ability to apply skills taught in prerequisite courses to practicum coursework.

Objectives - The student will be able to:

a. Outline (or diagram) and explain the steps of the design process.
b. Describe how mathematics and science knowledge support the design process.
c. Identify types of lines that make up a working drawing.
d. Perform computer-based research, using advanced search techniques.
e. Enter research citations into Systems Management Solutions online database.
f. Format presentation visual aids using a Systems Management Solutions workstation.
g. Present research results to peers.

Unit II: Electrathon Specifications & Human Factors

Goal: The student will demonstrate the ability to investigate information regarding Electrathon specifications and human factors necessary to design a concept model of an Electrathon class vehicle.

Objectives - The student will be able to:

a. Describe requirements and design considerations for Electrathon class vehicles.
b. Summarize human factors that are considered in Electrathon vehicle design.
c. Build a shared knowledge base about Electrathon vehicles, including specification details, design considerations, and library and online resources.
d. Describe desirable features for an Electrathon vehicle.

Unit III: Vehicle Aerodynamics

Goal: The student will demonstrate the ability to investigate the design of a road vehicle by constructing models and making careful measurements of aerodynamic quantities.

Objectives - The student will be able to:

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

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Unit IV: Introduction to Materials

Goal: The student will demonstrate the ability to investigate the weight, strength, and cost of candidate materials and apply that knowledge to the frame design considerations of road vehicles.

Objectives - The student will be able to:

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

Unit V: Engineering Analysis

Goal: The student will demonstrate the ability to investigate the value of computer modeling to the design process and analyze designs using engineering analysis software.

Objectives - The student will be able to:

a. Summarize the steps used to develop a computer-based model.
b. Explore the relative importance of various design factors for Electrathon concept cars.
c. Predict details of the performance of Electrathon concept vehicles based on a computer model.
d. Explore, understand, and enhance the computer model.

Unit VI: Computer Aided Drafting and Design

Goal: The student will demonstrate the ability to use SolidWorks software.

Objectives - The student will be able to:

a. Identify the parts that make up the SolidWorks window and describe their functions.
b. Navigate SolidWorks pull-down menus.
c. Display and reorganize docked and floating toolbars.
d. Enter commands using the keyboard and toolbars.

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e. Draw two-dimensional views of holes, cylinders, and rounded and polygonal features.
f. Recreate curved objects such as circles, arcs, ellipses, and donuts.
g. Create rectangles and regular polygons.
h. Describe methods of entering x, y coordinates.
i. Locate points and draw objects using the Cartesian coordinate system.
j. Apply the absolute, relative, polar, polar tracking, and direct distance methods of entering coordinates.
k. Complete SolidWorks tutorials.

Unit VII: Laboratory Safety Plan Development

Goal: The student will demonstrate the ability to survey shop safety practices of local research facilities and develop their own safety plan for the laboratory.

Objectives - The student will be able to:

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

Unit VIII: Concept Presentation & Evaluation

Goal: The student will demonstrate the ability to present and defend concept cars.

Objectives - The student will be able to:

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

Unit IX: Project Planning & Management

Goal: The student will demonstrate the ability to create a management plan and present the plan to project stakeholders.

Objectives - The student will be able to:

a. Describe the need for project management.
b. Develop an organizational chart for the construction of an electric vehicle.

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c. Discuss the qualities that an effective leader and an effective team member should possess.
d. Identify team leaders for the development phase of the project.

Unit X: Electrical Systems

Goal: The student will demonstrate the ability to learn and apply the concepts of voltage, work, and power of electrical systems.

Objectives - The student will be able to:

a. Differentiate between AC and DC current.
b. Identify the most common source of DC voltage.
c. Describe the sequence for connecting a DC circuit in series that will cause the voltages to be added.
d. Identify three components of a circuit, giving their symbols, including a source, conductor, and load.
e. Describe how frequency and hertz relate to AC current.
f. Describe how voltage can be considered a force.
g. Name at least three types of voltmeters.
h. Describe a situation that requires a technician to measure.
i. Describe work in electrical systems in terms of the equation: WORK = VOLTAGE X ELECTRICAL CHARGE MOVED.
j. Identify the effects of work done in electrical systems.
k. Identify workplace applications where work occurs in electrical systems.
l. Explain how efficiency relates to input work and output work in an electrical system.

Unit XI: Subsystem Design, Construction, and Testing

Goal: The student will demonstrate the ability to 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 - The student will be able to:

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

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i. Expedite the purchasing process for needed materials.
j. Communicate subsystem team progress to laboratory visitors.

Unit XII: Battery Theory & Operation

Goal: The students will demonstrate the ability to understand the behavior of lead acid batteries and the subsequent ramifications for optimizing performance and handling them safely.

Objectives - The student will be able to:

a. Describe the chemical reactions within lead-acid and nickel-hydride batteries.
b. Compare strengths and weaknesses of various exotic batteries.
c. Assess state of charge of a lead-acid battery using a hydrometer and a load resistor.
d. Monitor battery-charging process using a data acquisition system connected to a computer.

Unit XIII: Vehicle Suspension, Steering, & Control

Goal: The students will demonstrate the ability to investigate principles of automotive steering and suspension and refine original plans to include proper steering geometry.

Objectives - The student will be able to:

a. Identify and explain components of a typical automotive suspension system.
b. Identify and explain components of a typical automotive steering system, including all steering angles.
c. Design EV prototype frame with correct steering geometry.

Unit XIV: Advanced Fabrication

Goal: The student will demonstrate the ability to 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.

Objectives - The student will be able to:

a. Explain the need for jigs and fixture for precise welding.
b. Explain the specifications for the Systems Management Solutions frame fixture system.
c. Draw a frame fixture element that meets specifications.
d. Weld a piece of angle-steel or aluminum to a flat base using proper MIG welding techniques.
e. Manufacture a sufficient number of frame fixture elements to allow for future frame construction.

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f. Construct a usable EV prototype frame from straight tubing.

Unit XV: Data Acquisition and Vehicle Testing

Goal: The student will demonstrate the ability to 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 - The student will be able to:

a. Describe the components of a data acquisition system.
b. Explain principles behind Electrathon vehicle measurements.
c. Design and construct a buss to measure current, power, speed, and range for an Electrathon vehicle using a data acquisition device and a laptop computer.
d. Perform road trials to benchmark current vehicle design.
e. Analyze and record information collected from each trial.
f. Optimize subsystems based on vehicle test results.
g. Communicate testing techniques and test results to an appropriate audience.

Unit XVI: Vehicle Display and Project Video Segment

Goal: The student will demonstrate the ability to be display and demonstrate the Electrathon vehicle at various end of term functions.

Objectives - The student will be able to:

a. Describe guidelines for communicating technical results to an audience.
b. Communicate design process and results in a display format.
c. Communicate design process and results in a video segment.

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