Scientific Research and Design

Junior Level - Tsiolkovsky/Oberth Levels

Synopsis

1st Semester: Knowledge Bases and Skills

Goals: *application of the student's knowledge base, addition of knowledge, and the development of life and work skills - cognitive reasoning, critical thinking, problem-solving, design and development, testing and analysis, documentation, and teamwork and leadership.*

The first semester is designed to provide important information to the student through 15 modules supported by teacher-user-friendly PowerPoints used to ignite the student's desire to learn through the implementation of inquisitive learning within each of the three six weeks. The student will be informed of knowledge bases and problem-solving tools found within the four main energy systems: mechanical, fluid, electrical, and thermal. Hands-on projects are contained within the inquisitive learning curriculum for the first semester to support problem-solving, critical thinking, and cognitive reasoning.

2nd Semester: Project Design/Development

The second semester begins with giving the class/students a design and development project to get a one pound research package to an altitude of 5,280 feet or, achieve transonic flight.

The students, as a project team, develop the overall vehicle design through the use of computer modeling. The design will incorporate all the content mastered in the first semester concerning rocket flight. By offering this information it is expected the students, as a project team, will see the relevance and advance to the next logical step of developing organization and management. Here, the students are selected into component teams, are instructed about timeline management, and taught about critical decision making and project management. The teams, specific to component design and development, first develop a timeline for the product development (i.e. IPDS) and then enter into a research phase concerning the problem aspects of their component. Some of these aspects are function, mass envelope, simplicity, etc. A final argument is developed, usually in the form of mathematical calculations, to allow the component team to move forward into the design process. The mathematical calculations are reviewed by a professional in aerospace industry offering criticism of the calculations but no insight in to how it might be improved. The mathematical design will then be converted to a working drawing to represent the design of the component. Once the team has developed a mathematical argument and drawing for the design of their component, the team will then begin researching any appropriate material to acquire to develop their component. This is where critical decision making comes in to assist the team as they research multiple materials across such variables as safety, cost ability to work with, time to acquire, etc. At this point, once a design has been developed and reviewed, and once a material has been evaluated and decided upon, the team will then present a Critical Design Review (CDR) to the overall project team. If the component team gets a 'thumbs-up' from the other teams, then it is time to move forward to the development of the component. If not, then a redesign is needed until accepted by the rest of the teams. Once accepted by the project team, the component team will acquire the material and begin to develop their component based on the design/materials. At this point, each team will undergo a Flight Readiness Review (FRR) to make sure all components are completed 100% and the vehicle can undergo an 'all-up' configuration. After the vehicle has been tested, the students will enter into the final phase of the project by evaluating the performance of the vehicle through a Post Mission Analysis. This final report will be the end of the semester.

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Scope and Sequence

First Six Weeks

Module 1-1	Why technology?
Module 1-2	Global Impact - Cause and Effect
Module 1-3	What is technology?
Module 1-4	Energy
Module 1-5	Force Vectors
Module 1-6	Force Vector Lab
Module 1-7	Applied Force Vectors
Module 1-8	Mechanical Stresses
Module 1-9	Torque
Module 1-10	Newtonian Physics
Module 1-11	Safety
Module 1-12	First Generation Rocket Development
Module 1-13	Gen 1 Rocket Test/Flight Test Review (PMA)
Module 1-14	Flight Stability
Module 1-15	Six Weeks Summary and Evaluation

Second Six Weeks

Module 2-1	Flight Stability and Six Degrees of Freedom
Module 2-2	Gen 2 Rocket Development
Module 2-3	Gen 2 Flight Readiness Review
Module 2-4	Gen 2 Flight Profile Prediction
Module 2-5	Thrust to Weight Relationship
Module 2-6	Gen 2 Test
Module 2-7	Gen 2 Post-Test Analysis (PMA)
Module 2-8	Fluids in a System (Bernoulli's and Archimedes')
Module 2-9	Fluids - Drag and Lift Forces
Module 2-10	Dimensional Analysis
Module 2-11	Rate
Module 2-12	Resistance
Module 2-13	Resistance Lab
Module 2-14	Problem Solving 101
Module 2-15	12 Weeks Summary and Evaluation

Third Six Weeks

Module 3-1	Lab Intro to Modeling/RockSim
Module 3-2	Gen 3 Rocket Design
Module 3-3	Gen 3 Rocket Development
Module 3-4	Gen 3 Flight Readiness Review (FRR)
Module 3-5	Gen 3 Rocket Test
Module 3-6	Gen 3 Post-Test Analysis (PMA)
Module 3-7	Electricity in a System
Module 3-8	Electrical Circuits
Module 3-9	Electrical Lab
Module 3-10	Thermal Issues in a System
Module 3-11	Thermal Lab
Module 3-12	Work
Module 3-13	Power
Module 3-14	Problem Solving - Advanced
Module 3-15	18 Weeks Summary and Evaluation

Fourth, Fifth and Sixth Six Weeks

Design, Develop, Test, Evaluate