

Experiencing Engineering

Introduction to Design and Analysis (Rev 0; P. Schubert 2/13/2013)

The objective of this one semester course is to give students personal experience of engineering theory and practice. More generally, the goal is to generalize the principles and experience so that the problem solving approaches learned here can be applied to a range of living situations.

The core of the course is three projects that require use of the engineering design cycle. This cycle includes systematic analysis of the problem, application of previously learned scientific principles, design using simulators, construction, testing, analysis, and documentation. Concurrently, a number of supporting topics are introduced, including risk management, strategy of experimentation, and Bayesian probability, which are not normally covered at this level.

The course is designed so it maximizes readily available materials. A shop is not required and the cost of supplies and equipment is minimal. The student source-book will be available without charge.

Problem Solving

- Quantitative Problem Solving Methods
- Problem Solving Framework
- Problem Solving Cycle-Polya
- Heuristics
- Effective Group Dynamics
- Resourcefulness Skills
- Brainstorming
- Engineering Design Cycle
- Strategy for Difficult Exams

Data into Information

- Basis of Cognitive Learning
- Concept Maps
- Gantt Charts
- Principles of Graphical Analysis
- Data Analysis
- Strategy of Experimentation
- Engineering Models/Simulations
- Risk Assessment
- Bayes Probability

Projects:

Heating Project:

Demonstrate a system that raises the temperature of 100 mL of water by 10°C in 10 minutes.

Water Rocket:

Demonstrate a water rocket constructed from a 2L soda bottle meets performance based on design determined using NASA simulator.

Truss Bridges:

Build the most efficient bridge (strength to weight ratio) from bass wood or craft sticks, with guidance from the JHU truss simulator.

- General Problem Statement/Analysis
- Scientific Theory Review and Application
- Initial Design (Simulators for Rocket and Bridges)
- Construction/Compromises
- Reconciliation with Design
- Initial Test
- Analysis, Revisions, Modifications
- Final Test
- Project Report

Articles and Writing Assignments

- Thinking as Doing
- Strategy of Experimentation
- Engineering Disciplines
- Ethics/Citicorp Case Study
- Risk Management
- Engineering Challenges