

GIFTS: A Systems Engineering Approach to Conceptual Design in a 1st-Year Engineering Program

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Projects

Project 1 – Toaster Oven for a Blind Person: Cooking in the Dark

Project 2 – Coffee Maker for Persons with Hand Tremors

Project 3 – Blood Pressure Monitor for Persons with the use of One Arm or Hand

Project 4 – Energy Efficient Bread Toaster

Project 5 – Energy Efficient Refrigerator

Project 6 – Harvesting Kitchen Waste Energy

Project 7 – Team Shaped Project Topic

Harvesting Kitchen Waste Energy

- Paul T. Anastas of the University of Nottingham, United Kingdom and Julie B. Zimmerman of the University of Michigan talk about the 12 principles of green engineering in the March 1, 2003 journal of *Environmental Science and Technology*. Principle 10 is “Design of products, processes, and systems must include integration and interconnectivity with available energy and materials flows.” This principle can be interpreted to mean using waste energy from one system in another system

Harvesting Kitchen Waste Energy

- Maple Eco Friendly LLC wants to use waste energy generated in a kitchen to recharge a small device, such as a mobile phone. Waste energy is energy that performs no useful function. For example, an electric stove top continues to emit waste heat energy after the unit is turned off. As Tesla once said, *“Electric power is everywhere present in unlimited quantities and can drive the world’s machinery without the need of coal, oil, gas, or any other of the common fuels.”*
- **Design Statement:**
Design a means by which waste energy generated in a kitchen can be used to recharge a small device.

Overview

- **Step 1: Research Project**
- **Step 2: Write Requirements**
- **Step 3: Create Alternative Designs**
- **Step 4: Evaluate Alternative Designs**
- **Step 5: Complete and Verify Final Design**
- **Step 6: Final Presentation and Report**

Step 1 – Research Project

- Research to better understand the project
- Engineering school librarian creates a web-based resource for the projects
- Students spend 3-4 weeks researching their project and submit written results

Engineering Design

Research

Books & E-Books

Internet Resources

Consumer Reviews

Annotations

Academic Honesty & Plagiarism

Library Resources

Resources



The Design of Home Appliances for Young and Old Consumers by Athena Tsoukera
Call Number: F 604 .D6 T8 U5
ISBN: 9789040717550
Publication Date: 1999-11-01



Integrating Electrical Heating Elements in Appliance Design by Thor Magnus
Call Number: T 664 .O1 J43
ISBN: 9780224798406
Publication Date: 1997-04-15



A Handbook of Small-Scale Energy Technologies by Neil Hoole (Editor)
ISBN: 9781853397691
Publication Date: 2013-06-21



The Way Kitchens Work: The Science Behind the Microwave, Teflon Pan, Garbage Disposal, & More by Ed Soley
Call Number: T 9656 .S656
ISBN: 9781549767023
Publication Date: 2010-04-27



Refrigerator by Jonathan Ross
Call Number: TP 946 .R58
ISBN: 9781628924350
Publication Date: 2015-09-24



The Toaster Project by Thomas Trawles
Call Number: H 614 .A73 .T49
ISBN: 9781105092828
Publication Date: 2011-09-28



Assistive Technology for Visually Impaired and Blind People by Marion A. Moran (Editor), Michael A. Johnson (Editor), David Goetting
Call Number: HV 1701 .A87
ISBN: 9781846288978
Publication Date: 2010-05-12



Human Factors and Voice Interactive Systems by Danyle Gardner-Bonneau (Editor), Harry E. Blanchard (Editor)
Call Number: T 7382 .S65
ISBN: 9780203764590
Publication Date: 2007-12-05



Foundations for Designing User-Centered Systems by Faint E. Kinn, Gordon D. Baxter, Eileen F. Churchill
Call Number: QA76 .F5
ISBN: 9781447151340
Publication Date: 2014-04-11



Handbook of Human Factors and Ergonomics by Gavriel Salvendy
Call Number: TH 56 .H275
ISBN: 9781118129067
Publication Date: 2012-03-19

Subject Librarian



Make an appointment

Schedule Appointment



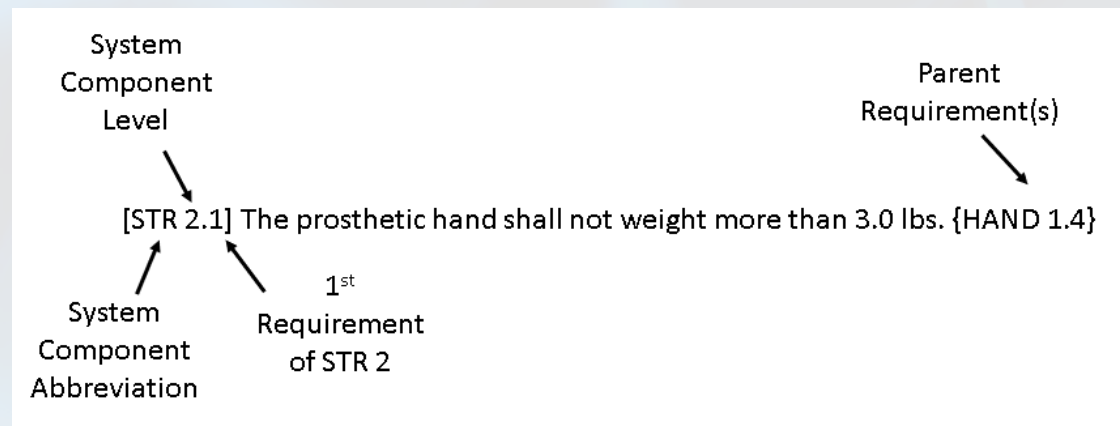
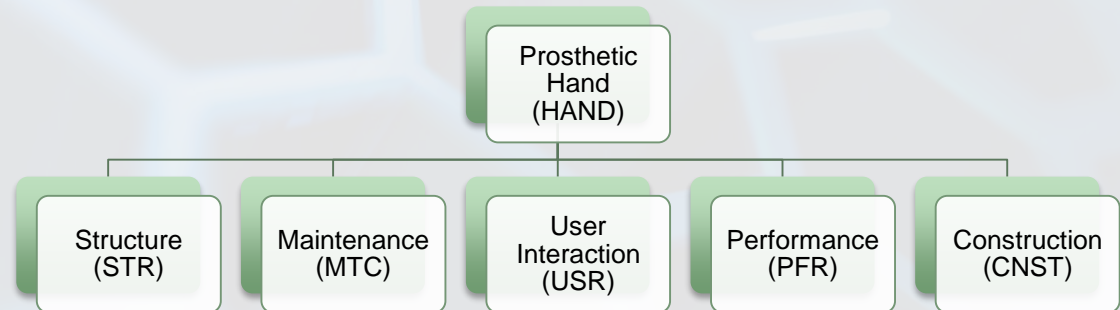
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1024 Science Library
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Step 2 – Write Requirements

- Student teams each write about 20 requirements
- Requirements get approval from project program manager



Step 3 – Create Alternative Designs

- **Brainstorm alternative design solutions**
 - **Rule 1:**
No criticism, evaluation, or negative comment about any suggestion.
 - **Rule 2:**
As many ideas as possible must be collected
 - **Rule 3:**
No idea is too weird
- **Select 3 ‘best’ design ideas**
- **Project team divides into 3 teams of 2 students**
- **Teams spend next 4 weeks creating the detailed alternative designs that meet the requirements.**

Step 4 – Evaluate Alternative Designs¹

		Design Candidate 1		...	Design Candidate n	
Criteria	Weighting Factor (W)	Numerical Value (NV ₁)	Weighted Value (W*NV ₁)	...	Numerical Value (NV _n)	Weighted Value (W*NV _n)
Cost ²				...		
Structure				...		
Maintenance				...		
User Interaction				...		
Performance				...		
Construction				...		
Total						

¹Pahl & Beitz

²Cost is not part of the system structure but considered.

Step 5 – Complete and Verify Final Design

- **Students make final design changes to the selected design, if needed.**
 - The entire team contributes to the final design.
- **Final design is verified to meet all requirements.**
- **Verifications are done by one or more of**
 - mathematical analysis
 - simulation
 - logical argument
- **If a requirement is not met, a plan must be offered to fix the design and/or negotiate with the customer (i.e., the program manager)**

Step 7 – Final Presentation and Report

- **Student teams make a final presentation to the class.**
- **The presentation includes**
 - Requirements
 - Alternative designs
 - Evaluation to select the final design
 - Verifications
- **Student teams submit final report**
 - Grading rubric accounts for individual and team contributions toward student grade.

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Thanks!

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