

## Design Project

### Outcomes:

The student will use the design process to develop a product. The product may be a toy, a tool or an appliance or other product. The student will demonstrate sketching techniques. The student will demonstrate the use of precision measuring equipment. The student will demonstrate the ability to work in a group setting. The student will demonstrate ip, iam and assembly mastery in Autodesk Inventor. The student will demonstrate advanced skill in dimensioning orthographic drawings. The student will construct a prototype.

### Procedure:

**Keep a log.** It will be graded. All documents and research is to be kept and handed in.

### Use the design process.

1. Problem Identification
  2. Conceptualization
  3. Refinement of Preliminary Ideas
  4. Design Analysis
  5. Development and Implementation
  6. Optimization
  7. Presentation
- Students are to work in groups of 2 -4.
  - Stage 1: Identify a problem
    - Market Research (Survey a group)
    - Design Brief
    - Identification and Classification of Constraints
  - Select a product. It might be a toy, a tool or an appliance or other product.
  - Stage 2: Conceptualization
    - Research
      - Data Collection
      - Resources for Information
      - Brainstorming
      - Sketching
  - Get it approved by the instructor.
  - Stage 3: Refinement of Preliminary Ideas
    - Identification of Workable Solutions
    - Development of Detailed/Annotated (ortho) Sketches
    - Graphical Analysis of Possible Solutions
  - Stage 4: Design Analysis
    - Comparison of Alternatives and Specifications
    - Creation of a Decision **Making Matrix**
    - Generation of Alternate Solutions
    - Narrowing of the Design Solutions
  - Stage 5: Development and Implementation
    - Detailed Documentation of the Final Design (Ortho/Assembly/Parts)
    - Prototyping of the Design Solution
    - Testing and Analysis

- Stage 6: Optimization
  - Reassessment of Design Specifications
  - Implementation of Modifications
  - Update of Drawings (make corrections)
- Stage 7: Presentation
  - Oral Report
  - Written Report
  - Visual Aids/Models
  - Complete a packet to the present the boss.

### **Design Project Report**

The report should be in technical form in a Power Point format.

The report should include the following:

- What product you choose.
- Why you choose the product.
- What problems did you encounter?
- How you solved those problems.
- What improvement did you make
- What did you get out of the project; i.e. group work, work with tools, saw how something worked...

See rubrics in you packet for grading.

# Design Project Stage 1

Date Due: \_\_\_\_\_

- Stage 1: Identify a problem
    - Market Research (Survey a group)
    - Marketing department asked to try and find out how much of a demand there is for the proposed new product.
    - Accomplished through the use of surveys.
    - Prepare graphs and charts to visually present the results of the surveys.
      - Develop a questionnaire
      - Interview experts
      - Research periodicals/internet/books
        - Visit [www.baddesigns.com](http://www.baddesigns.com)
      - Look at what is on the market now
        - Who? - would need it
        - What? - is needed
        - When? - is it needed
        - Where? - is it needed
        - Why? - is it needed
        - How Many? - are needed
          - Problem Statement/Definition:
          - These faucet handles look nice, but they are not functional when your hands are wet and soapy.
          - Redesign these handles so that when person's hands are wet and soapy, they can easily be gripped.
            - 20 pts
    - Design Brief
      - A clear and concise description of the problem.
      - Identification of the needs to solve the problem.
      - List any design constraints (limits), such as function, appearance, time, legal issues, cost, etc.
        - Problem statement
          - An Identification of a Problem...
          - An Observed Need...
          - A New Idea for a...
          - Product
          - System
    - 10 pts
  - Identification and Classification of Constraints
    - Aesthetics
    - Time
    - Information
    - Capital
    - Tools & Machines
    - Energy
    - Materials
    - People
    - Ethics
  - 10 pts
- Select the product. It might be a toy, a tool or an appliance or other product.



# Design Project

## Stage 2

Date Due: \_\_\_\_\_

- Stage 2: Conceptualization

Once a clear understanding of the function and performance expected of a product is determined, one can dream of possible solutions. These should be documented via written descriptions and notes.

- Research

- Data Collection

- Collate the data from your research
  - 10 pts

- Resources for Information (Print out web page or/or list)

- Present a list of resources used (at least 5)
  - Explore all possible sources for ideas
  - Existing Products
  - Earlier Patents
  - Design and Trade Journals
  - Museums
  - Trade Exhibitions
  - Hardware Stores
  - World Wide Web
- 5 pts

- Brainstorming (hand in your rough list)

- Record your thoughts and ideas with quick notes or sketches.
- Discuss these with your team members.
- Record any tangent concepts.
- Investigate any additions, sources, or ideas discussed.
- All solutions and ideas are welcome.
- Create a list of ideas

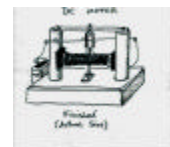
- 10 pts

- Sketching (minimum 3)

- Isometric thumbnails

- 20 pts

- Get it approved by the instructor.



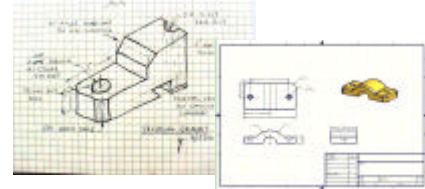
# Design Project

## Stage 3

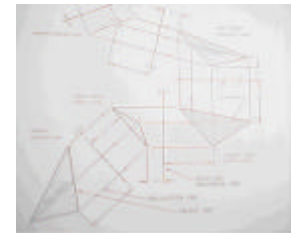
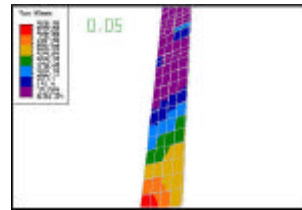
Date Due: \_\_\_\_\_

- The evaluation of different designs is done at this stage.
- More than one solution is still explored. However, the specifications and constraints are applied to limit the breadth of the designs.
- The designs are subjected to various types of analysis to help arrive at the final design.

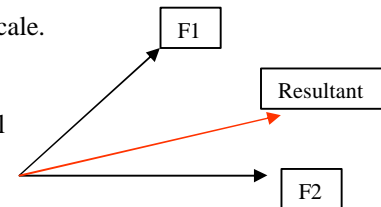
- Stage 3: Refinement of Preliminary Ideas
  - Identification of Workable Solutions
    - **Identify regulations associated with your design**
  - Development of Annotated (isometric and orthographic) Sketches
  - Graphical Analysis of Possible Solutions
    - Graphical analysis is used in design refinement to see which designs optimally perform under design parameters.



- Descriptive Geometry
- Vector Analysis
- Layout Analysis
- Finite Element Analysis
- 3D Modeling



- Vector: a quantity having both magnitude and direction.
- A vector can be represented by an arrow drawn to a particular scale.
- The direction of the arrow shows the direction of the vector.
- Usually involves two or more forces at work.
- When two or more forces are at work, you will get an additional force called a *resultant*.



- Develop a preliminary model(s)
  - Computer
  - Clay
  - Lego's
  - Wood
  - Graphs



**50 Points**

# Design Project

## Stage 4

Date Due: \_\_\_\_\_

- Stage 4: Design Analysis
  - When engineering tools are used to determine the best solution.
    - Comparison of Alternatives and Specifications
      - The design process always generates more than one solution.
      - These designs should be pursued so they can be sufficiently evaluated.
      - The alternate designs are then filtered through a design matrix to further refine the design choice.
    - Creation of a Decision **Making Matrix**
  - Design Selection Matrix

Selection 1

| Criteria  | Design 1 | Design 2 | Design 3 |
|---|----------|----------|----------|
| Organizer must be designed for specialized use (drafting tools)                                       | x        |          |          |
| Footprint should not exceed 18" x 12"   | x        |          |          |
| Volume should not exceed 18" x 12" x 10"  | x        |          |          |
| Must store pencils for easy identification and quick access and storage                               | x        |          |          |
| Must allow space for graphing calculator, pencils, pens, note pads, scale and papers, and other items | x        |          |          |
| Must free up space on table for placement of large drawings   | x        |          |          |
| Total +'s   | x        |          |          |
| Total -'s   | x        |          |          |
| Total S's   | x        |          |          |

- - Compare design solutions against one another
  - Develop a criteria of comparison based upon project requirements
  - Use a + for better than, a - for less than and an S for the same as
- Generation of Alternate Solutions
  - Once all the possible design alternatives are filtered through the matrix, the top designs are chosen for further development.
- Narrowing of the Design Solutions
- Refinement of Detailed/Annotated (isometric and orthographic) Sketches

**50 Points**

# Design Project

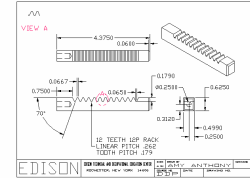
## Stage 5

Date Due: \_\_\_\_\_

- Stage 5: Development and Implementation

- Detailed Documentation of the Final Design (Ortho/Assembly/Parts)

- A drawing that supplies information and instructions for the manufacture or construction of machines and structures.
    - Typically shows individual views of the object.
    - A drawing showing the product in its completed state.
    - An exploded assembly is a very common type of assembly drawing. It shows the individual pieces of the object unassembled, and it shows the pieces aligned to each other demonstrating how to assemble the object.



- Prototyping of the Design Solution

- Models are used as representations of system design for refinement and testing of the product.
    - Mock-ups, prototypes, presentation
    - CAD: wireframe, surface, solid
    - Rapid prototype (RP): generating a physical model from a CAD database.



- Testing and Analysis

- Testing
      - Part or product must be able to stand up to the stresses that it will be subjected to during its operational lifetime.
      - Usually accomplished by subjecting the part or a model of the part to various forms of testing.
      - Testing Forms
        - non-destructive
        - destructive
        - computer analysis
    - Analysis
      - Three Types of Data
        - survey data
        - design data
        - comparison data
      - Which get turned into:
        - graphs
        - charts
        - Diagrams

# Design Project

## Stage 6

Date Due: \_\_\_\_\_

- Stage 6: Optimization

This entails further development and refinements to the design. These developments and refinements may be necessary to correct a problem or design flaw that was discovered as a result of the testing done in the last design stage.

- Material selection, manufacturing processes, and various other design requirements can also be refined at this stage.
- Every feature of the design and capability of the design should be evaluated and analyzed.
  - Reassessment of Design Specifications
  - Implementation of Modifications
  - Update of Drawings (make corrections)

# Design Project

## Stage 7

Date Due: \_\_\_\_\_

- Stage 7: Presentation
  - After all aspects of the design have been decided upon and the design selected, it must be “sold” to the clients or to supervisors.
  - An effective presentation of the design proposal is a critical step in the design process.
  - While a great design might be harmed by a poor presentation, the reverse is also true. A poor design could be helped by a great presentation.
    - The most important aspect of any *PRESENTATION* is *PREPARATION*
    - The most important aspect of *PREPARATION* is *ANTICIPATION*
    - Try to anticipate
    - A good presentation
    - What can go wrong
    - What questions might be asked
    - Alternative solutions
    - Expect the unexpected
  - Oral Report
    - The oral presentation is just as important as the written.
    - The presenter should:
      - Command attention
      - Be confident
      - Know the material
      - Be enthusiastic
  - Written Report
    - A written report is usually presented before an oral presentation.
    - Target your audience, engineers, sales, and consumers.
  - Visual Aids/Models
    - A great addition to the presentation is a visual aid and/or model.
    - These can take the form of charts or graphs, which should be simple and clearly convey the desired information.
    - The best way for someone to visualize the design is to have a physical model.
    - These can take the form of a mock-up, rapid prototype, or model.
  - **Complete a packet to present to the boss. MAKE IT PROFESSIONAL!**
    - **In a notebook or folder**
    - **Table of content**
    - **Group list**
    - **Other pertinent information**

# Design Project Grades

- Stage 1
  - Write out the Identified problem
  - Present your survey and group
- Stage 2
  - Printout of survey results
  - List of resources (web pages, books, patents, other surveys...)
  - List brainstorming ideas
  - Thumbnail Sketches: Minimum of 3 isometrics
- Stage 3
  - Document evaluation of different designs
  - Document graphical analysis of possible solutions
  - Develop a preliminary model(s)
- Stage 4
  - Design your own matrix and complete
  - Document alternative solutions
  - Document narrowing of the design solutions
  - Refined sketches: Use another color to show changes
- Stage 5
  - Detailed Documentation of the Final Design (Ortho/Assembly/Parts)
  - Design and build prototype model
  - Document test and analysis
  -
- Stage 6
  - Optimization (Implement changes)
- Stage 7
  - Presentation
  - Oral report
  - Written report
  - Present visual aids/models

