


Design Concepts & Engineering Principles


In order to highlight the design content of each project, the final reports will be required to include a section that addresses the following questions:

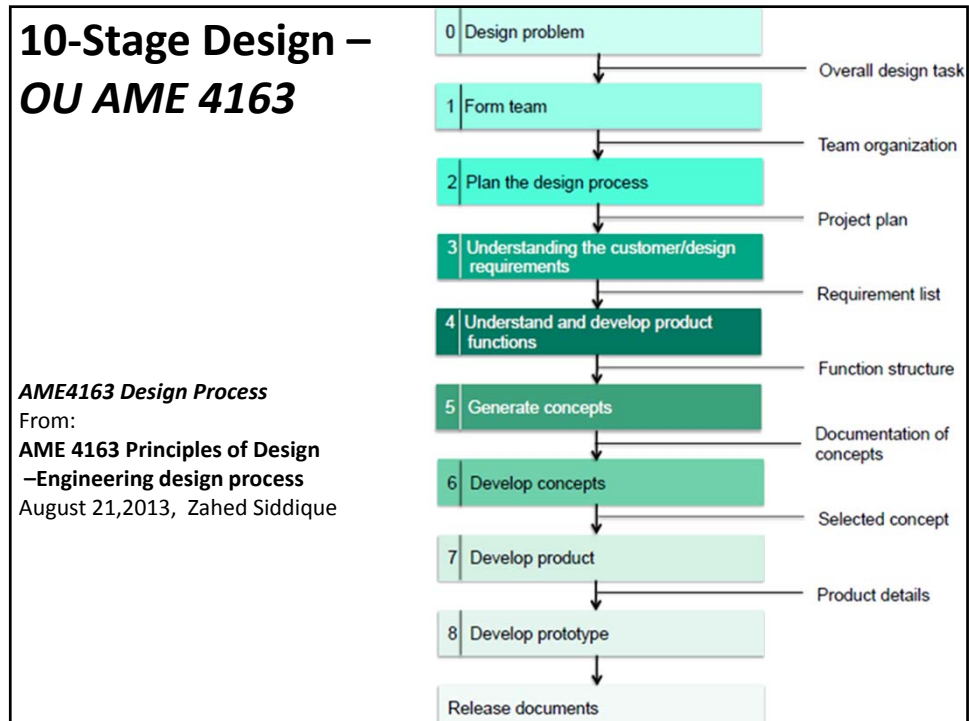
- 1) What was the open-ended design problem or goal that you addressed;**
Develop/design a biologically-compatible, flexible, robust coating to stop the plasticizer DEHP from leaching out of PVC biomedical materials (e.g. plasma bags and IV-tubes).
- 2) Describe in detail the system, component, or process that you designed to solve the problem or accomplish the goal;**
Developed process to measure DEHP leaching from PVC – used UV-Vis to look at DEHP go into aqueous solution from immersed PVC. Made a matrix of coatings on PVC. Tested each coating to find the best, then optimized the coatings parameters through different thicknesses, annealing, RF and plasma treatments etc.
- 3) What design concepts and engineering principles did you employ;**
Edisonian Approach –large matrix of samples, trial and error; Improve; Project Charter, GANTT Chart; Critical Paths, PERT Charts; 10-Stage Design; ITEA-Design Process
- 4) What realistic constraints were included;**
Economic, Environmental, Sustainability, Manufacturability, Ethical, Health and Safety, Social, Political:
- 5) How did you make use of mathematical modeling or simulation; and**
Matlab, Mathematica, L-EDIT, Spice; COMSOL Multiphysics, Monte Carlo; Mechanical drawing software I-DEAS, Finite Difference and Finite Element Analysis (FEA); ANSYS, Computational Fluid Dynamics (CFD); PHOENIX and SYNOW for Supernovae
- 6) How was your creativity expressed in your project?**
Built many prototypes, developed new procedures, new modeling techniques, developed new fitting software ...

Design concepts and engineering principles did you employ

- Edisonian Approach –large matrix of samples, trial and error
- Improve
- Project Charter GANTT Chart
- Critical Paths PERT Charts
- 10-Stage Design







Engineering-Physics Design Process

1. **Define the Problem**
2. *Brainstorm Possible Solutions*
3. *Research and Generate Ideas*
4. *Identify Criteria and Constraints*
5. *Explore Possibilities*
6. **Select an Approach**
7. **Develop a Design Proposal**
8. *Make a Model or Prototype*
9. *Test and Evaluate the Design*
10. *Refine the Design*
11. **Create or Make Solution**
12. Communicate All Results

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| 10-Stage Design | vs. | 12-Stage Design |
|--|-----|---|
| 1. Identify the problem/product innovation (1.) | ↔ | 1. Define the problem (1.) |
| 2. Define the working criteria/goals (4.) | ↔ | 2. Brainstorm Possible Solutions (4.) |
| 3. Research and gather data (3.) | ↔ | 3. Research and Generate Ideas (3.) |
| 4. Brainstorm / generate creative ideas (2.) | ↔ | 4. Identify Criteria and Constraints (4.) |
| 5. Analyze potential solutions (5.) | ↔ | 5. Explore Possibilities (5.) |
| 6. Develop and test models (7.,8.,9.) | ↔ | 6. Select an Approach (7.) |
| 7. Make the decision (6.) | ↔ | 7. Develop a Design Proposal (6.) |
| 8. Communication and specify (12.) | ↔ | 8. Make a Model or Prototype (6.) |
| 9. Implement and commercialize (11.) | ↔ | 9. Test & Evaluate the Design (6.) |
| 10. Perform post-implementation review and assessment (--) | ↔ | 10. Refine the Design (--) |
| | ↔ | 11. Create or Make Solution (9.) |
| | ↔ | 12. Communicate Results (8.) |

These Look better for a Product

from "Engineering Your Future: A Comprehensive Introduction to Engineering" by William C. Oakes, Les L. Leone, Craig J. Gunn, John L. Gruender - Oxford University Press ISBN 0199797560

These look better for Research

– ITEEA *Standards for Technological Literacy*