

Introduction to Machine Design

ME 423: Machine Design
Instructor: Ramesh Singh



Outline

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- Introductory remarks
- Grading policy
- Intro to Machine Design



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Contact Details

- Prof. Ramesh Singh
 - E-mail:
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 - Tel: 7507
 - Off. Hrs. (Prof. Singh): Fridays 3.25-5 p.m. in Machine Tools Lab
 - Also by appointment
 - Lecture notes will be posted on moodle
 - On website:
<http://www.me.iitb.ac.in/~ramesh/courses/ME423/me423.html>



Focus and Objectives of Course

- Basics of Engineering Design
- Selection of Engineering Materials for Mechanical Design
- Analysis of Machine Elements
- Need Analysis & Concept, Synthesis, Design, Modeling, Fabrication and Characterization of a complete system or a product (proposed and executed by each group of 10 students)



Introductory Remarks

- See second page of syllabus
 - Homework
 - Exams
 - Honor code



Grading Policy

- Assignments+ Quizzes 15%
- Midterm 25%
- Project 35% (15% In-sem in form of reports, presentations, stage-wise prototype if possible) + 20% Evaluation at the semester end for final presentation, report and prototype)
- End semester exam 25%
- Total 100 %

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Syllabus: Topics on Machine Elements:

1. Introduction to Design process
2. Review of Strength of Materials
3. Materials Selection
4. Steady loading failure
5. Variable loading failure
6. Simple machine parts
7. Welding and Fastening: Welded and Riveted joints, screw fasteners and connections
8. Lubrication and Bearings
9. Gears
10. Sensors and Actuators: DC motors, piezos, magnet-coil, and hydraulics
11. **Flexible mechanical elements: Belts and drives**
12. **Springs**
13. **Flywheels, Clutches, Brakes, Coupling**



Text Books

Text Books:

- *Machine Design: An integrated approach, R.L. Norton; Pearson Education Inc. (India), 2nd edition, 2000*
- *Shigley's Mechanical Engineering Design, R.G. Budynas,, J.K. Nisbett; Tata Mcgraw-Hill Publishing Co. Ltd., 2012*

References:

- *Materials Selection in Mechanical Design, M.F. Ashby; Elsevier, 2010*
- *Engineering Design: A project based approach*
- *Fundamentals of Machine Component Design, R.C. Juvinall, K.M. Marshek, John Wiley & Sons, 3rd edition, 2000*

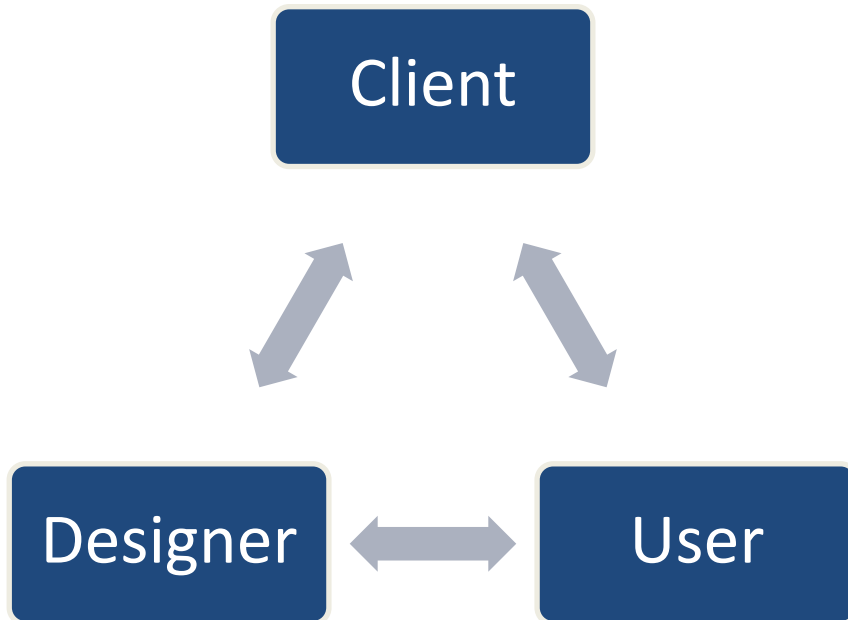


Course Summary

- Focus on:
 - Identifying the need and developing concepts
 - Analysis of Machine Elements and Synthesis
 - Materials Selection
 - Synthesis, Design, Modeling, Fabrication and Characterization of a product or system
- Teamwork will be encouraged
 - Homework
 - Project



Engineering Design: Key Roles in Design Process



- Client: A person or group or company that wants a design conceived
- User: A person who will employ or operate whatever is being designed
- Designer: Solve the client's problem in a way that meets the user's needs



Engineering Design: Definitions

- Engineering design is a systematic, intelligent process in which engineers generate, evaluate, and specify solutions for devices, systems, or processes whose form(s) and function(s) achieve clients' objectives and users' needs while satisfying a specified set of constraints.
- In other words, *engineering design is a thoughtful process for generating plans or schemes for devices, systems, or processes that attain given objectives while adhering to specified constraints.*



Key Definitions

- Design objective: A feature or behavior that the design should have or exhibit
- Design constraint: A limit or restriction on the features or behaviors of the design. A proposed design is unacceptable if these limits are violated
- Functions: Things a designed device or system is supposed to do.

Engineering functions almost always involve transforming or transferring energy, information, or material. It includes supporting and transmitting forces, the flow of current, the flow of charge, the transfer of material, and so on



Key Definitions

- Means: A way or a method to make a function happen e.g. *friction is a means of fulfilling a function of applying a braking force*
- Form: The shape and structure of something as distinguished from its material.

We will not deal with form but form is central to industrial design, a very important part of product design

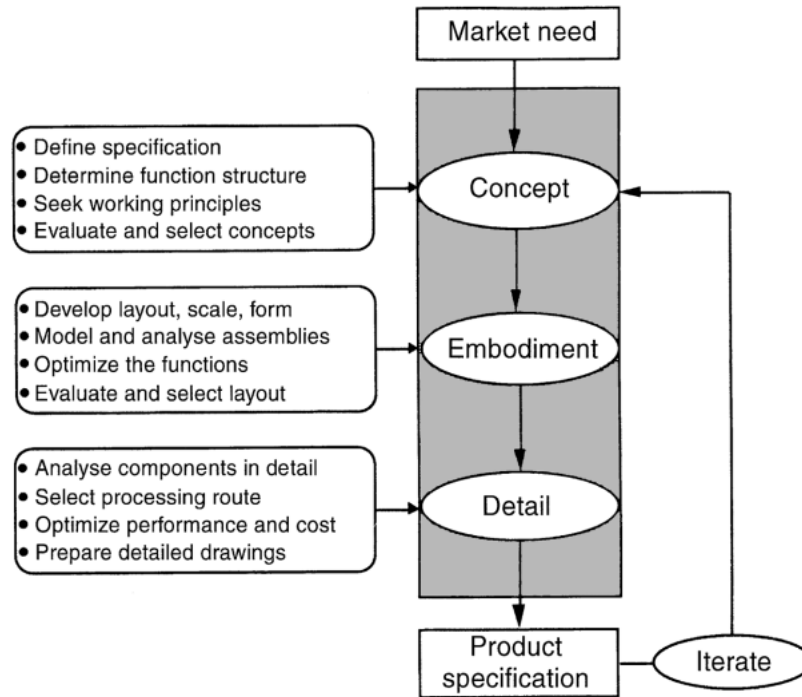


Measuring Success of Engineering Design

- Metric: A standard of measurement; in the context of engineering design, a scale on which the achievement of a design's objectives can be measured and assessed
- Specifications: A scale on which the achievement of a design's functions can be measured. Specifications are engineering statements of the extent to which functions are performed by a design



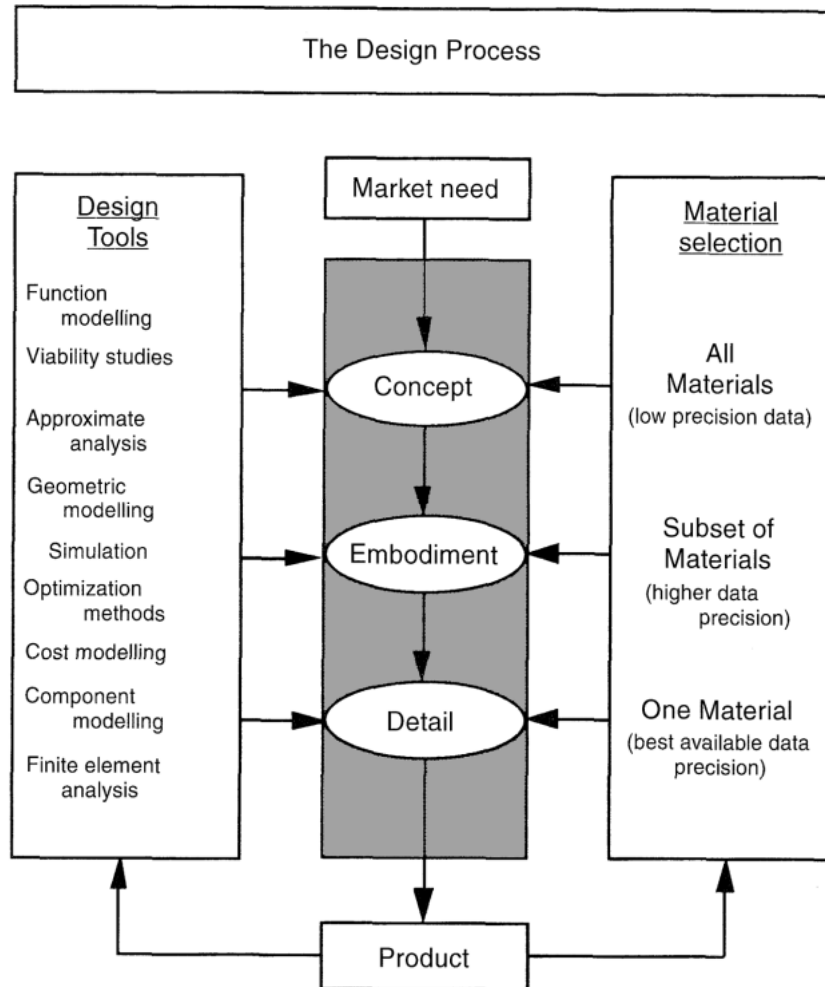
Design Process



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Design Process

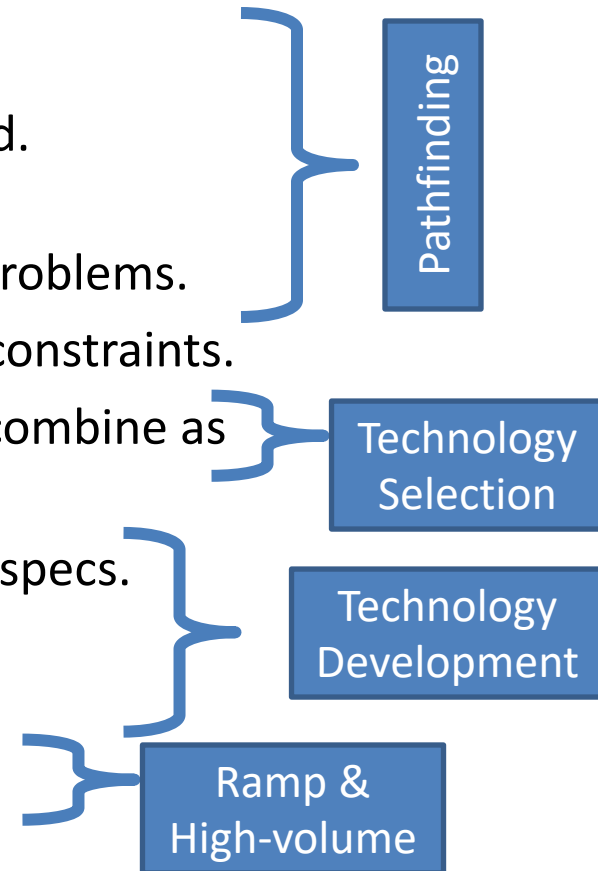


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Design Process Steps

- Identify the need. **Understand the need.**
- Describe the need: what is desired, what is undesired. Constraints. Break down the problem in parts.
- Research: what exists out there overall and for sub-problems.
- Identify options: that could meet the requirements/constraints.
- Analyze, evaluate: effectiveness of options. Modify, combine as needed. Select most effective option.
- Detailed design: CAD, stress analysis, manufacturing specs.
- Prototyping and Testing
- Manufacturing process design
- Production.



Laser Vent Cleaning



**Indian Institute of Technology Bombay
India**

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