

Machine Design-I

(Session- 2018-19)

Introduction to Machine Design



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Faculty:
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Mechanical Engineering
The Today and Tomorrow



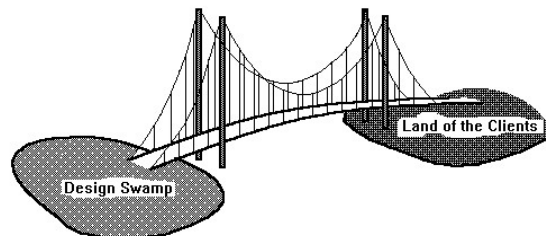
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MACHINE DESIGN I

(BMEC 0010)

U have to give a solution to the world



Introduction

Design of machine elements is concerned with the physical realization of a machine components as an output for a given problem with safe fail, economy and other considerations.

For the first time you will link the calculations with a practical design expresses in drawings.

This course majorly focuses on

- Recognizing and defining open ended engineering design problems
- Generating creative concepts and solutions
- Project planning
- Iterative Decision making for optimum design
- Modeling and analysis

Course Outline

Semester V

Credits: 03

Module	Content	Teaching Hours
I	<p>Introduction: Mechanical Engineering Design, Design considerations, Standards in Design, Material Selection, Modern Design Approaches.</p> <p>Design Against Static Load: Modes of Failure, Factor of Safety, Theories of Failure.</p> <p>Design Against Fluctuating Loads: Cyclic Stresses, Fatigue and Endurance Limit, Stress Concentration Factor; Design for Finite and Infinite Life, Soderberg, Goodman Criteria.</p>	14
II	<p>Design of Riveted Joints: Types of Riveted Joints, Failure of Riveted Joint, Efficiency of Riveted Joint, Design of Boiler Joints, Eccentric Loaded Riveted Joint.</p> <p>Design of Threaded Joint: Design of Bolted Joint, Eccentrically Loaded Bolted Joint.</p> <p>Design of Welded Joints- Stresses in Butt and Fillet Welds, Eccentrically Loaded Joint.</p> <p>Shafts: Cause of Failure in Shafts, Materials for Shaft, Design of Shafts, Shafts Subjected to Fatigue Loads.</p>	14
III	<p>Keys and Couplings: Types of Keys, Splines, Design of Square & Flat Keys, Couplings- Design of Rigid and Flexible Couplings.</p> <p>Mechanical Springs: Material for Helical Springs, Design of Helical Springs Subjected to Static and Fatigue Loading, Design of Leaf Spring.</p> <p>Power Screws: Forms of Threads, Multiple Threads, Efficiency of Square Threads, Trapezoidal Threads, Stresses in Screws, Design of Screw Jack.</p>	12

Resources

Text Books:

- Bhandari V.B., "*Design of Machine Elements*", Tata McGraw Hill Co.

Reference Books:

- Shigely Joseph E., "*Mechanical Engineering Design*", McGraw Hill Publications.
- Valance Alex and Doughtie VI, "*Design of Machine Members*", McGraw Hill Co.
- Spott M.F., "*Machine design*", Prentice Hall India.
- Maleev and Hartman, "*Machine Design*", CBS Publications.
- Black & Adams, "*Machine design*", Mc Graw Hill.

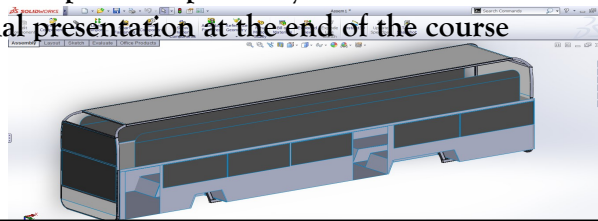
The Textbook



- It includes 25 chapters
- First 10 of it will be covered in Machine Design I, rest will be followed by Machine Design II in the next semester
- In addition, the course need the assistance of Design Data Handbook
- The course will have some case studies also

Key Expectations to 'Excel'

- Fundamentals of strength of material, Engineering mechanics and Engineering Drawing
- Mindset of working on designing projects rather than only learning
- "Practice" more than you study.
- Incorporate design software tools (ANSYS, CREO, CATIA etc.)
- your imagination and team work
- Prepare a final project report and present your team work in a good and clear formal presentation at the end of the course



Course Outcome

- *Analyze the stresses in machine elements and structural members under various loads*
- *Apply multidimensional failure criteria in the analysis and design of machine components*
- *Design temporary and permanent joints such as riveted, bolted and welded joints*
- *Design and determine the fatigue life of circular shafts under the combined loadings, selection of keys, and design of*

Metric for the course

- **Students will work in teams to complete a Design Project.**
- **Students will take one midterm exam.**
- **Students will complete 10 tutorial assignments.**
- **Students will take 5 or more surprise quizzes randomly distributed during the lecture hours throughout the semesters.**

No prior information regarding the date or the material for quizzes shall be given.

Instructor Contact Details

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- Design is essentially a decision making process
- For every problem, we need to design a solution

Design is to formulate a plan to satisfy a particular need and to create something with a physical reality.



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Design of a chair

Factors need to be considered

- The purpose for which the chair is to be designed
- Whether the chair is to be designed for a grown up person or a child
- Material for the chair, strength and cost need to be determined
- Aesthetics of the designed chair



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- Almost everyone is involved in design, in one way or the other, in our daily lives because problems are posed and they need to be solved.



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Basic concept of design

- Decision-making : every stage of design
- Consideration of different factors
- To draw certain conclusions leading to an optimum design
- Market survey to read people's mind
- Study of existing norms

A bad decision leads to a bad design and a bad product



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Design disciplines

- Ship design
- Clothing/fashion design
- Process design
- Bridge design
- Building design
- Many more....
- ***Machine design***



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Definition of a machine

- Machine is defined as a combination of resisting bodies with successfully constrained relative motions which is used to transform other forms of energy into mechanical energy or transmit and modify available energy to do some useful work.

Machines can receive mechanical energy and modify it so that a specific task is carried out.



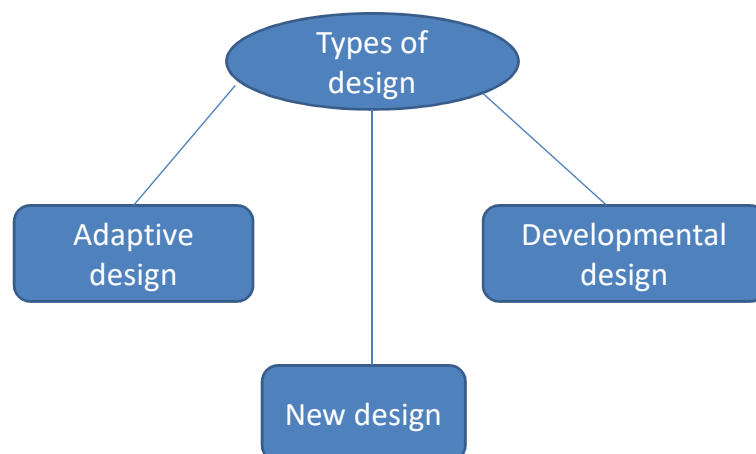
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Machine design

- Machine is the combination of several machine elements arranged to work together as a whole to accomplish specific purposes
- Machine design involves designing the elements and arranging them optimally to obtain some useful work



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Adaptive design

- Based on existing design, standard products or systems are adopted for a new application
- Conveyor belts, control system of machines and mechanisms or haulage systems are some of the examples where existing design systems are adapted for a particular use



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Developmental design

- Starting with an existing design, finally a modified design is obtained
- A new model of a car is a typical example of a developmental design



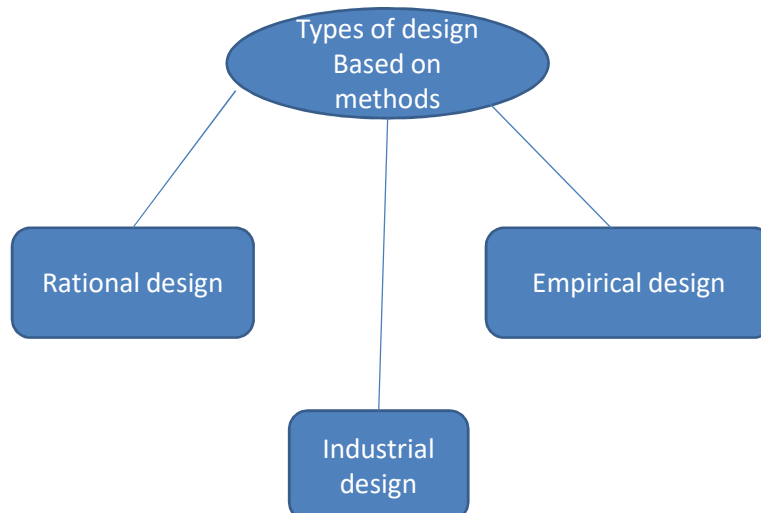
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New Design

- This type of design is an entirely new one but based on existing scientific principles
- No scientific invention is involved but requires creative thinking to solve a problem
- Examples of this type of design may include designing a small vehicle for transportation of men or material on board a ship or in a desert



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Rational design

- Based on determining the stresses and strains of components and thereby deciding their dimensions

Industrial design

- Based on industrial considerations and norms viz. market survey, external look, production facilities, low cost, use of existing standard products.



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Empirical design

- Based on empirical formulae which in turn is based on experience and experiments

eg. When we tighten a nut on a bolt, the force exerted or the stresses induced can not be determine exactly but experience shows that the tightening force may be given by $P=2840d$ where, d is the bolt diameter in mm and P is the applied force in N.

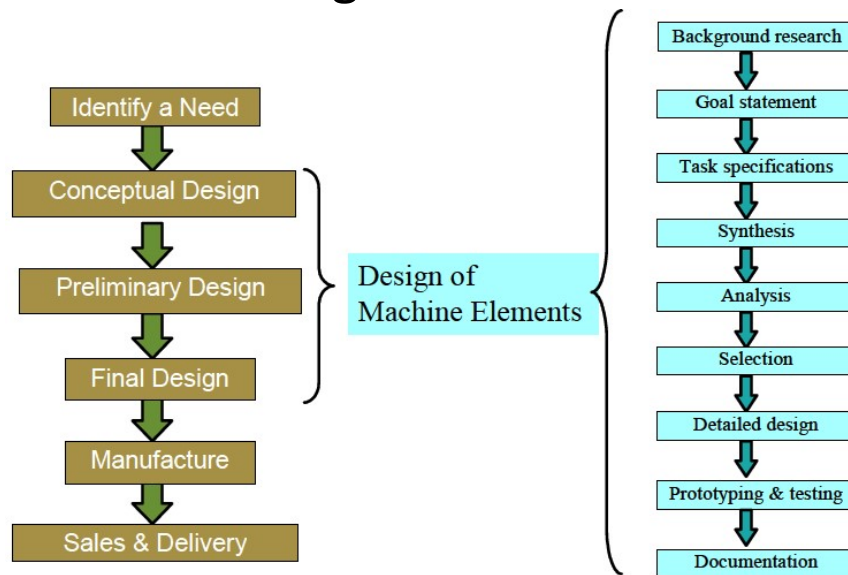
There is no mathematical backing of this equation but it is based on observations and experience

Design Requirements OR Design considerations

The design of a component or system may be influenced by a number of requirements. If a requirement affects design, it is called a design consideration. For example, if the ability to carry large loads without failure is important, we say that strength is a **design consideration**. Most product development projects involve a number of design considerations:

- | | | |
|------------------------|-----------------------------------|----------------------|
| - Strength/stress | - Cost | - Thermal properties |
| - Distortion/stiffness | - Processing requirements | - Surface finish |
| - Wear | - Weight | - Lubrication |
| - Corrosion | - Life | - Marketability |
| - Safety | - Noise | - Maintenance |
| - Reliability | - Aesthetic considerations | - Volume |
| - Friction | - Shape | - Recyclability |
| - Usability/utility | - Environmental protection | - Size |

Design Procedure





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Thank You