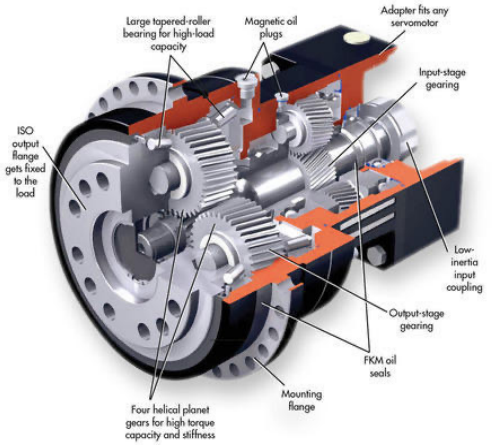
Machine Design

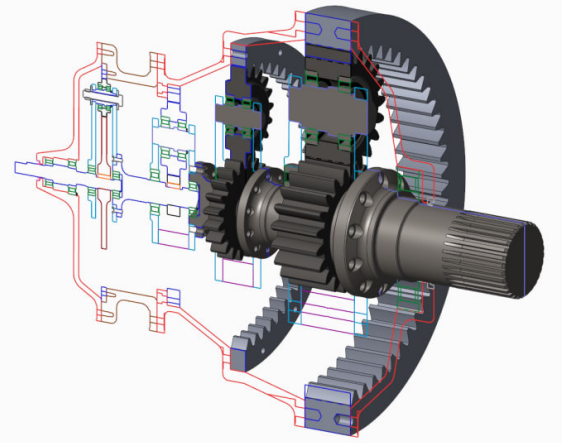
Course No. MEC3110

Introduction

Machine design is an area of study in which one learns to design machine parts by utilizing its whole knowledge and experience in field of mechanical engineering.

- **Machine** - Combination of linkages having definite motion and capable of performing useful work.
- **Machine Design** - Creation of plans for the machine to perform the desired functions.
- **Basis** - Scientific principles, technical knowledge and imagination are used to develop a machine or mechanical system to perform specific functions with maximum economy and efficiency.





Knowledge of basic and engineering sciences such as Physics, Mathematics, Engineering Mechanics, Strength of Materials, Theory of Machines, Thermodynamics and Heat Transfer, Vibrations, Fluid Mechanics, Metallurgy, Manufacturing Processes and Engineering Drawing.

Objectives

- **DESIGN FOR STRENGTH**

  Part to be designed should strong enough to withstand forces in its service. It also required to be resist some probable happening during service due to increased load by some reason.

- **DESIGN FOR FUNCTION**

  Each part in a machine has its own function for which it is applied in machine. designer should ensure that the part to be designed should fulfill its function satisfactory.

- **DESIGN FOR MANUFACTURING PROCESS**

  All designs have to synchronise with available manufacturing processes and their limitations and strengths.

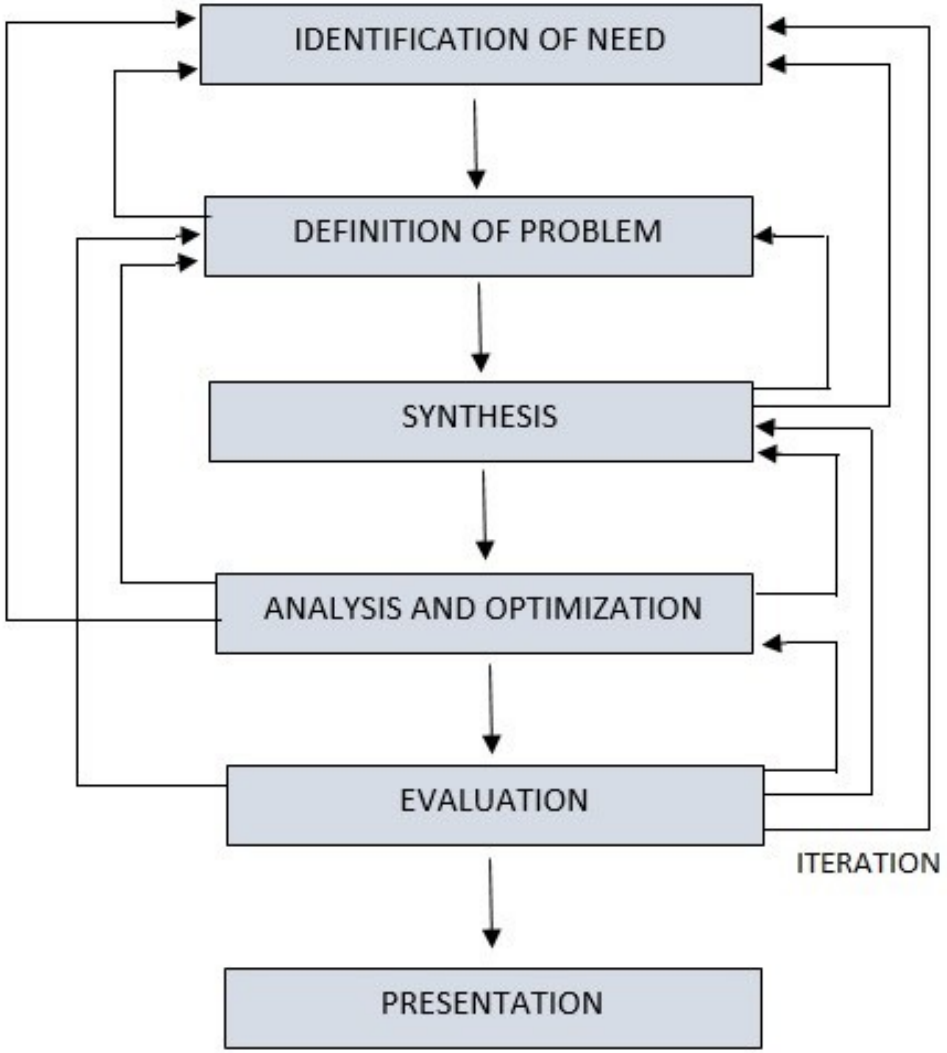
- **DESIGN FOR SAFETY**

  A designed part should be safe in use and any life or health hazard should not emanate from its working.

- **DESIGN FOR LOOK AND COMFORT**

  With a secondary priority a part should have high level of comfort for user and also good looks.

Design Process



Design Activity

- Determine the motion, forces and energy transfer involved so as to determine the sizes, shapes and materials for each element of the machine.
- When any component of machine ceases to perform its intended function, machine element or machine is said to have failed.
- Generally, the machine elements are designed on the basis of strength and rigidity so that they are able to withstand the applied load with permissible deformation or stress.
- In addition to strength and stiffness, other factors that are considered in design of machine element are weight, cost, wear, safety, reliability etc.
- Design work may involve concentrating on one component at a time, but it is very important to simultaneously consider its relation with the other components and the product as a whole

Design Process Steps

- Problem to be solved or desired purpose of the machine is completely and clearly stated.
- Possible mechanisms that will provide the desired motion or set of motions are selected.
- Forces acting on and energy transmitted by each element of the machine are determined.
- Best suitable material is selected for each of the machine element.
- Allowable values of stress and deflection are determined for each machine element, depending upon its material and functional requirements.
- Size and shape of each machine element is determined so that it can withstand the applied loads without failure.
- Dimensions of the machine elements are modified considering manufacturing aspects.
- Assembly and detailed drawings of the machine are made with complete specification of materials and manufacturing methods.

Design Considerations

1. Functionality
2. Strength
3. Stiffness
4. Wear
5. Corrosion
6. Thermal Properties
7. Surface Finish
8. Lubrication
9. Friction
10. Weight
11. Noise
12. Shape
13. Size
14. Safety
15. Reliability
16. Manufacturability
17. Utility
18. Maintenance
19. Liability
20. Cost
21. Life
22. Styling
23. Control
24. Volume
25. Marketability
26. Remanufacturing

Course Contents

Course Title	:	Machine Design II
Course	:	MEC3110
Credits	:	4
Course Category	:	DC
Pre-Requisites(s)	:	MEC2130
Contact Hours	:	3-1-0
Type of Course	:	Theory
Course Assessment	:	Course work 15% Mid Semester Examination (1 Hour) 25% End Semester Examination (2 Hours) 60%

Course Objectives

1. Understanding the process and methods of design of machines elements.
2. Abilities of developing equations pertaining to the design of machines.
3. Knowledge of different materials and their properties for designing the components of machine elements and the ability to design new machines or modify existing machine according to the need.

Course Outcomes

After taking this course students should be able to

1. Design of different clutches and brakes and will be able to design and analyse welded connections.
2. Select and design appropriate bearing as per the requirement.
3. Identify and design the type of spring and design the same as per the requirement.
4. Design of geared transmission system.

Syllabus

Unit-I	:	Welded Joints: Types of Welded connections, Design of Simple and eccentrically loaded welded connections. Clutches & Brakes: Plate, Cone and Centrifugal Clutches, Classification and Design of Brakes.
Unit-II	:	Bearings & Lubrication: Laws of friction, Lubrication, Hydrodynamic and Hydrostatic bearings, Ball and Roller bearings, Method of load estimation and Selection of bearings.
Unit-III	:	Springs: Design of helical springs, design of torsion and leaf springs, elementary idea of rubber springs.
Unit-IV	:	Power Transmission with Toothed Gears: Selection of Gears and Gear Materials, Tooth Forces, Design of different types of Gears.

Books:

1. Joseph E. Shigley; Mechanical Engineering Design, McGraw Hill.
2. V. B. Bhandari; Design of Machine Elements, Tata McGraw-Hill Education
3. M.F. Spott; Design of Machine Element, Prentice Hall.

Course Contents

- Unit 1: Welded Joints, Clutches and Brakes
- Unit 2: Bearing and Lubrication
- Unit 3: Spring
- Unit 4: Gears