

INTRODUCTION & SCOPE OF MECHANICAL ENGINEERING

Broad Overview

Subdivisions of Mechanical Engineering

History & Timeline

Impact on Economy & Society

Role & Responsibility of Mechanical Engineer

Introduction

Prof. Nilesh Kashinath Birajdar

- 08 years of teaching experience

Nilesh.birajdar@mitwpu.edu.in

Learning Objectives

- To introduce Mechanical Engineering discipline
- To impart basic concepts of Mechanical Engineering
- To understand history and development of Mechanical Engineering
- To expose students to multidisciplinary nature of engineering profession
- To introduce frontiers of Mechanical Engineering

Definition.

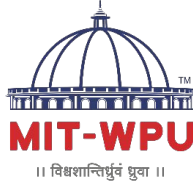
Engineering is the discipline, art, skill and profession of acquiring and applying scientific, mathematical, economic, social and practical knowledge to design and build structures, machines, devices, systems, materials and processes that safely realize improvements to the lives of people.

Mechanical engineering is the discipline that applies engineering physics, engineering mathematics, and materials science principles to design, analyze, manufacture, and maintain mechanical systems.

What is Mechanical Engineering?

- Mechanical engineering is the largest and one of the oldest disciplines; broadest of all engineering disciplines.
- Mechanical engineers apply the principles of mechanics and energy to the design of machines and devices:

ENERGY and MOTION



Dr. Vishwanath Karad

**MIT WORLD PEACE
UNIVERSITY** | PUNE

TECHNOLOGY, RESEARCH, SOCIAL INNOVATION & PARTNERSHIPS

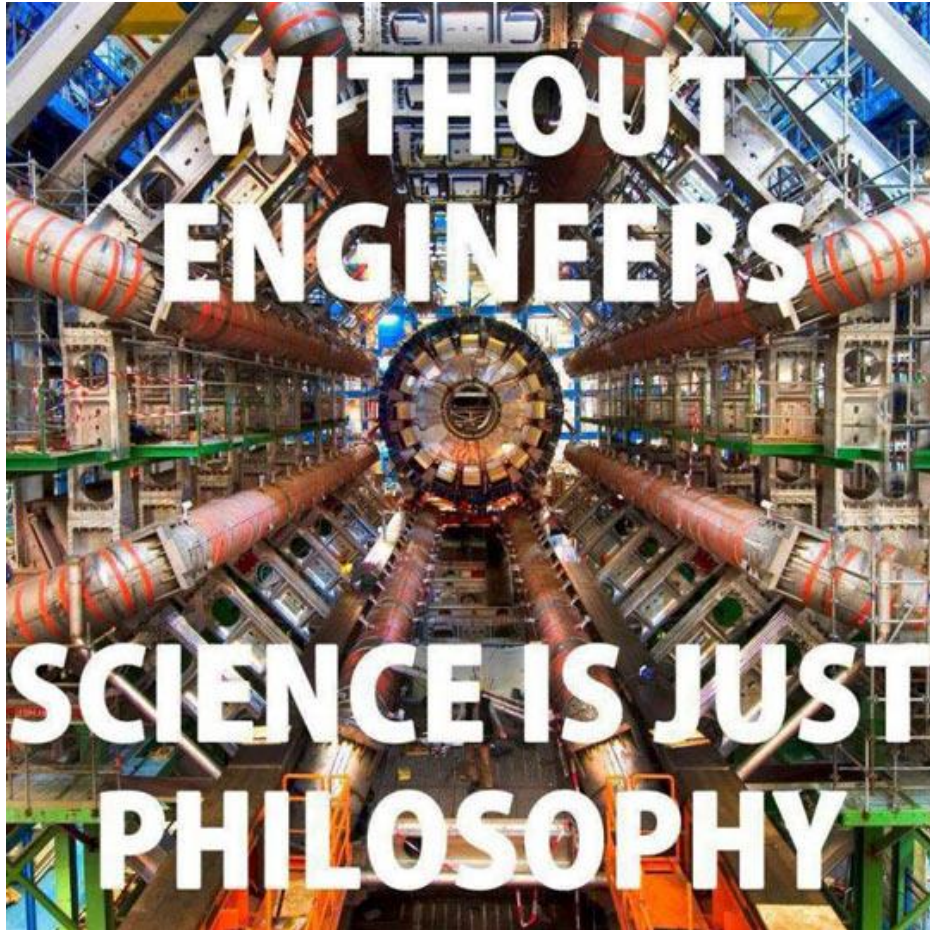
Engineering



What did you see in this video?

- Structures
- Automobiles
- Space-crafts
- Computer Aided Designing
- CNC machines
- Manufacturing Processes
- Fighter Planes
- Bio-Medical Engineering
- Environment and Safety
- Heavy Engineering
- Earth moving equipment
- Cranes
- Bridges
- Nuclear Power plant
- Wind mill
- Roller Coaster

We engineers Design, Develop, Create and Innovate !



Scientists study the world as it is; engineers create the world that has never been.

Scientists try to understand nature.
Engineers try to make things that do not exist in nature.

Mechanical Engineering is

- The branch of engineering that encompasses the generation and application of heat and mechanical power and the design, production and use of machines and tools.
- A branch of engineering concerned with the design, construction and operation of machines and machinery.
- The branch of engineering that specializes in the design, production and uses of **machines**.

Multi-faceted Nature of Mechanical Engineering

**Mechanical Engineering is a
broad spectrum of
Occupations and Challenges.**

Research

Development

Design

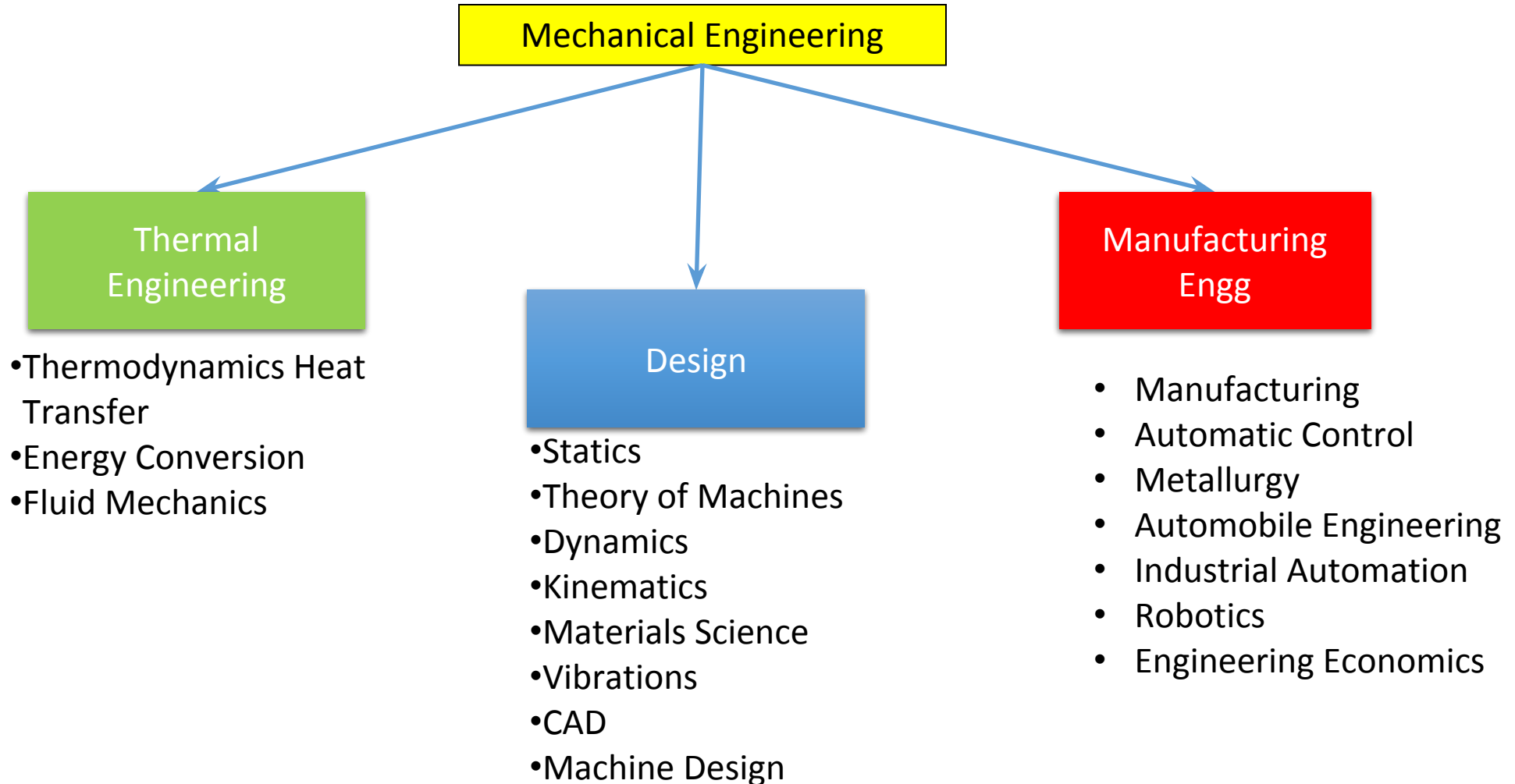
Testing

Manufacturing And Production

Operations And Maintenance

Marketing And Sales

Subdivisions of Mechanical Engineering.



The Engineering Design Process:

(Core of Engineering)

- Problem Identification: Get with Customer.
- Conceptual Design: Ideas, Sketches and Solution Lists.
- Refinement: Computer Modeling, Data Base Development.
- Testing: Analysis and Simulation of All Design Aspects.
- Prototyping: Visualizing and Improving the Design.
- Communication: Engineering Drawings, Specifications.
- Production: Final Design, Manufacturing, Distribution.

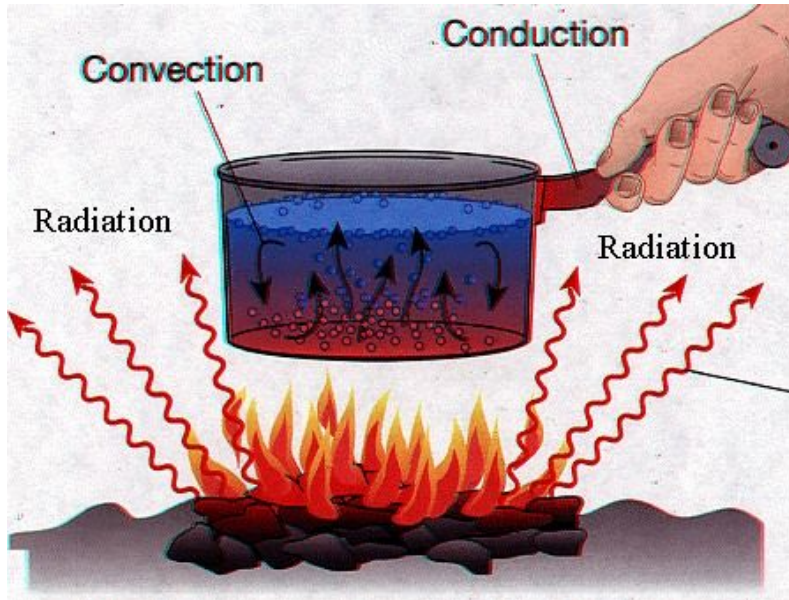
Thermal or Thermal Sciences

Thermodynamics

The science of thermodynamics deals with the amount of heat transfer as a system undergoes a process from one equilibrium state to another

Thermodynamics is concerned with the transition of a system from one equilibrium state to another.

Heat Transfer



Heat transfer is the passage of thermal energy from a hot to a cold body.

Transfer of thermal energy occurs mainly through conduction, convection or radiation. Heat transfer can never be stopped; it can only be slowed down.

Energy Conversion

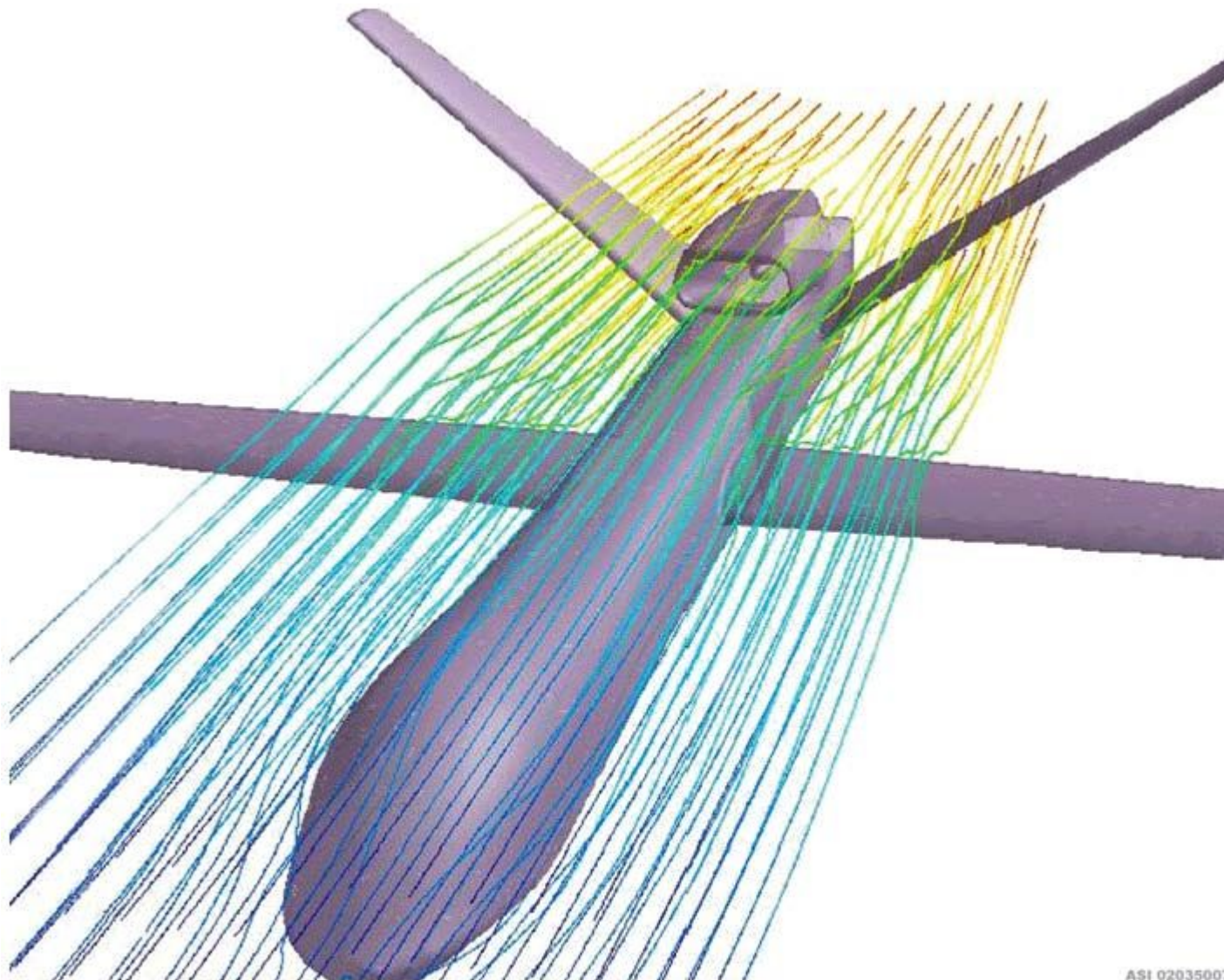
Energy Conversion is concerned with the transformation of energy from sources such as fossil and nuclear fuels and the sun into conveniently used forms such as electrical energy, rotational and propulsive energy, and heating and cooling.

Branches of Mechanical Engineering.

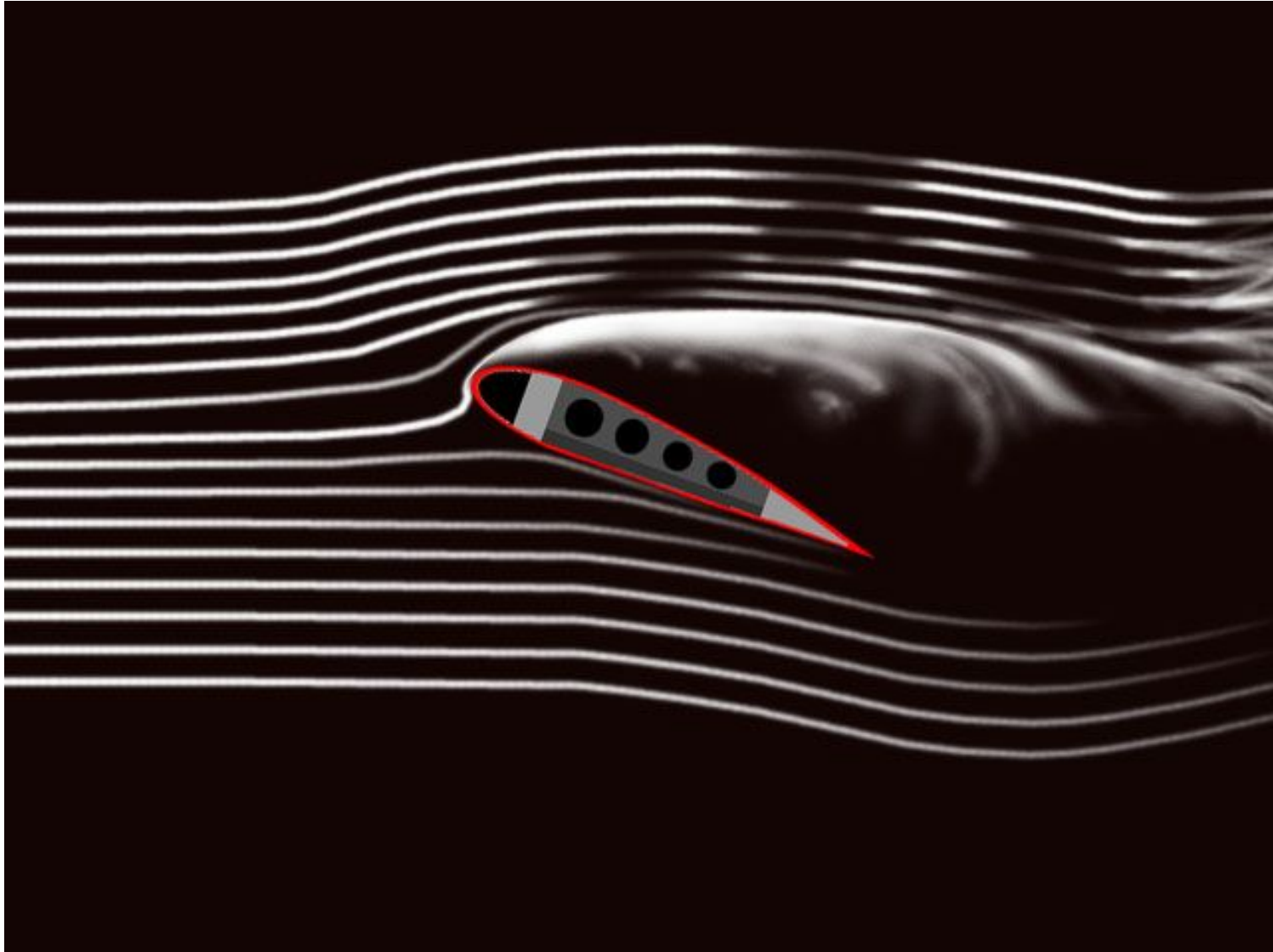
Thermal

Fluid Mechanics

Fluid mechanics is the study of fluids - liquids and gases. It involves study of various properties of the fluid, such as velocity, pressure, density and temperature as functions of space and time.



ASI 02035007





Design or
Mechanical Design

Statics

Statics is the branch of mechanics concerned with the analysis of loads (force, torque/moment) on physical systems in static equilibrium, that is, in a state where the relative positions of subsystems do not vary over time, or where components and structures are at a constant velocity.

Branches of Mechanical Engineering.

Design

Theory Of Machines

Theory of machines is that branch of science which deals with the study of relative motion between the various parts of a machine and forces which act on them.

Kinematics

Kinematics is that branch of Theory of Machines which deals with the study of relative motion between the various parts of the machines. Here the various forces involved in the motion are not considered. Thus kinematics is the study to know the displacement, velocity and acceleration of a part of the machine.

Branches of Mechanical Engineering.

Design

Dynamics

Dynamics is that branch of theory of machines which deals with the study of various forces involved in various parts of the machine. The forces may be either static or dynamic

Materials Science

Materials science deals with fundamental properties and characteristics of materials. **Materials science** is an interdisciplinary field applying the properties of matter to various areas of science and engineering. This scientific field investigates the relationship between the structure of materials at atomic or molecular scales and their macroscopic properties. It incorporates elements of applied physics and chemistry.

Vibrations

Mechanical vibration is the study of measurement of a periodic process of oscillations with respect to an equilibrium point.

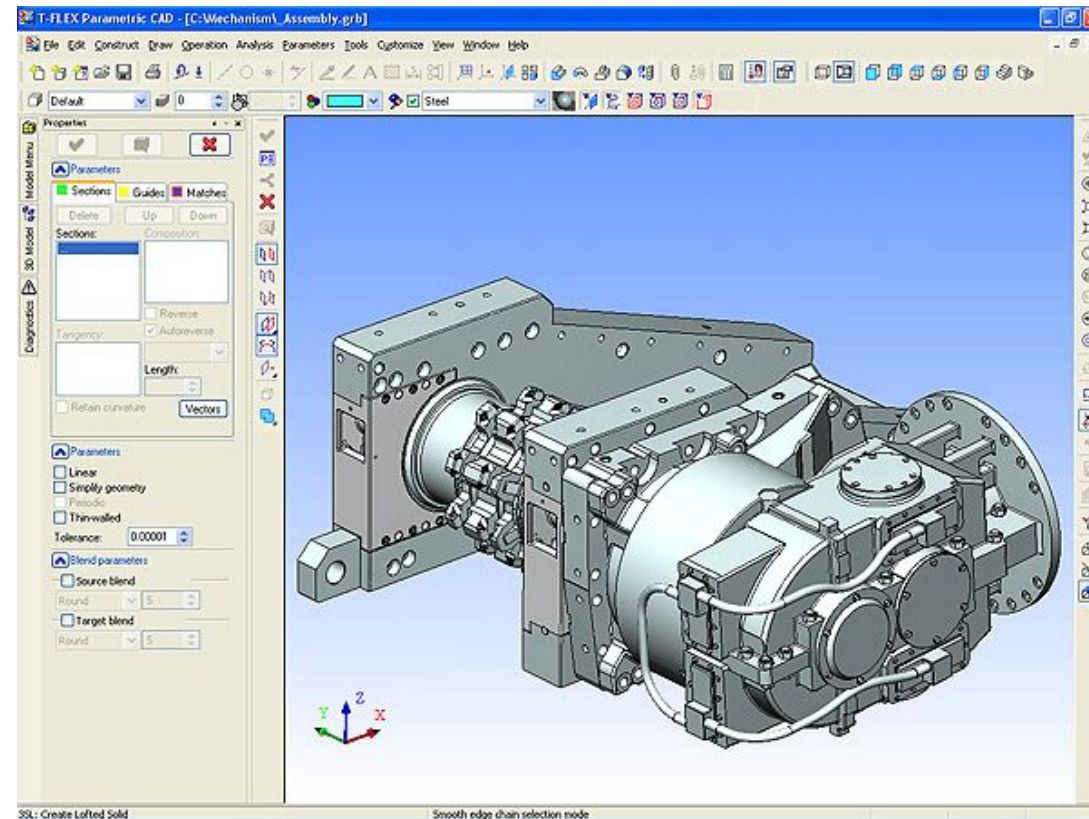
Attention will be given to vibrating systems such as beams, strings, springs, plates and membranes, vibration isolation, critical speeds, the balancing of rotating and reciprocating machinery.

Basic principles of control theory will be studied from feedback control systems.

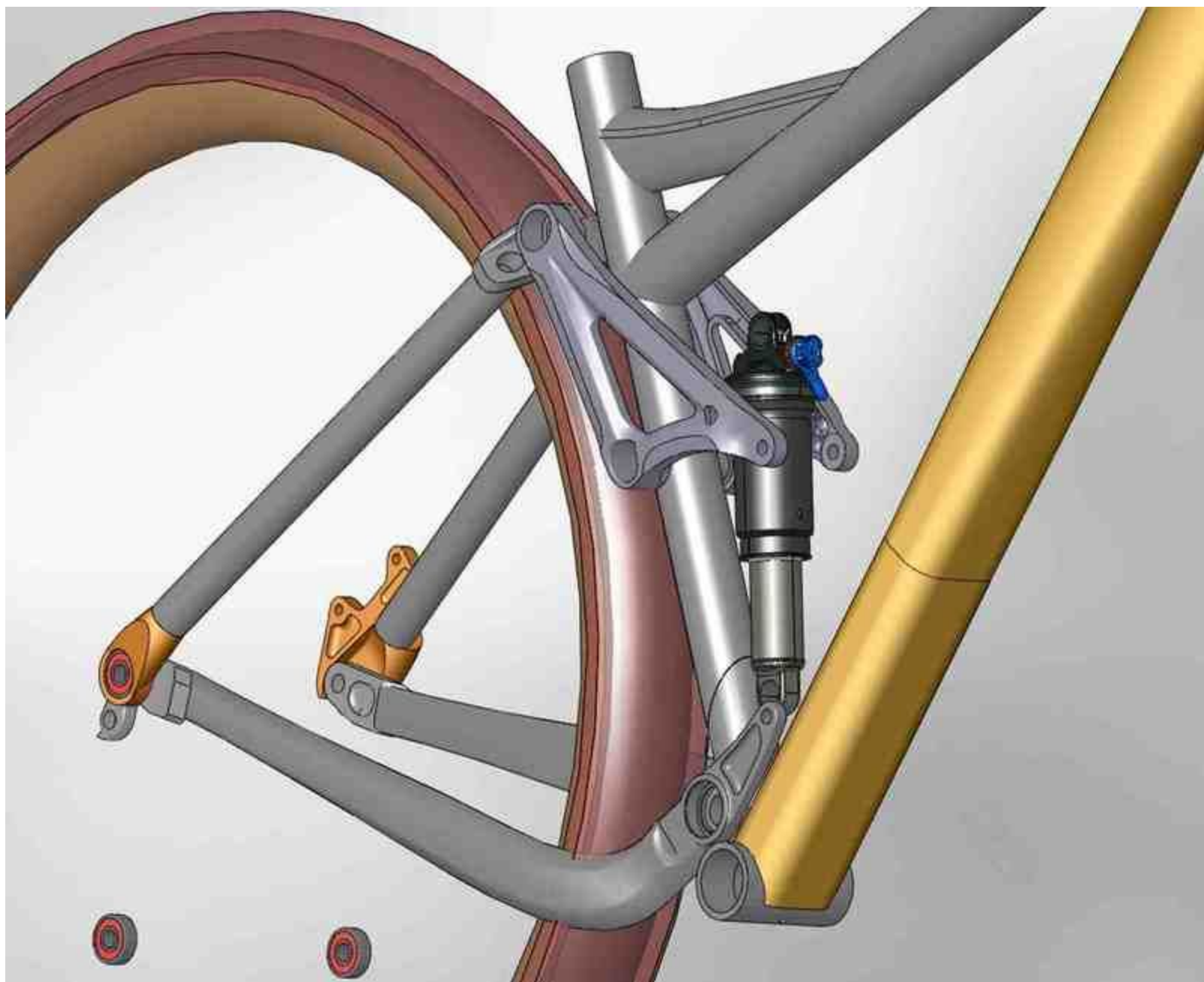
Branches of Mechanical Engineering.

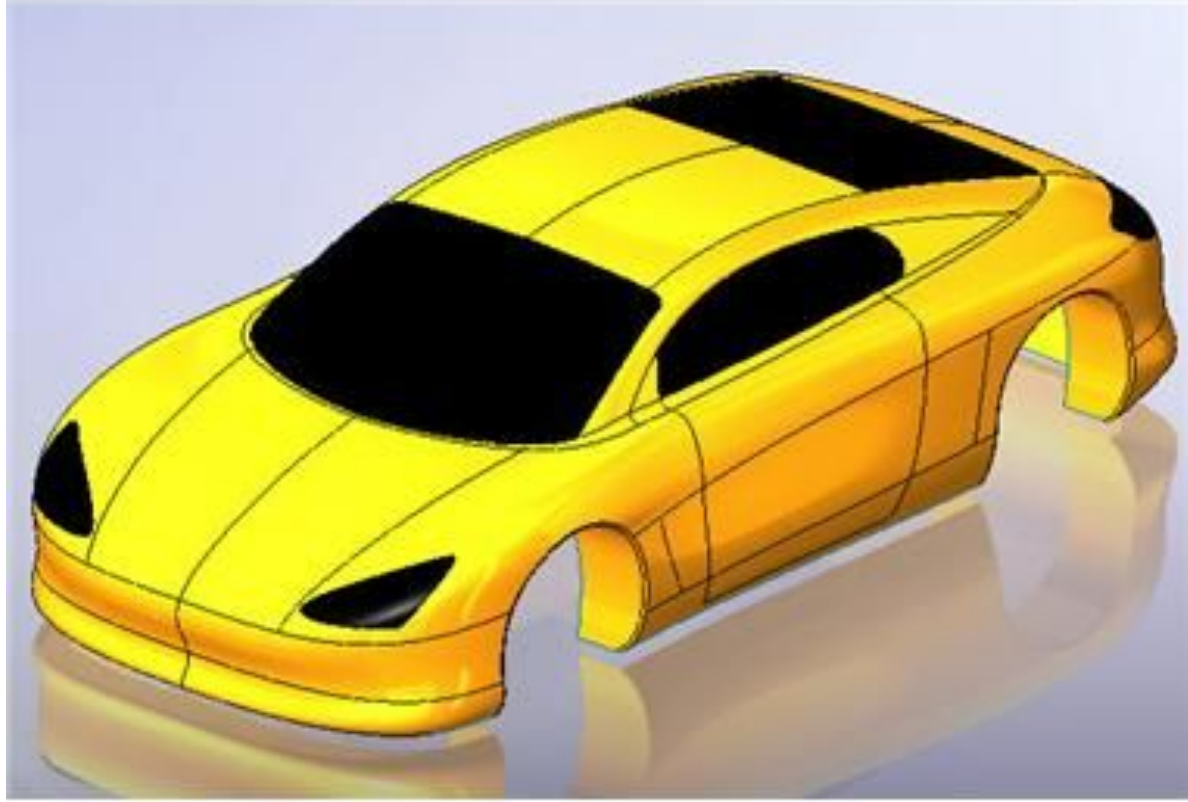
Design

CAD – Computer Aided Design



Computer-aided design (CAD), also known as **computer-aided design and drafting (CADD)**, is the use of computer technology for the process of design and design-documentation.





Machine Design

Machine design is creation of plans for machine to perform desired functions.

The machine may be entirely new in concept performing new type of work or it may perform more economically the work that can be done by existing machine.

It may be an improvement or enlargement of an existing machine for better economy & capability.

Production or
Manufacturing
Engineering.

Manufacturing

Engineering activities involved in the creation and operation of the technical and economic processes that convert raw materials, energy and purchased items into

a) components for sale to other manufacturers

Or

b) end products for sale to the public.

Metallurgy

Metallurgical Engineering is a broad field that deals with all sorts of metal-related areas. The three main branches are physical metallurgy, extractive metallurgy, and mineral processing.

Physical metallurgy deals with problem solving: developing the sorts of metallic alloys needed for different types of manufacturing and construction.

Extractive metallurgy involves extracting metal from ore.

Mineral processing involves gathering mineral products from the earth's crust.

Automatic Control

Automatic control is also a methodology or philosophy of analyzing and designing a system that can self-regulate a plant (such as a machine or an industrial process) operating condition

Or

parameters by the controller with minimal human intervention.

Industrial Automation & Robotics

Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services.

Robotics is the branch of technology that deals with the design, construction, operation, structural disposition, manufacture and application of robots.

Automobile Engineering

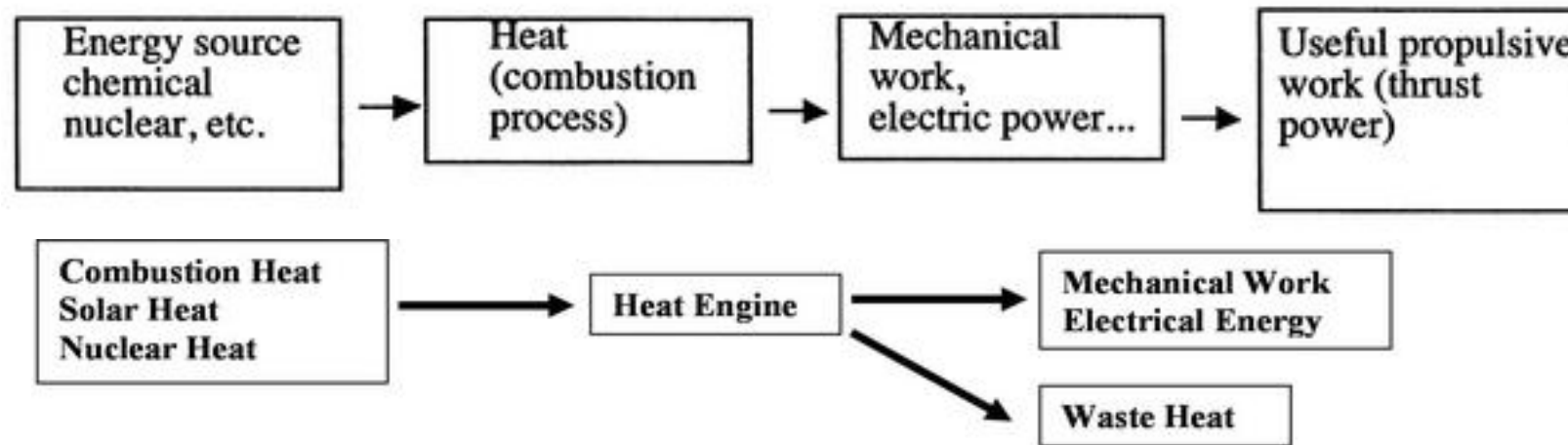
Automotive Engineering is a field closely related to Mechanical Engineering. With the specialist expertise in power plant (engine and transmission) design, vehicle dynamics, vehicle aerodynamics, CAD/CAM, advanced manufacturing and quality systems and project management. One will be able to work on the design, construction, production and maintenance of automotive components and assemblies in a thriving engineering sector.

Engineering Economics

An engineering economy study involves technical considerations and it is a comparison between technical alternatives in which the differences between the alternatives are expressed so far as practicable in financial terms.

Introduction to Thermodynamics

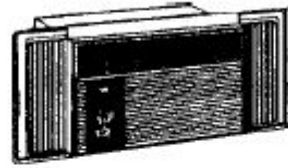
- **Thermodynamics:** The science of *energy*.
- The name *thermodynamics* stems from the Greek words *Therme* (heat) and *dynamis* (power).
- Thermodynamics is a science and, more importantly, an engineering tool used to describe processes that involve changes in temperature, transformation of energy, and the relationships between heat and work



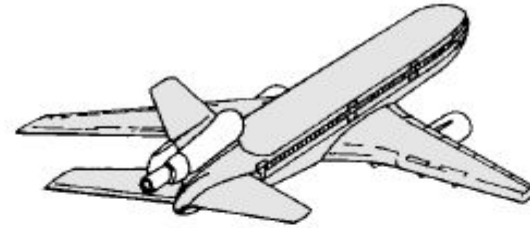
Some Applications of Thermodynamics



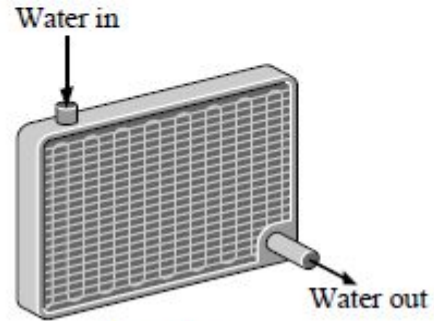
The human body



Air-conditioning
systems



Airplanes



Car radiators



Power plants



Refrigeration systems

Associations:

- Indian Society of Mechanical Engineers (ISME).
- Society for Automotive Engineers (SAE) International.
- American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
- American Society of Mechanical Engineers (ASME).
- The Institution of Mechanical Engineers (IMechE).

Indian Society of Mechanical Engineers (ISME).

"Indian Society of Mechanical Engineers" is a non-profit Technical Society in India updating vital information in field of Engineering and Technology.

ISME was established in Madras in 1990 and is being sponsored and supported by various professional membership organizations, Societies, Institutions, Industries & others.

ISME seeks to bring together individuals, and institutions and Govt. agencies & industries and Education to evolve and develop Engineering practices in India.

Society for Automotive Engineers (SAE) International.

SAE is an organization for engineering professionals in the aerospace, automotive, and commercial vehicle industries. The Society is a standards development organization for the engineering of powered vehicles of all kinds, including cars, trucks, boats, aircraft, and others.

SAE International has 120,000 members around the world. The mission of SAE International is to enable voluntary consensus on standards development. The *SAE Foundation* raises funds to support science and technology education in students from elementary school through to college.

American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).

The **American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)**, is an international technical society for all individuals and organizations interested in heating, ventilation, air-conditioning, and refrigeration (**HVAC&R**).

The Society, organized into Regions, Chapters, and Student Branches, allows exchange of HVAC&R knowledge and experiences for the benefit of the field's practitioners and the public. ASHRAE provides many opportunities to participate in the development of new knowledge via, for example, research and its many Technical Committees.

These committees meet typically twice per year at the ASHRAE Annual and Winter Conferences. A popular product show, the AHR Expo, is held in conjunction with each Winter Meeting. The Society has approximately 50,000 members and has headquarters at Atlanta, Georgia, USA.

American Society of Mechanical Engineers (ASME).

The **American Society of Mechanical Engineers (ASME)** is a professional body, specifically an engineering society, focused on mechanical engineering.

The ASME was founded in 1880. The organization is known for setting codes and standards for mechanical devices. The ASME conducts one of the world's largest technical publishing operations through its ASME Press,

As of 2006, the ASME has 120,000 members.

Tubular Exchanger Manufacturers Association (TEMA)

- The Tubular Exchanger Manufacturers Association (also known as TEMA) is an association of fabricators of shell and tube type heat exchangers.
- TEMA has established and maintains a set of construction standards for heat exchangers, known as the TEMA Standard.
- TEMA also produces software for evaluation of flow induced vibrations and of flexible shell elements .
- TEMA was founded in 1939, and is based in Tarrytown, New York.
- The association meets regularly to revise and update the standards, respond to inquiries, and discuss topics related to the industry.
- The TEMA® standards and software have achieved worldwide acceptance as the authority on shell and tube heat exchanger mechanical design.
- Members are market-aware and actively involved, meeting several times a year to discuss current trends in design and manufacturing.
- This cooperative technical effort creates an extensive network for problem-solving, adding value from design to fabrication.