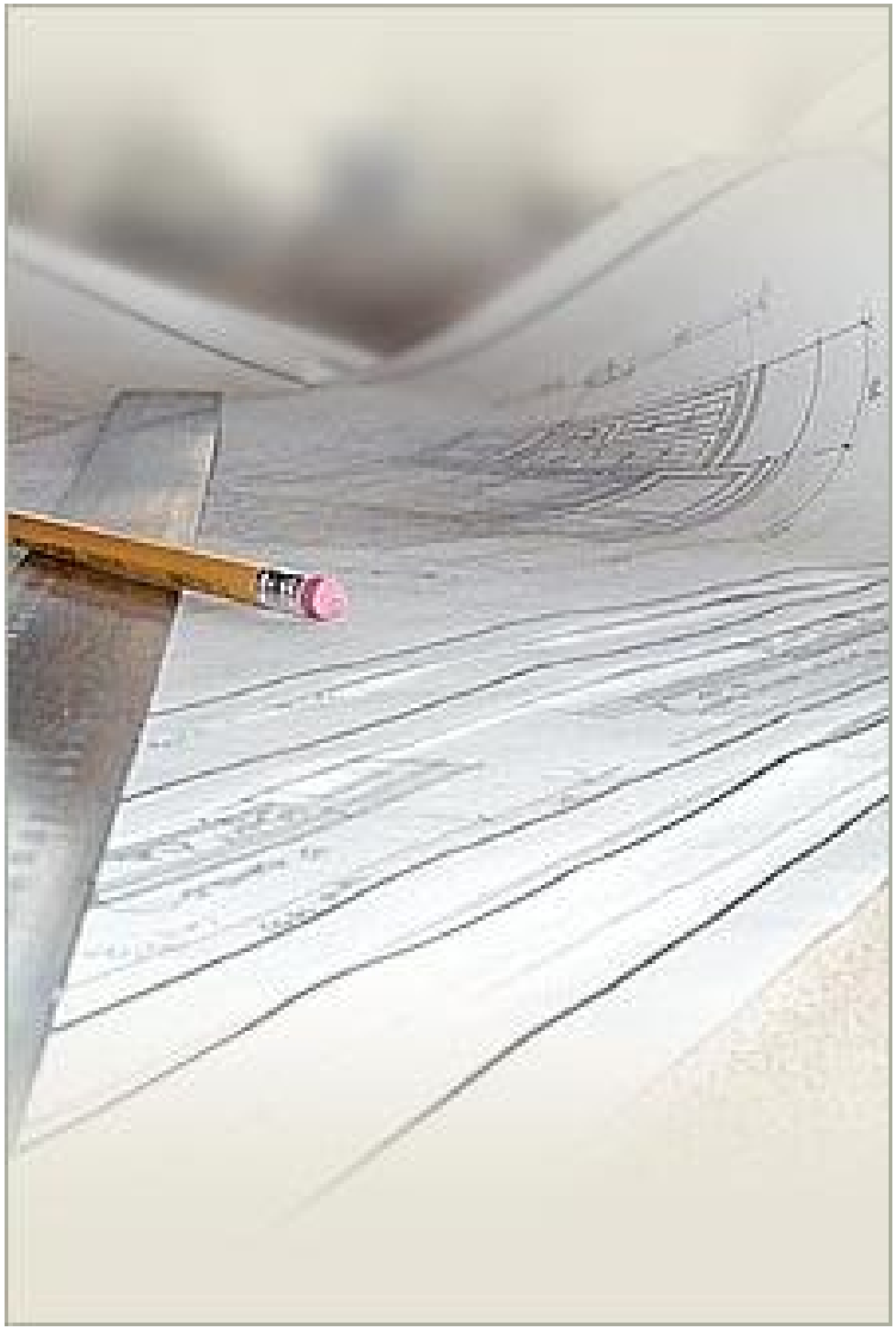


MACHINE DESIGN

Chapter 1

Introduction

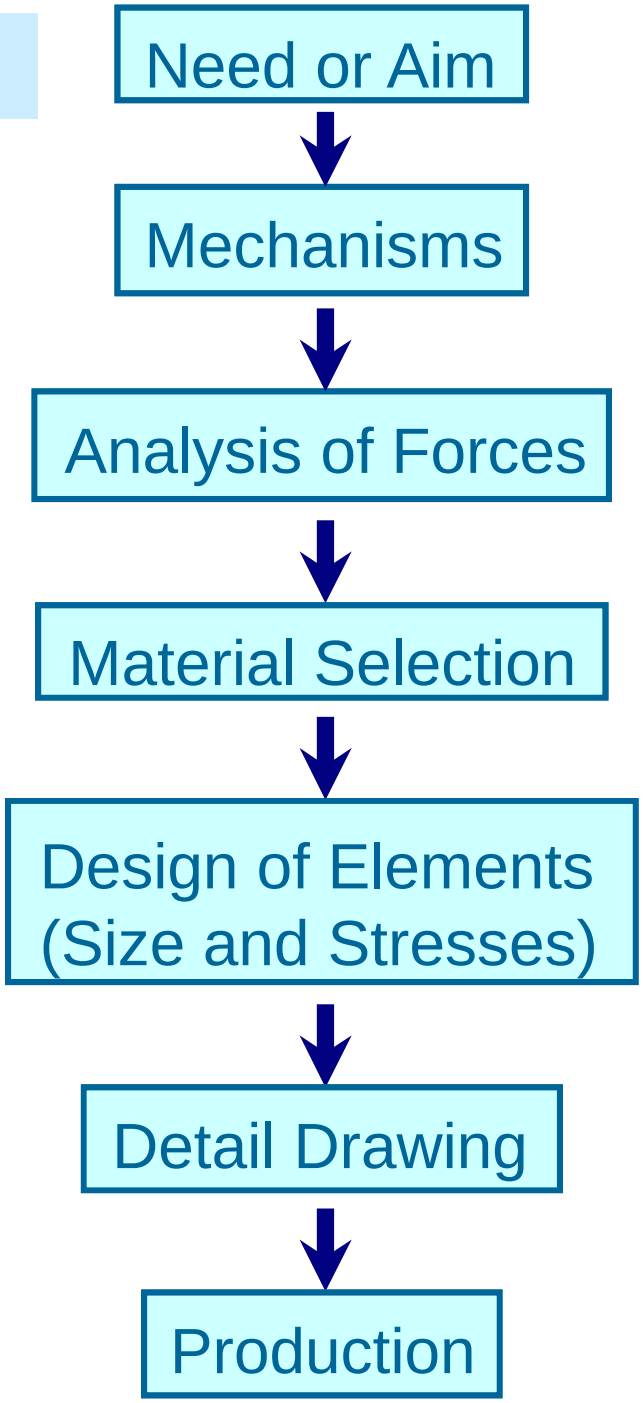


What is “Machine Design” ?

The subject Machine Design is the creation of new and better machines and improving the existing ones. A new or better machine is one which is more economical in the overall cost of production and operation.

In designing a machine component, it is necessary to have a good knowledge of many subjects such as Mathematics, Engineering Mechanics, Strength of Materials, Theory of Machines, Workshop Processes and Engineering Drawing.

Design Procedure



Mass – Weight - Force

Force

$$F = m.a = \text{Mass} \times \text{Acceleration}$$

Mass

The amount of the body

Weight

$$F = m.g = \text{Mass} \times \text{Aceleration due to gravity}$$

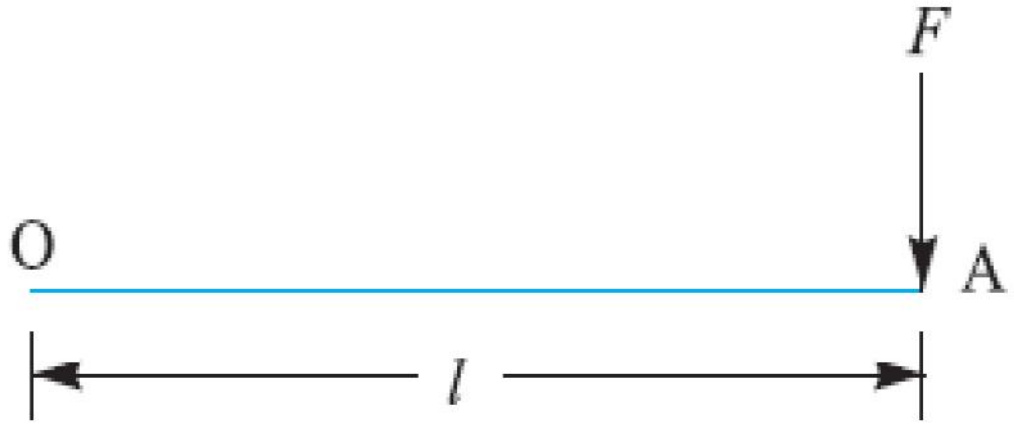
Moment of Force

Moment of a force = $F \times l$

where

F **=** Force acting on the body, and

l **=** Perpendicular distance of the point and the line of action of the force (F) as shown in Figure.



Mass Moment of Inertia

It has been established since long that a rigid body is composed of small particles. If the mass of every particle of a body is multiplied by the square of its perpendicular distance from a fixed line, then the sum of these quantities (for the whole body) is known as
mass moment of inertia of the body. It is denoted by *I*.

$$I = m\ k^2$$

The distance ***k*** is called the ***radius of gyration.*** It may be defined ***as the distance, from a given reference, where the whole mass of body is assumed to be concentrated to give the same value of***
I.

Classification of Engineering Materials

The engineering materials are mainly classified as :

1. Metals and their alloys, such as iron, steel, copper, aluminium, etc.

2. Non-metals, such as glass, rubber, plastic, etc.

The metals may be further classified as :

(*a*) Ferrous metals, and (*b*) Non-ferrous metals.

Selection of Materials for Engineering Purposes

The following factors should be considered while selecting the material :

1. Availability of the materials,
2. Suitability of the materials for the working conditions in service, and
3. The cost of the materials.

Manufacturing Processes

- ***Primary shaping processes:*** The common operations used for this process are casting, forging, extruding, rolling, drawing, bending, spinning, powder metal forming, etc.

- ***Machining processes:*** The processes used for giving final shape to the machine component, The common operations used for this process are turning, shaping, drilling, boring, sawing, milling, grinding, etc.

- ***Surface finishing processes:*** The processes used to provide a good surface finish. The common operations used for this process are polishing, electroplating, superfinishing, etc.

- ***Joining processes:*** The processes used for joining machine components. The common operations used for this process are welding, riveting, screw fastening, pressing, sintering, etc.

- ***Processes effecting change in properties:*** These processes are used to impart certain specific properties to the machine components so as to make them suitable for particular operations or uses. Such as heat treatment, hot-working and cold-working.