Engineering Mechanics (Statics)

Stage: First Year

ENG. MECHANICS (STATICS)

FIRST YEAR

College of Engineering

Course Number: Engineering Mechanics (Statics)

Credit hours:

Textbook: Hibbeler R. C., Engineering Mechanics, Statics , 14th ed, 2015

References:

1. M. E. Plesha, Engineering Mechanics Statics, 1st ed, 2010.
2. A. Bedford, Engineering Mechanics Statics, 5th ed, 2008.

Course Contents:

This course covers: principles of statics, Resultant of a force system, Equilibrium of a force system, Moment of a force, Friction, centroid and center of gravity, Moment of inertia, analysis of internal forces, Strain, Stress-Strain diagram, Hook's law, Shearing deformation, Poisson's Ratio, Volumetric strain, Thin walled cylinders, Thermal stress, Shear and bending moment in beam.

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Contents

1. Chapter One: Review and Fundamental concepts:

Mechanics is a branch of the physical sciences that is concerned with the state of rest or motion of bodies that are subjected to the action of forces. In general, this subject can be subdivided into three branches: rigid-body mechanics, deformable-body mechanics, and fluid mechanics. In this semester we will study rigid-body mechanics since it is a basic requirement for the study of the mechanics of deformable bodies and the mechanics of fluids. Furthermore, rigid-body mechanics is essential for the design and analysis of many types of structural members, mechanical components, or electrical devices encountered in engineering. Rigid-body mechanics is divided into two areas: **statics** and **dynamics**.

Statics deals with the equilibrium of bodies, that is, those that are either at rest or move with a constant velocity; whereas ***dynamics*** is concerned with the accelerated motion of bodies. We can consider statics as a special case of dynamics, in which the acceleration is zero; however, statics deserves separate treatment in engineering education since many objects are designed with the intention that they remain in equilibrium.

Scientific method:

- Recognize a question (unexplained fact)
- Make an educated guess (hypothesis)
- Make prediction about the consequences of the hypothesis
- Perform an experiment or make calculations
- Formulate a general rule

1.1. Fundamental concepts and units of measurement

The following four quantities are used throughout mechanics:

1. Length
2. Time
3. Mass
4. Force

TABLE 1–1 Systems of Units

Name	Length	Time	Mass	Force
International System of Units SI	meter m	second s	kilogram kg	newton* N $\left(\frac{kg \cdot m}{s^2}\right)$
U.S. Customary FPS	foot ft	second s	slug* $\left(\frac{lb \cdot s^2}{ft}\right)$	pound lb

*Derived unit.

TABLE 1–2 Conversion Factors

Quantity	Unit of Measurement (FPS)	Equals	Unit of Measurement (SI)
Force	lb		4.448 N
Mass	slug		14.59 kg
Length	ft		0.3048 m

1.2. General procedure for analysis

- ✓ Read the problem carefully and try to correlate the actual physical situation with the theory studied.
- ✓ Tabulate the problem data and draw to a large scale any necessary diagrams.
- ✓ Apply the relevant principles, generally in mathematical form. When writing any equations, be sure they are dimensionally homogeneous.
- ✓ Solve the necessary equations, and report the answer with no more than three significant figures.
- ✓ Study the answer with technical judgment and common sense to determine whether or not it seems reasonable.

Example:

Convert 2 km/h to m/s. How many ft /s is this?

Solution:

Since 1 km = 1000 m and 1 h = 3600 s, the factors of conversion are arranged in the following order, so that a cancellation of the units can be applied:

$$\frac{2\ km}{h} = \frac{2\ \cancel{km}}{\cancel{h}}\left(\frac{1000m}{\cancel{km}}\right)\left(\frac{1\ \cancel{h}}{3600\ s}\right) = \frac{2000\ m}{3600\ s} = 0.556\ m/s$$

From Table 1–2, 1 ft = 0.3048 m. Thus,

$$0.556\ \frac{m}{s} = 0.556\ \frac{\cancel{m}}{s}\left(\frac{1\ ft}{0.3048\ \cancel{m}}\right) = 1.82\ ft/\ s$$