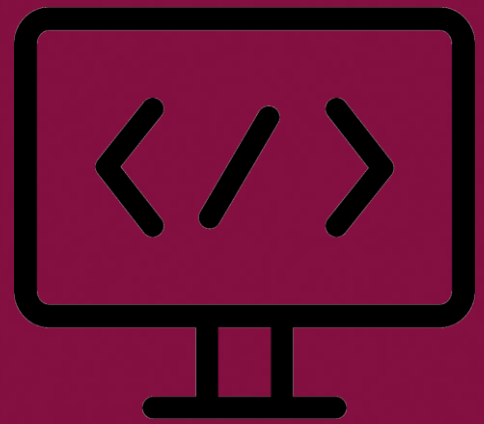
SEEM1113 ENGINEERING MECHANICS

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

CH1
Fundamental Concepts



Dr. Mohd Saiful Azimi Mahmud (azimi@utm.my)
P19a-04-03-30, School of Electrical Engineering, UTM

OBJECTIVES

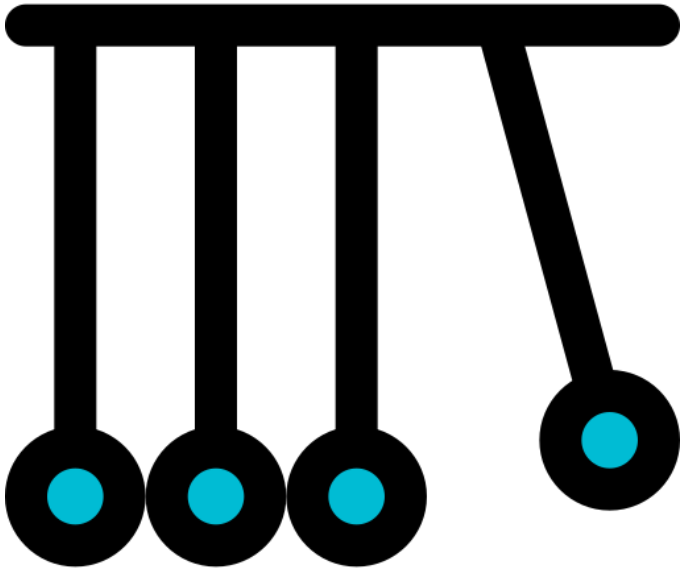
At the end of this lesson, you should be able to:

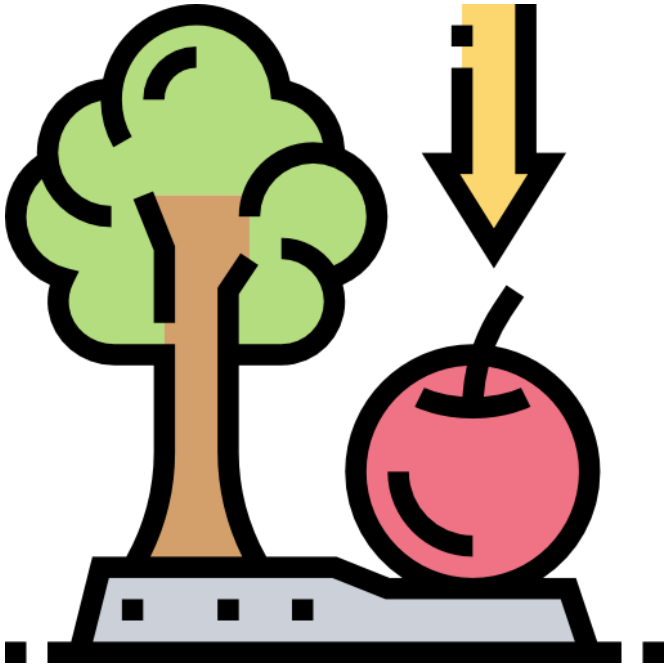
1. Explain mechanics/statics
2. Give statement of Newton's Law of motion
3. Apply the SI system of unit
4. Perform numerical calculation using general guide for solving problems.

FUNDAMENTAL CONCEPTS

WHAT IS MECHANICS?

- Mechanics allows one to describe and predict the conditions of rest or movement of particles and bodies subjected to the action of forces.
- Can also be defined as the science of the motion bodies.





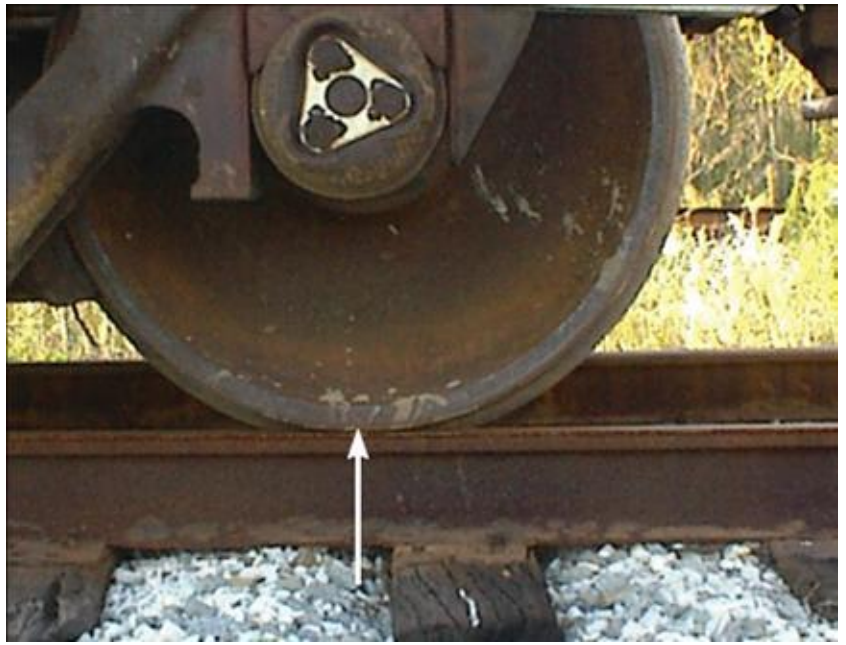
WHAT IS MECHANICS?

The design of this rocket and gantry structure requires a basic knowledge of both statics and dynamics, which forms the subject matter of engineering mechanics.

WHAT IS MECHANICS?

Study of what happens to a "thing" (the technical name is "BODY") when FORCES are applied to it.

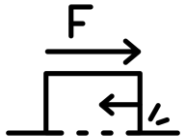
Either the body or the forces can be large or small.



WHAT IS MECHANICS?

PHYSICS

THERMODYNAMICS



MECHANICS

ELECTRICITY

RIGID-BODY MECHANICS

DEFORMABLE-BODY MECHANICS

FLUID MECHANICS

STATICS
Deals with equilibrium of bodies, that are either rest or move with constant velocity

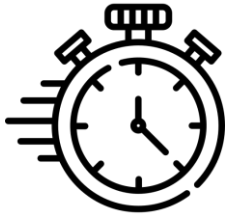
DYNAMICS
Concerned with the accelerated motion of bodies

FUNDAMENTAL CONCEPTS

BASIC QUANTITIES

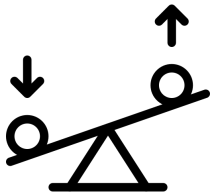
LENGTH

- Used to locate the position of a point in space and thereby describe the size of a physical system



TIME

- Conceived as a succession of events
- Statics are time independent, important in dynamics



MASS

- Measure of a quantity of matter that is used to compare the action of one body with that of another

FORCE

- ''Push'' or ''pull'' exerted by one body on another
- Occur when there is direct contact between the bodies

FUNDAMENTAL CONCEPTS

MODELS OR IDEALIZATIONS

- Used in mechanics in order to simplify applications of the theory.
- 3 important models/idealizations

Particles

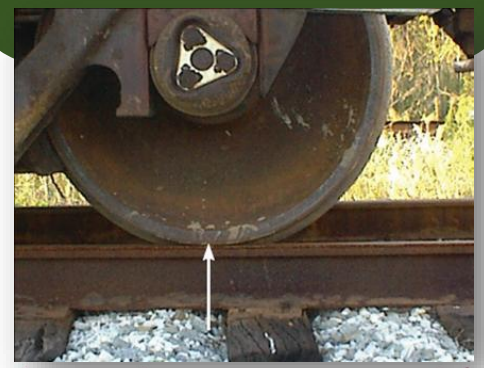
- Has a mass but size can be neglected
- In an orbital system, an earth can be considered as a particle. Why?
- The hook at A can be assumed as a particle.

Rigid Body

- Considered as a combination of larger number of particles in which all the particles remain at a fixed distance from one another, both before and after applying a load.
- Material properties of any body that is assume to be rigid will not have to be considered when studying the affect of forces acting on body.

Concentrated Force

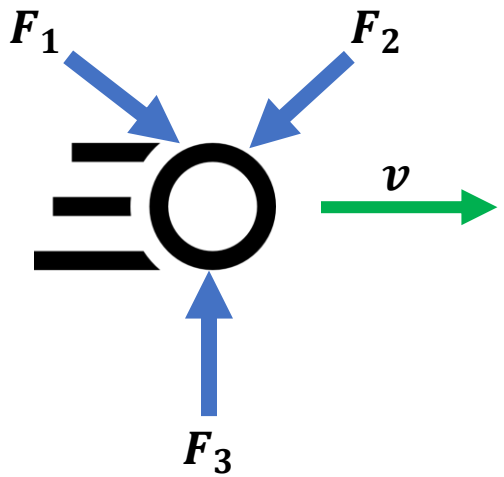
- The effect of loading which is assumed to act at a point of body.
- Load can be represented by a concentrated force.



FUNDAMENTAL CONCEPTS

NEWTON'S LAW : THE FIRST LAW

"A particle originally at rest, or moving in a straight line with constant velocity, will remain in this state provided that the particle is not subjected to an unbalanced force"



Equilibrium

FUNDAMENTAL CONCEPTS

NEWTON'S LAW : THE SECOND LAW

"A particle acted upon by an unbalanced force F experiences an acceleration a that has the same direction as the force and a magnitude that is directly proportional to the force"

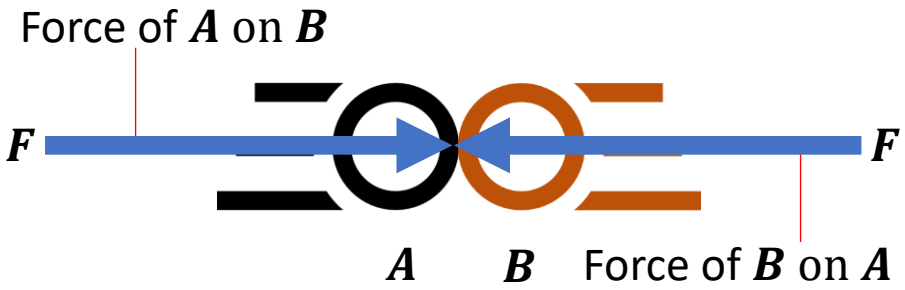
Accelerated motion

$$F = ma$$

FUNDAMENTAL CONCEPTS

NEWTON'S LAW : THE THIRD LAW

"The mutual forces of action and reaction between two particles are equal and, opposite and collinear"



FUNDAMENTAL CONCEPTS

UNIT OF MEASUREMENT : SI UNITS

- SI = Système International d'Unités
- The SI units are used as a world standard for measurement.

Quantity	Unit
Length	
Time	
Mass	
Force	

Exponential	Multiple	Prefix	SI symbol
10^{9}	1 000 000 000		
10^{6}	1 000 000		
10^{3}	1 000		
10^{-3}	0.001		
10^{-6}	0.000 001		
10^{-9}	0.000 000 001		

- For a very large or small numerical quantity, units can be modified by using a prefix.

FUNDAMENTAL CONCEPTS

UNIT OF MEASUREMENT : SI UNITS

- No plurals (e.g., m = 5 kg, not kgs)
- Most symbols are in lowercase.
  - Some exceptions are **N**, **Pa, M** and **G.**
- Exponential powers apply to units, e.g., cm • cm = cm^2
- Spacing between number and unit, eg. 10 m, 2 s

FUNDAMENTAL CONCEPTS

UNIT OF MEASUREMENT : RULES

- Quantities defined by several units which are multiples of one another are separated by a dot
- The exponential power on a unit having a prefix refers to both the unit and its prefix
- With the exception of the base unit, the kilogram, the used of the prefix in the denominator of composite unit is avoided
- After calculation, it is best to keep numerical value between 0.1 to 1000; otherwise suitable single prefix should be chosen

FUNDAMENTAL CONCEPTS

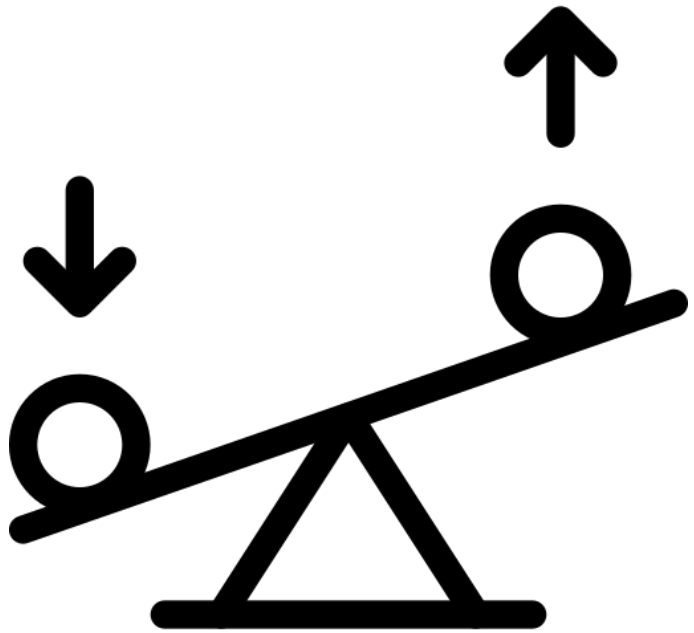
UNIT OF MEASUREMENT : NUMERICAL CALCULATION

- Dimensional Homogenous
- Significant Figures
- Rounding of Number
- Calculation

FUNDAMENTAL CONCEPTS

MASS & WEIGHT

- Mass is a property of matter that does not change from one location to another.
  - Mass is an absolute quantity.
- Weight is a force which refers to the gravitational attraction of the earth on a quantity of mass.
  - Not an absolute quantity, depends on location.



FUNDAMENTAL CONCEPTS

EXAMPLE 1

Convert 2 km/h to m/s

UTM
UNIVERSITI TEKNOLOGI MALAYSIA

univteknologimalaysia utm_my utmofficial

Thank You

www.utm.my

innovative • entrepreneurial • global