Engineering Mechanics (ME102)

Lecture by
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भारतीय प्रौद्योगिकी संस्थान पटना

Indian Institute of Technology (IIT) Patna

ME102	Engineering Mechanics	L-T-P-C: 3-1-0-8	Prerequisites: Nil

Instructor: **G1: Dr. Murshid Imam**

Course Group: G1: **CE+CB+CS**

Class Timings:
G1 Theory: Mon: 9 AM -10 AM, Fri: 9 AM – 11 AM (R102)
Tutorial: Wed: 8 AM - 9 AM (R102-G1, R102-G2)

Course Objectives: The objective of this first course in mechanics is to enable engineering students to analyze basic mechanics problems and apply vector based approach to solve them.

Expected learning outcomes: Following learning outcomes are expected after going through this course.
a) Learn and apply general mathematical and computer skills to solve basic mechanics problems.
b) Apply the vector based approach to solve mechanics problems.

Syllabus before Mid Semester

1. Rigid body statics: Equivalent force system. Equations of equilibrium, Free body diagram, Reaction, Static indeterminacy.

2. Structures: 2D truss, Method of joints, Method of section. Beam, Frame, types of loading and supports, axial force, Bending moment, Shear force and Torque Diagrams for a member:

3. Friction: Dry friction (static and kinetic), wedge friction, disk friction (thrust bearing), belt friction, square threaded screw, journal bearings, Wheel friction, Rolling resistance.

4. Centroid and Moment of Inertia

5. Virtual work and Energy method: Virtual Displacement, principle of virtual work, mechanical efficiency, work of a force/couple (springs etc.), Potential Energy and equilibrium, stability.

Syllabus after Mid Semester

6. Introduction to stress and strain: Definition of Stress, Normal and shear Stress. Relation between stress and strain, Cauchy formula.

7. Stress in an axially loaded member, Stresses due to pure bending, Complementary shear stress, Stresses due to torsion in axi-symmetric sections

8. Two dimension state of stress, Mohr's circle representation, Principal stresses and strains.

Text books:

F. P. Beer and E. R. Johnston, Statics and Dynamics/Vector Mechanics for Engineers: Vol I - Statics, Vol II – Dynamics, Tata McGraw Hill. **– 150 Copies in the Library**

F. P. Beer and E. R. Johnston, J.T. Dewolf, and D.F. Mazurek, Mechanics of Materials, McGraw Hill Education (India) Pvt. Ltd.. **– 80 Copies in the Library**

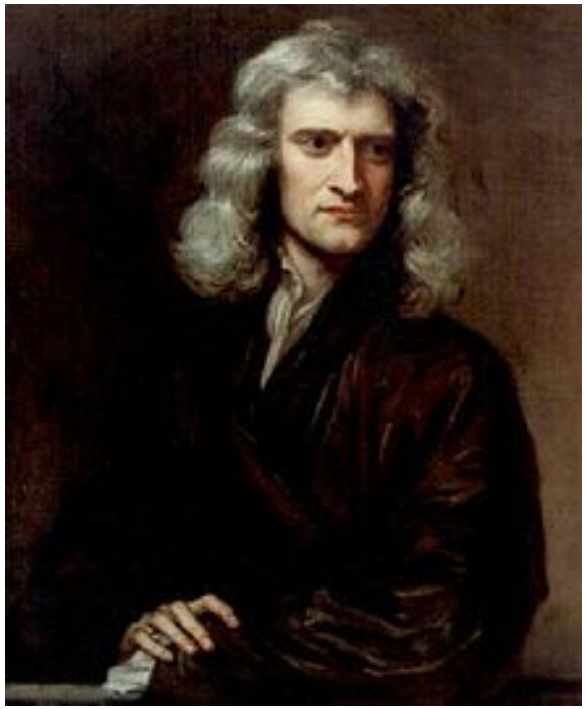
Grading Scheme:
Mid-Semester Examination: 25%
End-Semester Examination: 35%
Class test: 24%
Attendance: 8%
Tutorials*: 8%

* Tutorial problems are required to be solved in class on A4 size paper, stapled together and submitted at the end for evaluation. Instructors and TA's will be available to help clarify any fundamental doubts. You are allowed to bring the course textbook during the tutorial sessions. However, no discussion among the students is allowed.

Schedule:

Total Number of advanced announced class test: 2 (one before Mid Sem and one after Mid Sem)

Total Number of Surprise Class test: 4 (two before Mid Sem and two after Mid Sem)



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Sir Isaac Newton (1643–1727)

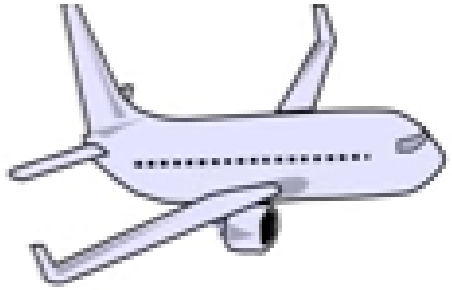
Click@Cambridge University Visit, UK

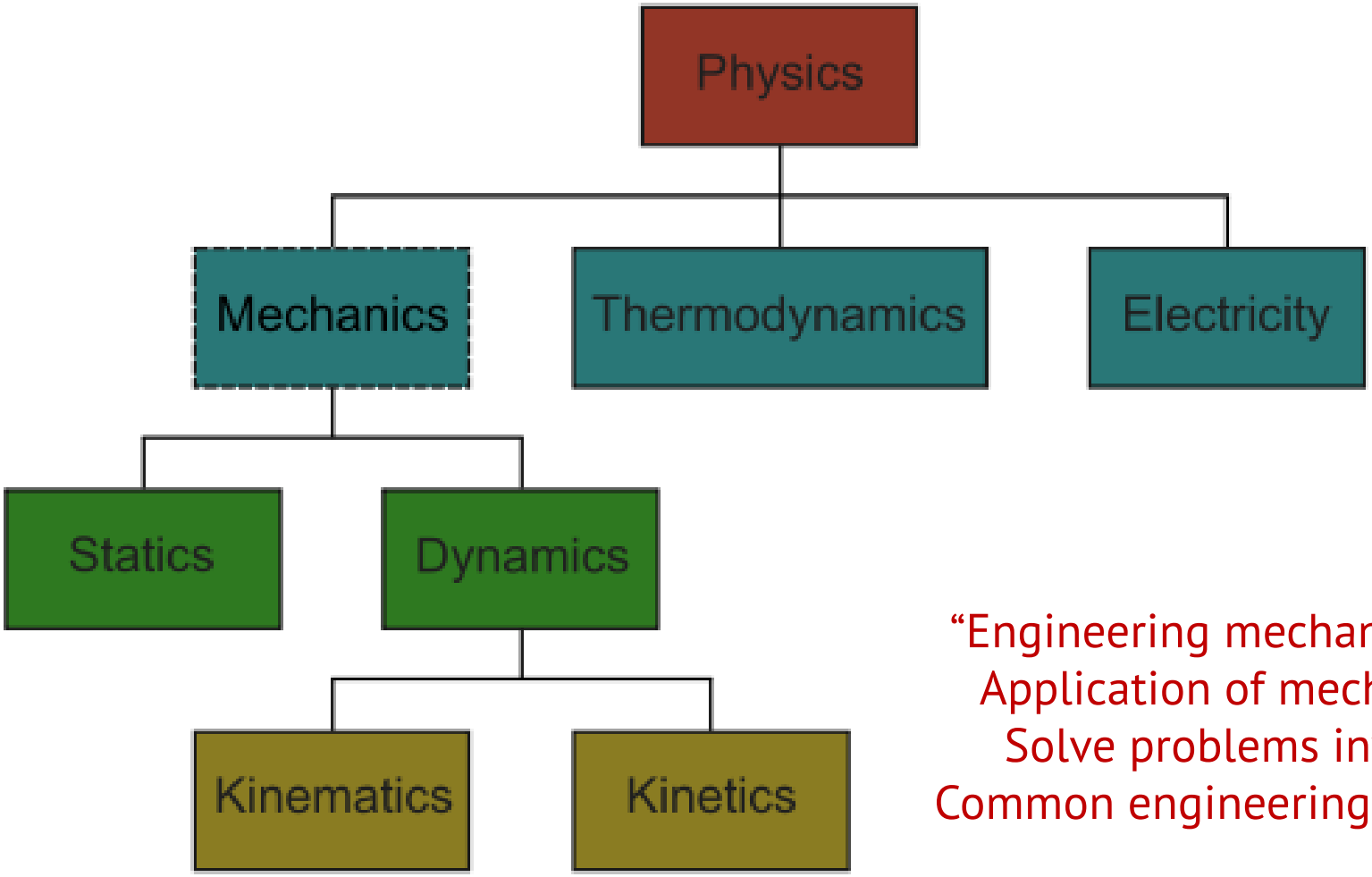
Newton Laws of Motion

"Every object persists in its state of rest or uniform motion in a straight Line unless it is compelled to change that state by Forces impressed on it."

"Force is equal to the change in momentum (mV) per change in time. For a constant mass, force equals mass times acceleration."

"For every action, there is an equal and opposite re-action."

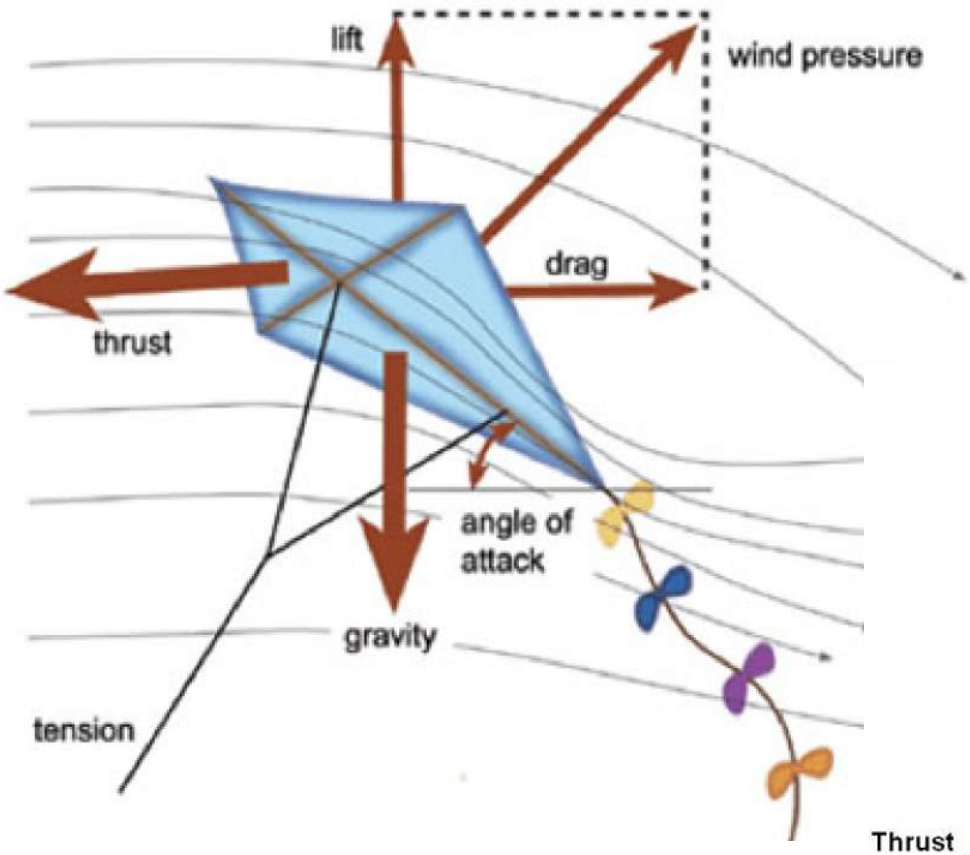


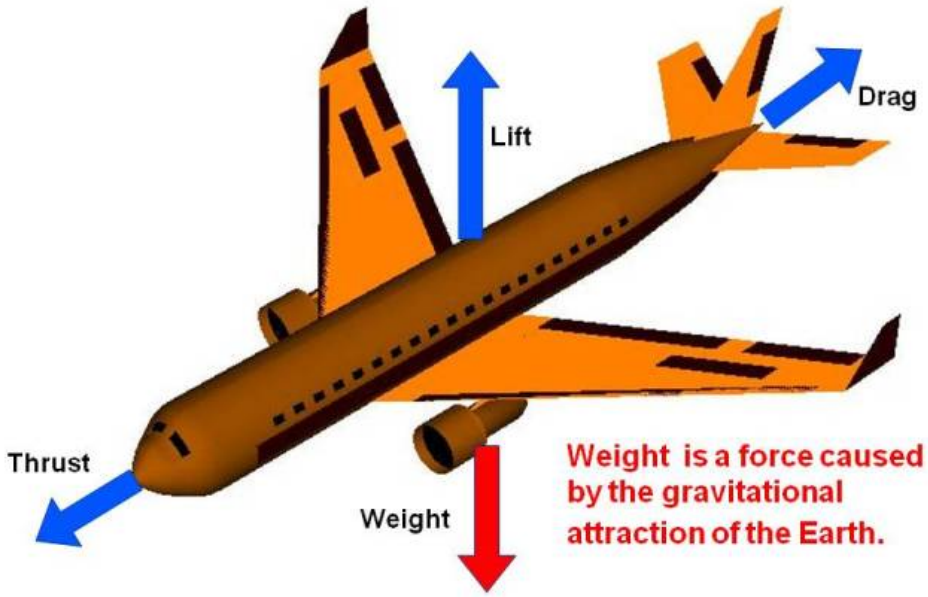


"Engineering mechanics is the Application of mechanics to Solve problems involving Common engineering problems"

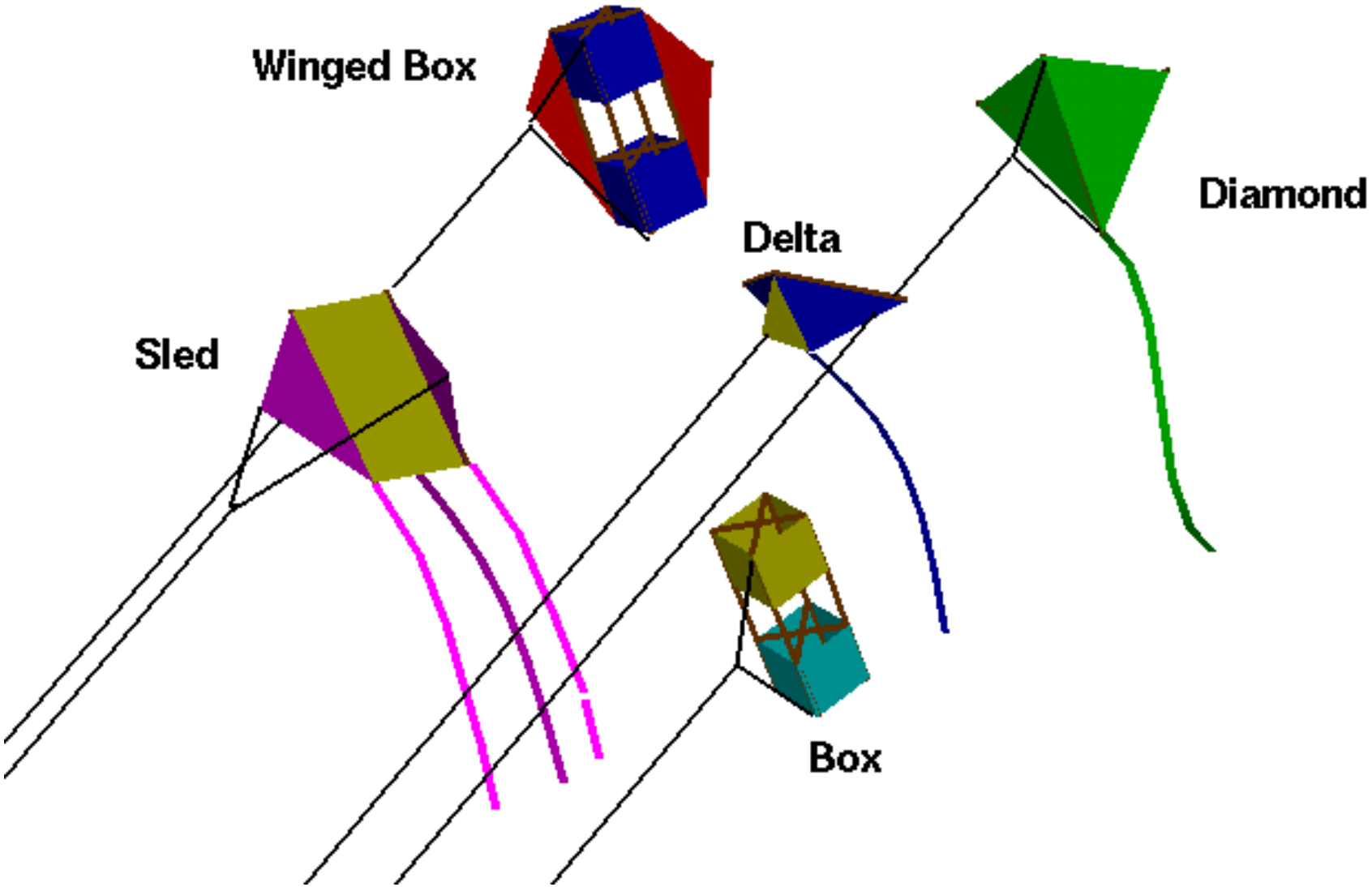
Understanding the Newton Law's of motion

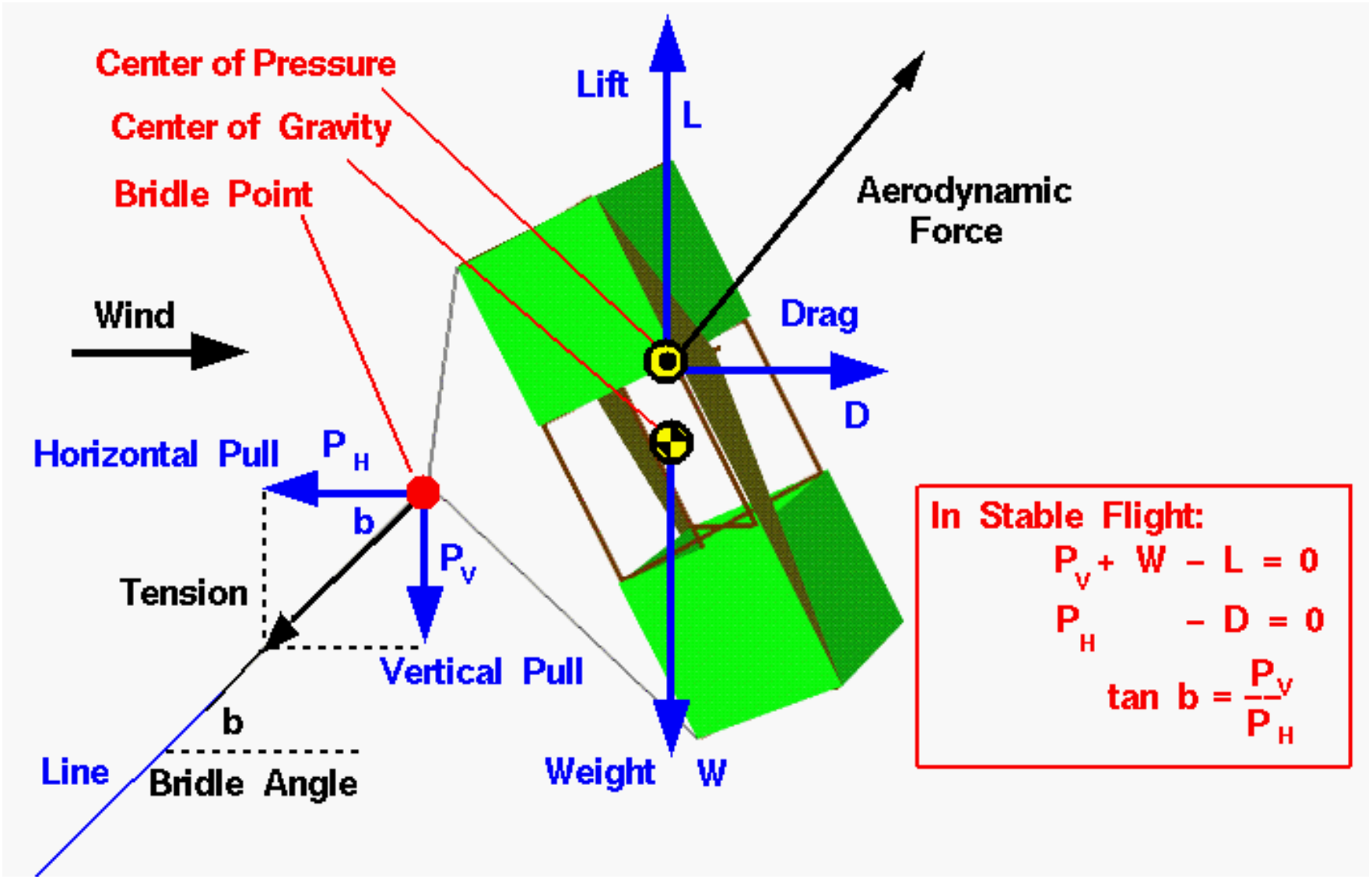
Mechanics of flying Kite

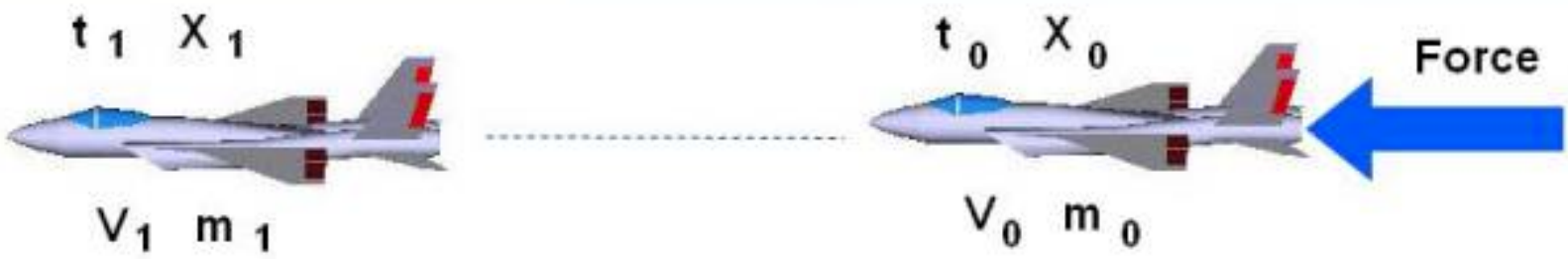




Types of Kites




Center of Pressure
Center of Gravity
Bridle Point
Lift
L
Aerodynamic Force
Wind
Drag
D
Horizontal Pull
P_H
b
P_V
Tension
Vertical Pull
b
Line
Bridle Angle
Weight W
In Stable Flight:
$P_V + W - L = 0$
$P_H - D = 0$
$\tan b = \frac{P_V}{P_H}$



Force = Change of Momentum with Change of Time

Difference form: $$F = \frac{m_1 V_1 - m_0 V_0}{t_1 - t_0}$$

With constant mass: $$F = m \frac{V_1 - V_0}{t_1 - t_0}$$

t = time
X = location
m = mass
V = Velocity

$$F = m\ a$$

Force = mass x acceleration

Velocity, acceleration, momentum and force are vector quantities