Introduction to Dynamics

Introduction to Dynamics

- Syllabus
  - Section 7 website
    http://pioneer.netserv.chula.ac.th/~anopdana/212.htm
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- What is Mechanics (กลศาสตร์) ?
- What is Dynamics (พลศาสตร์) ?

What is Mechanics?

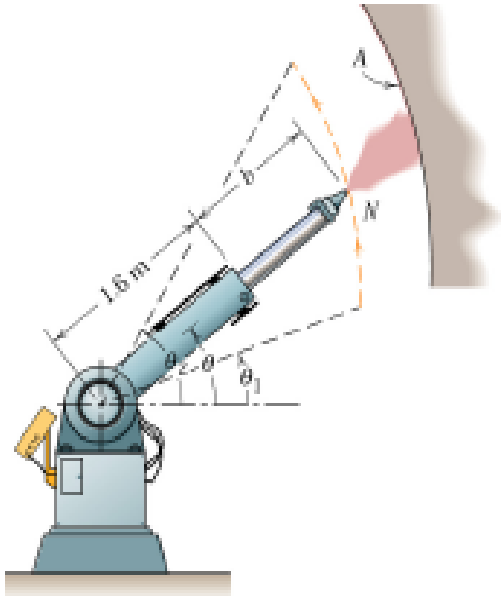
- A branch of physical science which deals with the effects of forces on objects
- Two parts: *Statics* (equilibrium of bodies) and *Dynamics* (motion of bodies)
- Applications:
  - Strength of structures and machines (houses, robots, cars, airplanes)
  - Vibrations (engine vibrations, bridges, wheels)
  - Fluid mechanics (airplanes, fluid machinery)
  - Electrical machines and apparatus (motors, transducers)

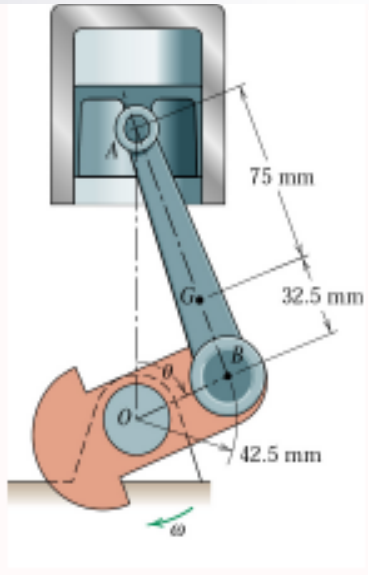
Mechanics Fields of Study

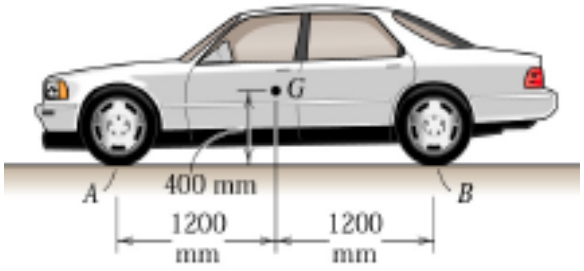
- *Statics*
  - **Rigid** bodies in **equilibrium** → Forces
- *Dynamics*
  - **Rigid** bodies in **motions** → Forces and motions
- *Strength of Materials (Mechanics of Materials)*
  - **Deformable** bodies in **equilibrium** → Strength and deformation
- *Fluid Mechanics*
  - **Deformable** bodies in **motions** → Pressure and flow
- *Mechanics of Machinery*
  - Dynamics of mechanism including linkages
- *Vibration*
  - **Rigid** and **deformation** bodies in **repetitive motions**

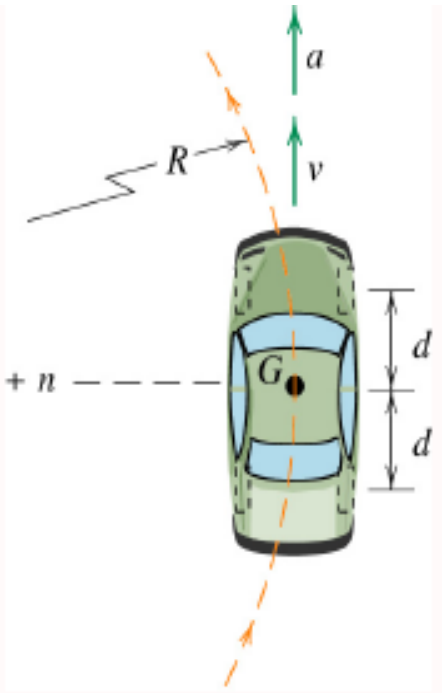
Applications of Dynamics

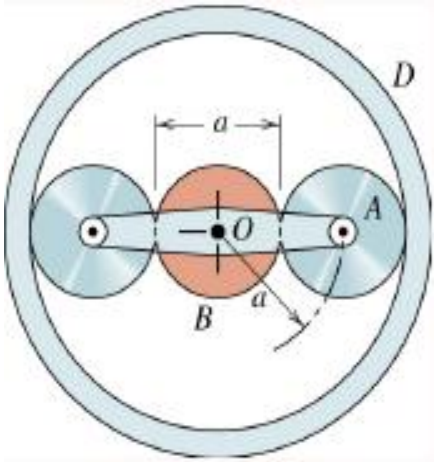
- Robot Arm
- Car Engine
- Vehicle Dynamics
  - braking/accelerating
  - cornering
- Planetary Gear











Laws/Equations in Dynamics Class

- Newton's Laws (3A, 6A)
- Work – Energy Equation (3B, 6B)
- Conservation of Energy (3B, 6B)
- Impulse – Momentum Equation (linear and angular) (3C, 6C)

Dynamics Class Topics

For Midterm

- Chapter 2: Kinematics of Particles
  - Displacement, velocity, acceleration of a particle in 1 and 2 dimensions
- Chapter 3: Kinetics of Particles
  - Newton's laws
  - Work-Energy
  - Impulse-Momentum
    - impact

    in 1 and 2 dimensions

Dynamics Class Topics

For Final

- Chapter 5: Plane Kinematics of Rigid Bodies
- Chapter 6: Plane Kinetics of Rigid Bodies

Not included in the exams but worth reading

- Chapter 1: Introduction
- Chapter 4: Kinetics of Systems of Particles

Learning Strategies

Recommendation:

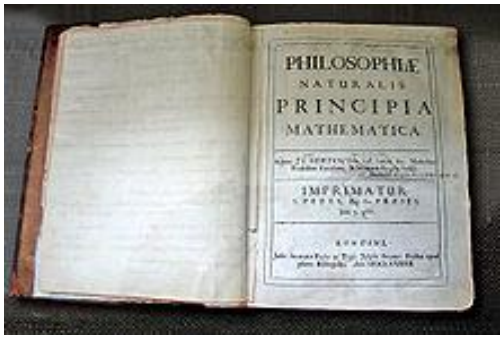
- If possible, read ahead
  - read ahead (+20% understanding), class (+30%), exercise (+40%)
- Two notebooks: for notes and exercises
- Exercise:
  - do exercise before looking at solutions
  - do in steps and make it easy to read
  - in case of getting stuck, ask or look at solutions

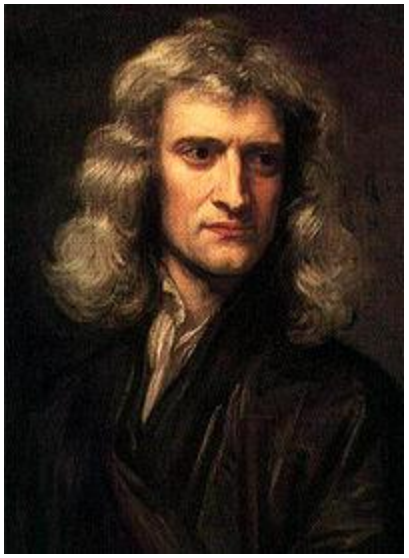
Exam Strategies

- Do step by step
- Write the laws to be used: 2nd law…
- Draw Free Body Diagram
- Show coordinates: x, y…
- Define variables
- Show calculations
- State directions of vectors: vel, acc, force…
- Show units at numerical answers: N, m/s…
- Use common sense to check the answer
- Make it clean

Who is Newton?

- Born: 1643 in England
- Physicist, Mathematician, Astronomer, Philosopher etc.
- “Mathematical Principles of National Philosophy” known as “Principia” (1687)
  - Classical mechanics: Laws of Gravitation, Laws of Motion
- Calculus, Reflecting telescope, law of cooling, speed of sound, Newton’s method for finding roots of a function, power series etc.





Interesting Stuff

- Monument: Westminster Abbey, England
- Apple tree
- Stocks
  - Lost 20,000 GBP in stock in 1720s ($2.72M)
  - *He stated "I can calculate the motions of heavenly bodies, but not the madness of people."*