ME 3050 Lecture - Dynamics Review - Lecture 1

- **Dynamic**

  "Dynamics is the study of how moving objects behave. Dynamics is the part of mechanics that studies movement and its causes. The study of the causes of motion and changes in motion is known as dynamics. Dynamics is the study of how moving objects behave."

  "The dynamical system concept is a mathematical formalization for any fixed "rule" which describes the time dependence of a point's position in its ambient space. "

- **Translational Motion**
  - Position
  - Velocity
  - Acceleration

- **Rotational Motion**
  - Position
  - Velocity
  - Acceleration

- **Particle Motion**
  - What do mean by this?

- **Rigid-Body Motion**
  - What do mean by this specifically? Mathematically?

- **Degrees of Freedom (DOF)**
  - What does this mean?
  - Examples:

- **The dynamics are represented as ordinary differential equations called the _____ of _____.**

- **Deriving the _____ of _____ is typically done in one of two ways.**

1. Newtonian Approach - Vector Based Method
   - Translational
   - Rotational

2. Conservation of Energy Approach - Energy Based Method
   - Kinetic Energy
   - Potential Energy

- **Example:** DJI Phantom with 3-axis Camera Gimbal

- **Simpler Example:** Quarter Car Suspension Model

  - Problem Statement - **Derive the equations of motion using (1) Newton's approach and validate using the (2) Conservation of Energy.**

  - Assumptions - **List the assumptions used in the modeling process.**

– **Figure(s) - Draw a free body diagram (FBD) and/or a sketch of the system. Some problems will require more than one. You need at least one per degree of freedom .**

– **Newton's Approach**

1. Draw a Free Body Diagram

2. Determine all forces acting on the system and their directions.

3. Write Newton's second law for the appropriate DOF.

4. Re-write the ODE in the standard form of a system equation.

– **Conservation of Energy Approach**

1. Draw a Free Body Diagram

2. Determine all energies present in the system and their type.

3. Write Conservation of Energy for system. Call this equation 1.

4. Re-write the ODE in the standard form of a system equation.