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# VEMU INSTITUTE OF ENGINEERING AND TECHNOLOGY

IMPORTANCE OF MATHEMATICS IN ENGINEERING SCENARIO

## BY Dept of Mathematics



# 1.MECH

## **Simple Harmonic Motion**



Consider a mass suspended from a spring attached to a rigid support. (This is commonly called a **spring-mass system**.) Gravity is pulling the mass downward and the restoring force of the spring is pulling the mass upward. when these two forces are equal, the mass is said to be at the equilibrium position. If the mass is displaced from equilibrium, it oscillates up and down. This behavior can be modeled by a second-order constant-coefficient differential equation.  $\mathbf{x''}+\boldsymbol{\omega}^2(\mathbf{x})=\mathbf{0}$ , which gives the position of the mass at any point in time. The motion of the mass is called simple harmonic motion.



#### Modeling a Motorcycle Suspension System

For motocross riders, the suspension systems on their motorcycles are very important. The off-road courses on which they ride often include jumps, and losing control of the motorcycle when they land could cost them the race.



This suspension system can be modeled as a damped spring-mass system. We define our frame of reference with respect to the frame of the motorcycle. Assume the end of the shock absorber attached to the motorcycle frame is fixed. Then, the "mass" in our springmass system is the motorcycle wheel. We measure the position of the wheel with respect to the motorcycle frame. This may seem counterintuitive, since, in many cases, it is actually the motorcycle frame that moves, but this frame of reference preserves the development of the differential equation

that was done earlier. As with earlier development, we define the downward direction to be positive. When the motorcycle is lifted by its frame, the wheel hangs freely and the spring is uncompressed. This is the spring's natural position. When the motorcycle is placed on the ground and the rider mounts the motorcycle, the spring compresses and the system is in the equilibrium position.



We can use a spring-mass system to model a motorcycle suspension.

This system can be modeled using the same differential equation we used before mx"+bx'+kx=o.

#### LANDING VEHICLE

NASA(National Aeronautics and Space Administration) is planning a mission to Mars. To save money, engineers have decided to adapt one of the moon landing vehicles for the new mission. However, they are concerned about how the different gravitational forces will affect the suspension system that cushions the craft when it touches down. The acceleration resulting from gravity on the moon is 1.6 m/sec<sup>2</sup>, whereas on Mars it is 3.7 m/sec<sup>2</sup>. The suspension system on the craft can be modeled as a damped spring-mass system. In this case, the spring is below the moon lander, so the spring is slightly compressed at equilibrium.



The landing craft suspension can be represented as a damped spring-mass system.

We retain the convention that down is positive. Despite the new orientation, an examination of the forces affecting the lander shows that the same differential equation can be used to model the position of the landing craft relative to equilibrium: mx"+bx'+kx=0

## The RLC Series Circuit

**2.**EEE



The charge on the capacitor in an *RLC* series circuit can also be modeled with a second-order constant-coefficient differential equation of the form

$$L\frac{d^2q}{dt^2} + R \frac{dq}{dt} + \frac{1}{C}q = E(t)$$



Many buildings use a steel structural framework to support the weight of the building, its furnishings, and all the people who work or visit there. Other materials can be used to support buildings, including <u>reinforced concrete</u>, which is concrete with an internal <u>steel frame</u> called rebar. Architects design the beam structure using calculations for the various stresses that occur from the building weight, people or vehicles, and any possible effects of wind or snow. Stresses cause beam deflection, which is the bending or twisting of the structural members due to building loads, movement of people, or changing weather. The beam deflection equation can be written in the form

$$EI\frac{d^4y}{dx^4} = -q$$

#### The Role Of Differential Equation In Computer Science



### 5.ECE

## **Circuit analysis**

The operation of an electronic circuit is described by a set of simultaneous differential equations. These must either be solved or simulated to determine the operation of the circuit.