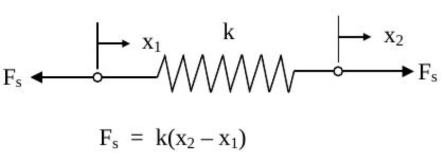
AE31002 Structural Dynamics

Anup Ghosh

Discrete Systems and Spring



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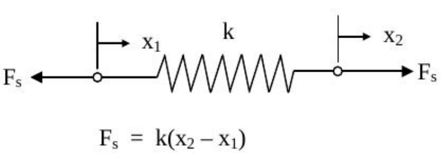

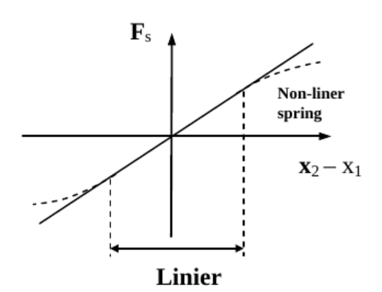

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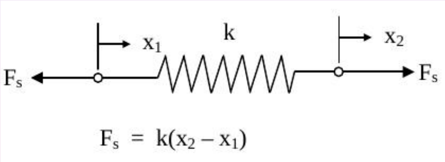

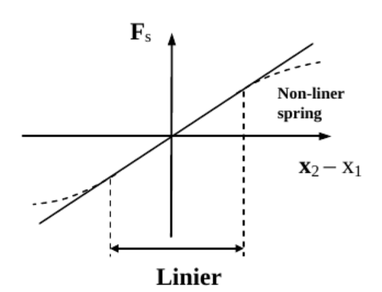

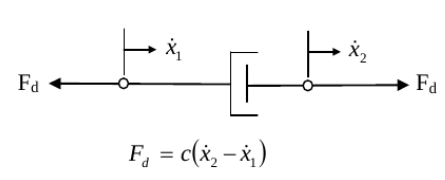

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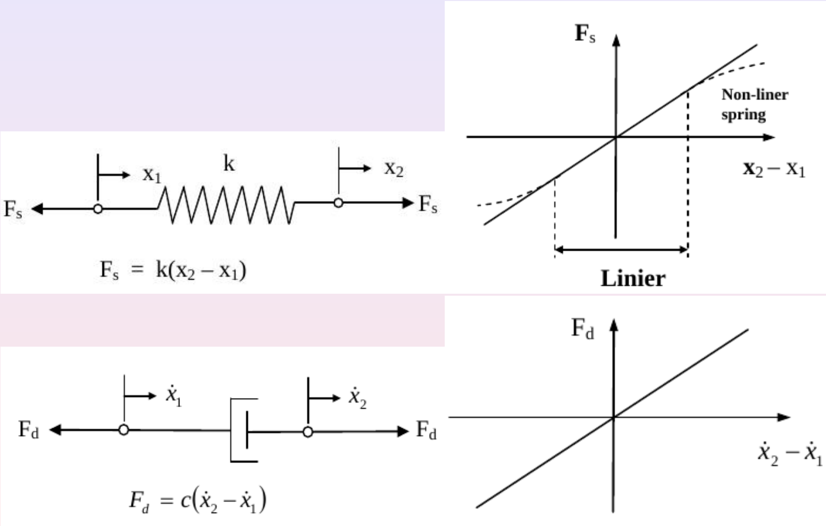

Parallel Springs

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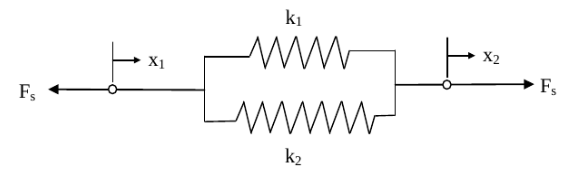

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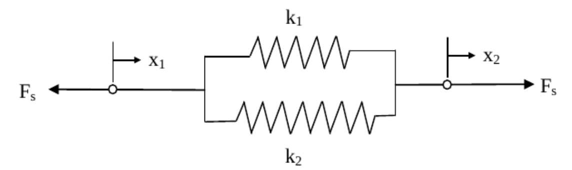

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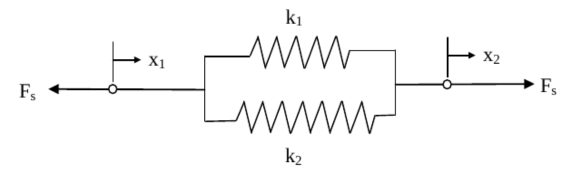

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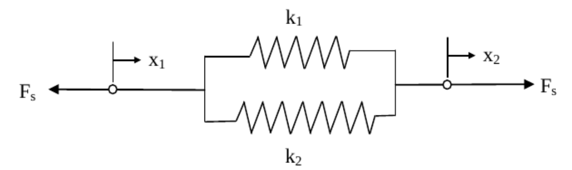

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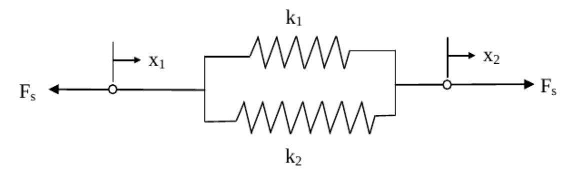

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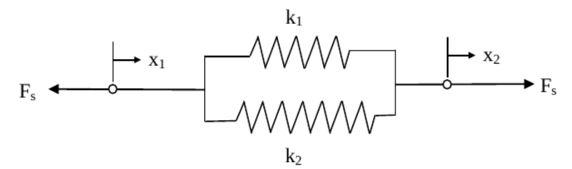

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Similarly for n number of parallel springs

$$k_{eq} = \sum_{i=1}^{n} k_i$$

Springs in Series

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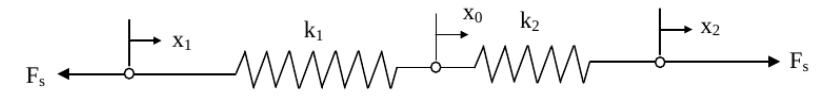

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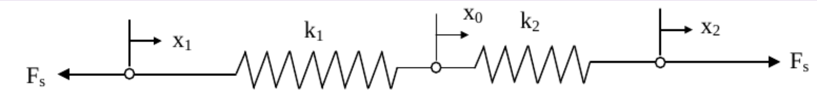

$F_s = k_1(x_0 - x_1)$ and

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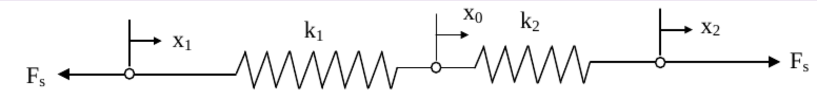

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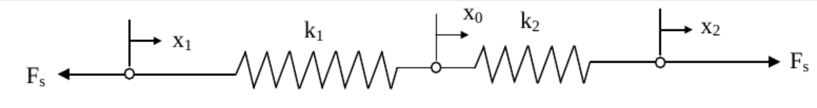

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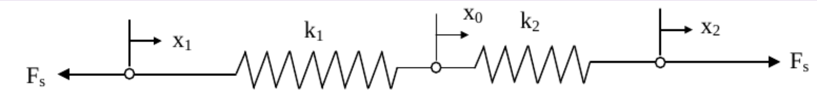

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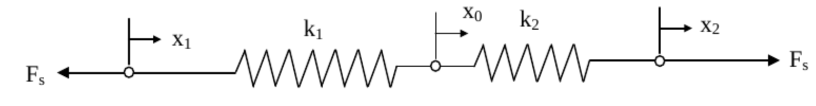

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Where $k_{eq} = \{\frac{1}{k_1} + \frac{1}{k_2}\}^{-1}$;
Similarly for n number of springs in series

$$k_{eq} = \left(\sum_{i=1}^{n} \frac{1}{k_i}\right)^{-1}$$

D‘Alemberts‘s Principle

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In the case of **static elastic deformation**, the internal **elastic forces**, try to restore the system to the position of equilibrium.

D'Alemberts's Principle

In the case of **pendulum**, restoring force is force of **gravity** (Rigid body motion).

D‘Alemberts‘s Principle

In the case of **vibration**, D‘Alembert reasoned that the **sum of the forces** acting on a particle result in acceleration $\ddot{x}$. The inertial force can be computed by multiplying the mass of the body, $F = m\ddot{x}$.

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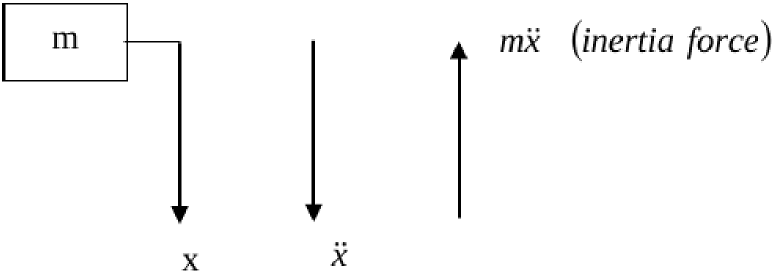
If the **force** so computed is applied to the body **at its mass center** in the direction **opposite to its acceleration**, the dynamic problem is reduced to one of statics. This is the D'Alembert principle.

D'Alemberts's Principle



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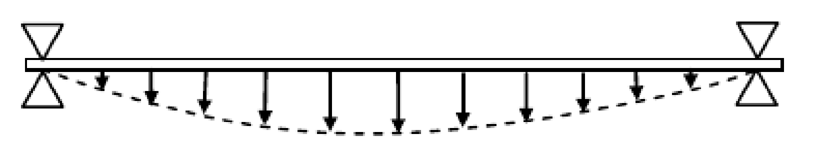

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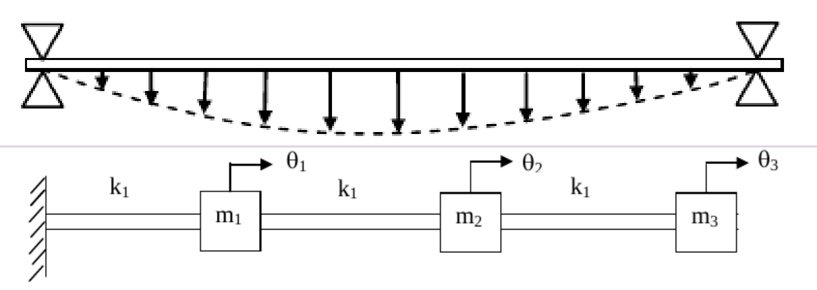

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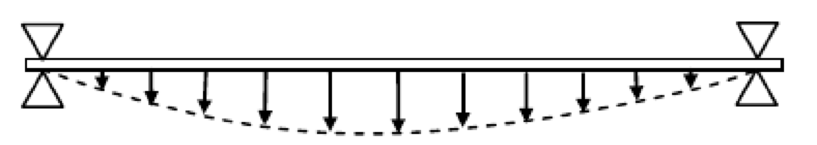

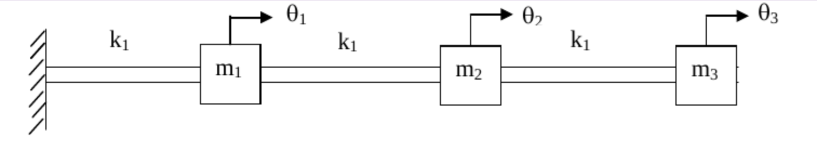

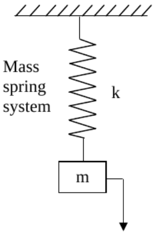

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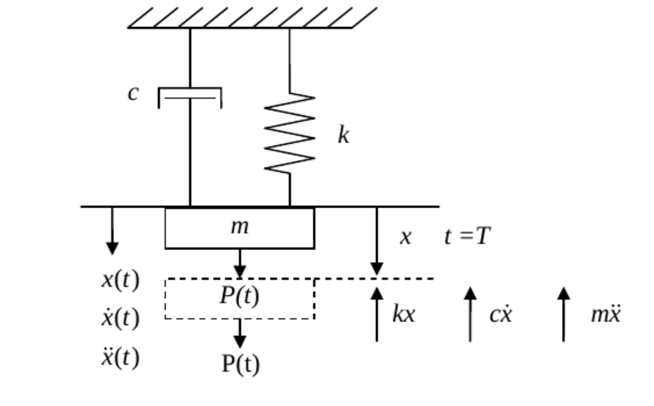

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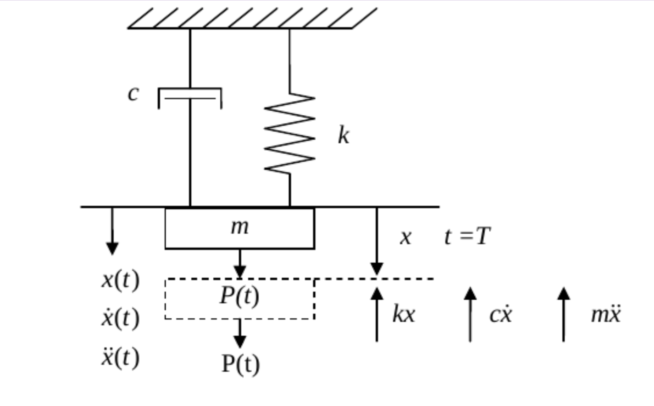

Equilibrium equation

$m\ddot{x} + c\dot{x} + kx = P(t)$, — Dynamic Equilibrium Equation.

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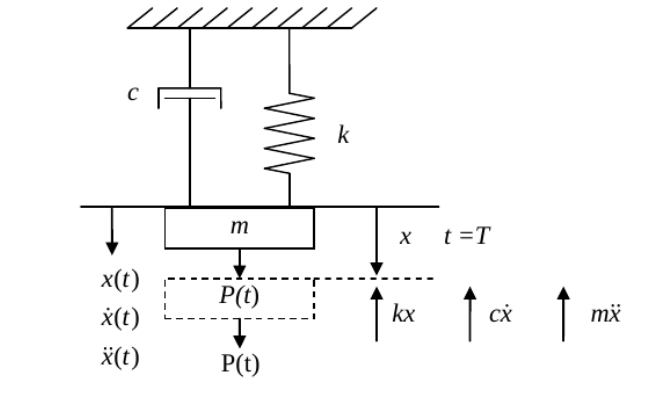

Equilibrium equation
$m\ddot{x} + c\dot{x} + kx = P(t)$, — Dynamic Equilibrium Equation.
If $p(t) = 0$, it is free vibration.