

Key equations

Quantity	Equation	Notes
Power	Power = effort × flow	Force × velocity or torque × angular velocity
Translation: inertia	F = m a	Newton's second law
Translation: spring	F = k x	
Translation: damper	F = b v	Friction element
Rotation: inertia	τ = J α	J = mass moment of inertia about the centre of mass
Rotation: spring	τ = k θ	
Rotation: damper	τ = d ω	
Gear rolling constraint	r₁ θ₁ = r₂ θ₂	Equal arc length along both pitch circles
Work and power (translation)	W = ∫ F dx; P = dW/dt = F v	
Work and power (rotation)	W = ∫ τ dθ; P = dW/dt = τ ω	
Drive equations	m dV/dt = F_{drive} - F_{load}; J dω/dt = τ_{drive} - τ_{load}	

Key takeaways

- Energy is stored in states such as mass or capacitance and dissipated in resistive elements such as electrical resistors or suspension dampers.
- A parallel spring-dashpot carries the same force, with deformations adding; in series, each has its own deformation and the forces sum.
- Gear trains give speed reduction and torque amplification. Lossless (ideal) gears pass power unchanged, so torque rises by the factor speed falls; real gears lose some to friction and heat.
- Equivalent inertia lumps several rotating parts into one inertia to simplify analysis; see the related Moment of Inertia sheet.
- The gear-train and equivalent-inertia equations in the article are images and are not reproduced here.