# Applied Mechanics 1 Formulae

## Rules of Cosine and Sine

## Linear Motion

where:

* : Initial velocity
* : Final velocity
* : Displacement
* : Acceleration
* : Time

## Angular Motion

where:

* : Initial angular velocity (rad/s)
* : Final angular velocity (rad/s)
* Angular displacement (rad)
* : Angular acceleration (rad/s2)
* : Time (s)

## Relation Between Linear and Angular Motion

The relationship between linear and angular motion is described by the following equations:

(linear displacement and angular displacement ).

(linear velocity and angular velocity ),

(linear acceleration and angular acceleration ).

## Centre of Gravity

## Centroid

## Parallel Axis Theorem

To find the moment of inertia about an axis parallel to the centroidal axis:

## Radius of Gyration

where:

* : Moment of inertia about the axis
* : Area of the cross-section (for area calculations)
* : Mass of the body (for mass calculations)

### Rectangle (about its centroidal axis)

* Dimensions: ( b ) (breadth), ( h ) (height)
* Radius of gyration about the centroidal x-axis:

### Circle (about its centroidal axis)

* Radius: ( r )
* Radius of gyration:

## Beam Calculations

| Sum of Horizontal Forces | Sum of Vertical Force | Sum of Moments |
| --- | --- | --- |
|  |  |  |

| **Load Type** | **Shear Diagram Shape** | **Moment Diagram Shape** |
| --- | --- | --- |
| Point Load | Rectangular (constant) | Triangular |
| Uniformly Distributed Load (UDL) | Triangular | Parabolas (second degree) |

## Dynamics

### Linear momentum

Where:

* Linear momentum is in kg·m/s.
* is the mass of the object in kilograms.
* is the velocity of the object in meters per second.

### Angular momentum

Where:

* is the moment of inertia in .
* is the angular velocity in .

### Moment of inertia

Where:

* is the moment of inertia in .
* is the mass in .
* is the radius of gyration in .

### Turning moment

Where:

* is the torque in .
* is the moment of inertia in .
* : Angular acceleration in .

### Power by Torque

Where:

is the power in watts (W),

is the torque in newton-meters (Nm), and

is the angular velocity in radians per second (rad/s).

### Kinetic Energy of Rotation

Where:

* is the moment of inertia in .
* is the angular velocity in radians per second (rad/s).

## Stress and Strain

### Stress

Where:

* is the stress (Pa),
* is the shearing stress (Pa),
* is the shearing force (N),
* is the cross-sectional area (m).

### Strain

Where:

* is the strain (unitless),
* is the change in length,
* is the original length.

### Hooke’s Law

Where:

* is the stress (Pa).
* is the strain (unitless).
* E: Young’s modulus (Pa), a material property (modulus of elasticity).

### Factor of Safety (FOS)

## Hydrodynamics

### Volume Flow

Where:

: Volume flow rate,

: Cross-sectional area of the flow,

: Mean (average) velocity of the fluid,

### Mass Flow

Where:

: mass flow rate,

: density,

: volume flow,

### Specific Weight

Where:

: specific weight,

: gravitational acceleration,

: density,

### Continuity Equation

### Energy Equation

Each term has units of m, therefore:

* Potential energy is known as the elevation head.
* Kinetic energy is known as the velocity head.
* Pressure energy is known as the pressure head.

### Bernoulli’s Equation

Where:

* and are the pressures at points 1 and 2, respectively.
* is the density of the fluid.
* and are the velocities of the fluid at points 1 and 2, respectively.
* is the acceleration due to gravity.
* and are the heights of the fluid at points 1 and 2, respectively.

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| Table 1: Centroids of Common Shapes   | Shape | Area |  |  | | --- | --- | --- | --- | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |  |  |  |  | |

## Second Moments of Common Shapes

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| Table 2: Second moments   | Shape | Second moment () | Second moment () | | --- | --- | --- | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |  |  |  | |