



# Frequency of Under Damped Forced Vibrations Formulas

Calculators!

Examples!

Conversions!

Bookmark calculatoratoz.com, unitsconverters.com

Widest Coverage of Calculators and Growing - 30,000+ Calculators!

Calculate With a Different Unit for Each Variable - In built Unit Conversion!

Widest Collection of Measurements and Units - 250+ Measurements!

Feel free to SHARE this document with your friends!

Please leave your feedback here...





## List of 15 Frequency of Under Damped Forced Vibrations Formulas

## Frequency of Under Damped Forced Vibrations

1) Complementary Function 🚰

$$\mathbf{f}\mathbf{x} \left[ \mathbf{x}_1 = \mathbf{A} \cdot \cos(\omega_\mathrm{d} - \phi) 
ight]$$

Open Calculator 🗗

$$= 1.689698 \text{m} = 5.25 \text{m} \cdot \cos(6 \text{Hz} - 55^{\circ})$$

2) Damping Coefficient

$$\mathbf{k} = \frac{ an(\phi) \cdot \left(k - m \cdot \omega^2\right)}{\omega}$$

Open Calculator

$$\underbrace{\text{4.998518Ns/m} = \frac{\tan(55°) \cdot \left(60\text{N/m} - .25\text{kg} \cdot \left(10\text{rad/s}\right)^2\right)}{10\text{rad/s}} }$$

3) Deflection of System under Static Force



Open Calculator

4) External Periodic Disturbing Force

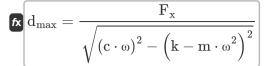
$$\mathbf{f}\mathbf{x}ig[\mathbf{F}=\mathbf{F}_{\mathrm{x}}\cdot\cos(\omega\cdot\mathbf{t}_{\mathrm{p}})ig]$$

Open Calculator

$$\texttt{ex} \ 16.87708 \texttt{N} = 20 \texttt{N} \cdot \cos(10 \texttt{rad/s} \cdot 1.2 \texttt{s})$$



#### 5) Maximum Displacement of Forced Vibration 🗗



Open Calculator

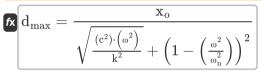
$$0.560112 m = \frac{20 N}{\sqrt{\left(5 N s / m \cdot 10 rad / s\right)^2 - \left(60 N / m - .25 kg \cdot \left(10 rad / s\right)^2\right)^2}}$$

## 6) Maximum Displacement of Forced Vibration at Resonance

Open Calculator

$$= 0.56101 \text{m} = 0.3333333 \text{m} \cdot \frac{60 \text{N/m}}{5 \text{Ns/m} \cdot 7.13 \text{rad/s}}$$

## 7) Maximum Displacement of Forced Vibration using Natural Frequency



Open Calculator

$$= \frac{0.3333333m}{\sqrt{\frac{\left((5 \text{Ns/m})^2\right) \cdot \left((10 \text{rad/s})^2\right)}{\left(60 \text{N/m}\right)^2}} + \left(1 - \left(\frac{(10 \text{rad/s})^2}{(7.13 \text{rad/s})^2}\right)\right)^2} }$$

## 8) Maximum Displacement of Forced Vibration with Negligible Damping

$$\mathbf{fx} \mathbf{d}_{\mathrm{max}} = rac{\mathbf{F_x}}{\mathbf{m} \cdot \left(\omega_{\mathrm{n}}^2 - \omega^2
ight)}$$

Open Calculator

$$= \frac{20 \text{N}}{.25 \text{kg} \cdot \left( \left( 7.13 \text{rad/s} \right)^2 - \left( 10 \text{rad/s} \right)^2 \right)}$$



#### 9) Particular Integral

$$\mathbf{x}_{2} = rac{F_{\mathrm{x}} \cdot \cos(\omega \cdot t_{\mathrm{p}} - \phi)}{\sqrt{\left(\mathbf{c} \cdot \omega
ight)^{2} - \left(\mathbf{k} - \mathbf{m} \cdot \omega^{2}
ight)^{2}}}$$

Open Calculator

$$\boxed{ 0.024914 m = \frac{20 N \cdot \cos(10 rad/s \cdot 1.2 s - 55°)}{\sqrt{(5 N s/m \cdot 10 rad/s)^2 - \left(60 N/m - .25 kg \cdot (10 rad/s)^2\right)^2} }$$

### 10) Phase Constant

$$\phi = a an \left(rac{ ext{c} \cdot \omega}{ ext{k} - ext{m} \cdot \omega^2}
ight)$$

Open Calculator 🖸

ex 
$$55.00798^{\circ} = a \tan \left( \frac{5 \text{Ns/m} \cdot 10 \text{rad/s}}{60 \text{N/m} - .25 \text{kg} \cdot (10 \text{rad/s})^2} \right)$$

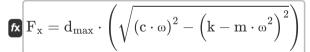
#### 11) Static Force

$$\mathbf{fx}[\mathbf{F}_{\mathrm{x}} = \mathbf{x}_{\mathrm{o}} \cdot \mathbf{k}]$$

Open Calculator 🚰

 $= 20 N = 0.3333333 m \cdot 60 N/m$ 

### 12) Static Force using Maximum Displacement or Amplitude of Forced Vibration



Open Calculator

$$\boxed{ 20.03171 \mathrm{N} = 0.561 \mathrm{m} \cdot \left( \sqrt{\left(5 \mathrm{Ns/m} \cdot 10 \mathrm{rad/s}\right)^2 - \left(60 \mathrm{N/m} - .25 \mathrm{kg} \cdot \left(10 \mathrm{rad/s}\right)^2\right)^2} \right) }$$

## 13) Static Force when Damping is Negligible

$$\mathbf{F}_{\mathrm{x}} = \mathrm{d}_{\mathrm{max}} \cdot \left( \mathrm{m} \cdot \omega_{\mathrm{n}}^2 - \omega^2 
ight)$$

Open Calculator

$$-48.970125 \mathrm{N} = 0.561 \mathrm{m} \cdot \left(.25 \mathrm{kg} \cdot (7.13 \mathrm{rad/s})^2 - (10 \mathrm{rad/s})^2\right)$$





14) Total Displacement of Forced Vibration given Particular Integral and Complementary Function 🗗



$$\mathbf{f}\mathbf{x} egin{bmatrix} \mathbf{d}_{\mathrm{tot}} = \mathbf{x}_2 + \mathbf{x}_1 \end{bmatrix}$$

Open Calculator 🚰

1.7m = 0.02m + 1.68m

15) Total Displacement of Forced Vibrations

 $d_{tot} = A \cdot cos(\omega_d - \phi) + \frac{F_x \cdot cos(\omega \cdot t_p - \phi)}{\sqrt{\left(c \cdot \omega\right)^2 - \left(k - m \cdot \omega^2\right)^2}}$ 

Open Calculator

ex

$$\boxed{1.714612 \text{m} = 5.25 \text{m} \cdot \cos(6 \text{Hz} - 55\degree) + \frac{20 \text{N} \cdot \cos(10 \text{rad/s} \cdot 1.2 \text{s} - 55\degree)}{\sqrt{(5 \text{Ns/m} \cdot 10 \text{rad/s})^2 - \left(60 \text{N/m} - .25 \text{kg} \cdot (10 \text{rad/s})^2\right)^2}}$$



#### Variables Used

- A Amplitude of Vibration (Meter)
- C Damping Coefficient (Newton Second per Meter)
- dmax Maximum Displacement (Meter)
- dtot Total Displacement (Meter)
- **F** External Periodic Disturbing Force (Newton)
- **F**<sub>x</sub> Static Force (Newton)
- **k** Stiffness of Spring (Newton per Meter)
- **m** Mass suspended from Spring (Kilogram)
- t<sub>p</sub> Time Period (Second)
- X<sub>1</sub> Complementary Function (Meter)
- X<sub>2</sub> Particular Integral (Meter)
- Xo Deflection under Static Force (Meter)
- Φ Phase Constant (Degree)
- w Angular Velocity (Radian per Second)
- ω<sub>d</sub> Circular Damped Frequency (Hertz)
- ω<sub>n</sub> Natural Circular Frequency (Radian per Second)





#### Constants, Functions, Measurements used

- Function: atan, atan(Number)
   Inverse tan is used to calculate the angle by applying the tangent ratio of the angle, which is the opposite side divided by the adjacent side of the right triangle.
- Function: cos, cos(Angle)

  Cosine of an angle is the ratio of the side adjacent to the angle to the hypotenuse of the triangle.
- Function: sqrt, sqrt(Number)
   A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Function: tan, tan(Angle)

  The tangent of an angle is a trigonometric ratio of the length of the side opposite an angle to the length of the side adjacent to an angle in a right triangle.
- Measurement: Length in Meter (m)
  Length Unit Conversion
- Measurement: Weight in Kilogram (kg)
  Weight Unit Conversion
- Measurement: Time in Second (s)

  Time Unit Conversion
- Measurement: Force in Newton (N) Force Unit Conversion
- Measurement: Angle in Degree (°)
   Angle Unit Conversion
- Measurement: Frequency in Hertz (Hz)
  Frequency Unit Conversion
- Measurement: Surface Tension in Newton per Meter (N/m) Surface Tension Unit Conversion
- Measurement: Angular Velocity in Radian per Second (rad/s)
   Angular Velocity Unit Conversion
- Measurement: Damping Coefficient in Newton Second per Meter (Ns/m)
   Damping Coefficient Unit Conversion





#### Check other formula lists

- Load for Various Types of Beams and Load Conditions Formulas
- Effect of Inertia of Constraint in Longitudinal and Transverse Vibrations Formulas
- Frequency of Free Damped Vibrations Formulas
- Frequency of Under Damped Forced Vibrations Formulas (

- Natural Frequency of Free Transverse Vibrations Formulas
- Critical or Whirling Speed of Shaft Formulas Values of length of beam for the various types of beams and under various load conditions Formulas (
  - · Values of static deflection for the various types of beams and under various load conditions Formulas
  - Vibration Isolation and Transmissibility Formulas (

Feel free to SHARE this document with your friends!

#### PDF Available in

English Spanish French German Russian Italian Portuguese Polish Dutch

9/30/2024 | 8:34:01 AM UTC

Please leave your feedback here...



