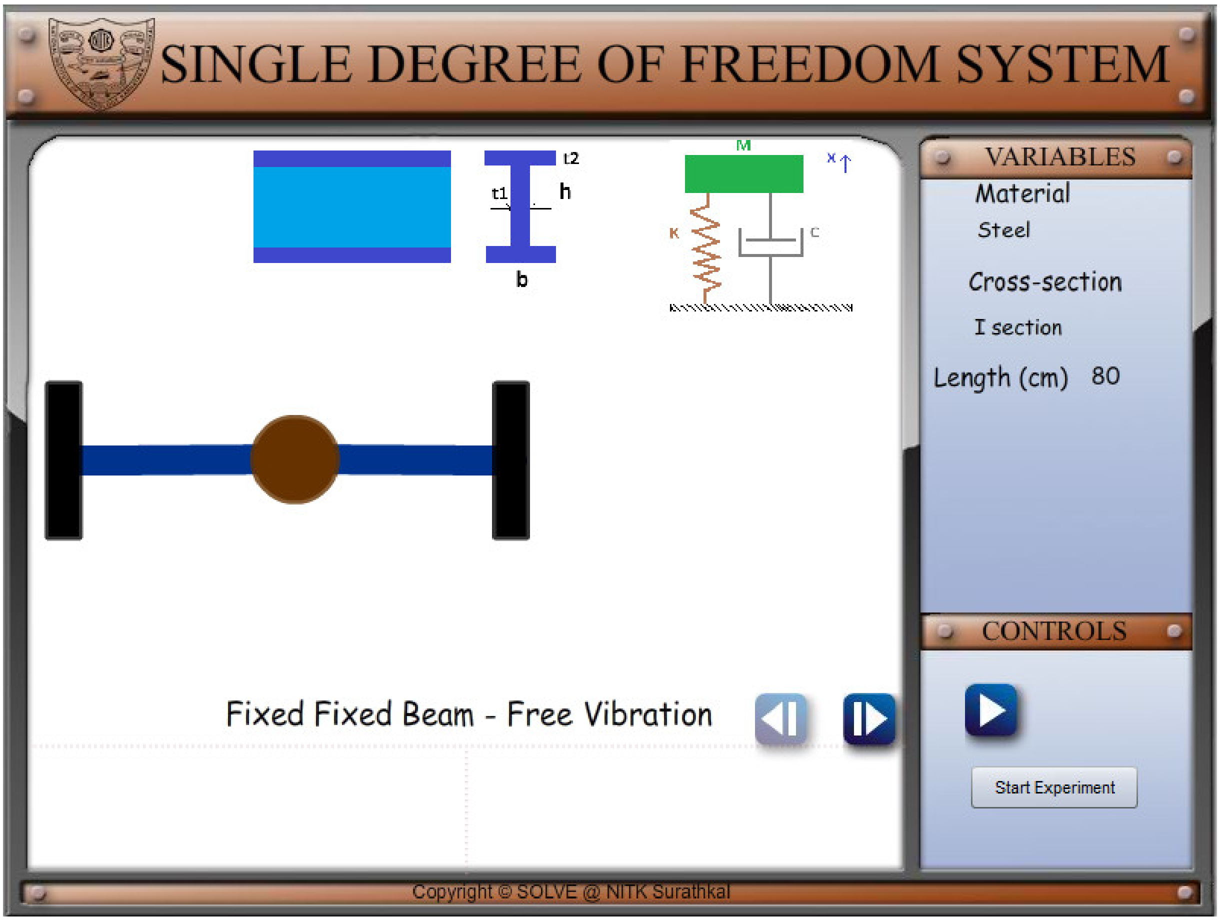
FREE VIBRATION SDOF SYSTEM - expT PROCEDURE

AIM:

To find the damping (c) of the given beam.

PROCEDURE:

Begin the experiment by clicking the start experiment button.



1. Find logarithmic decrement (δ) from displacement v/s time graph.

The logarithmic decrement is defined as follows.

$$\delta = \frac{1}{n} \ln \left(\frac{x_1}{x_n} \right)$$

Here x_1 and x_n refer to the displacements at the first and nth peak in the displacement v/s time graph. The displacements at the peaks can be found using the location slider.

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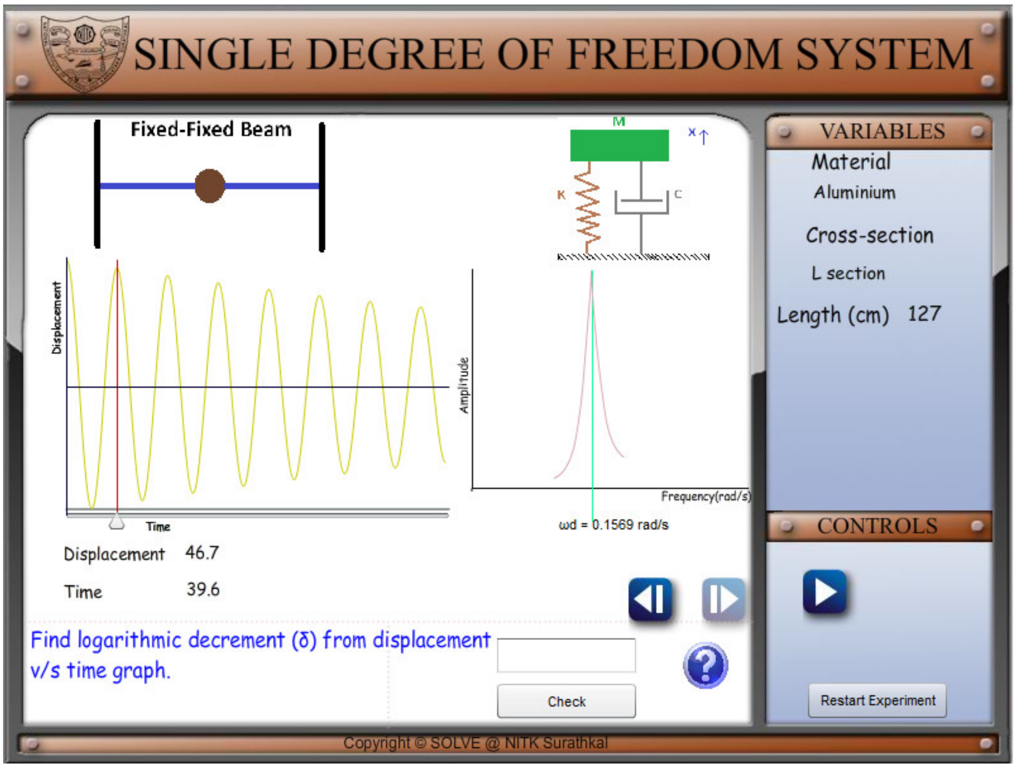

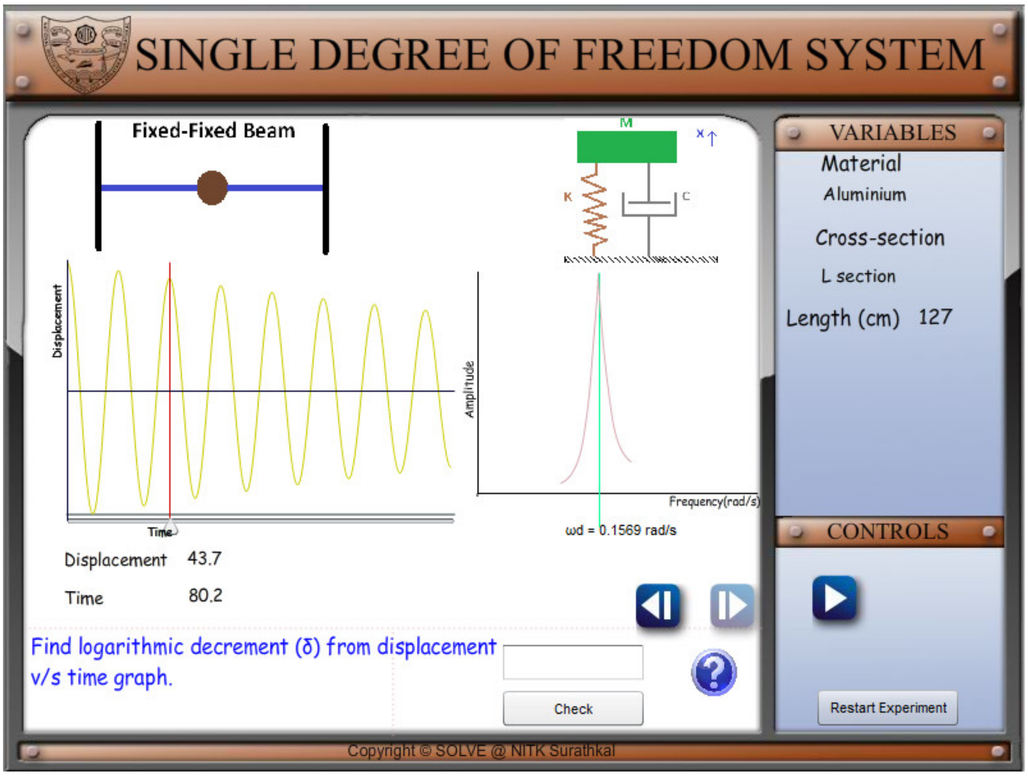

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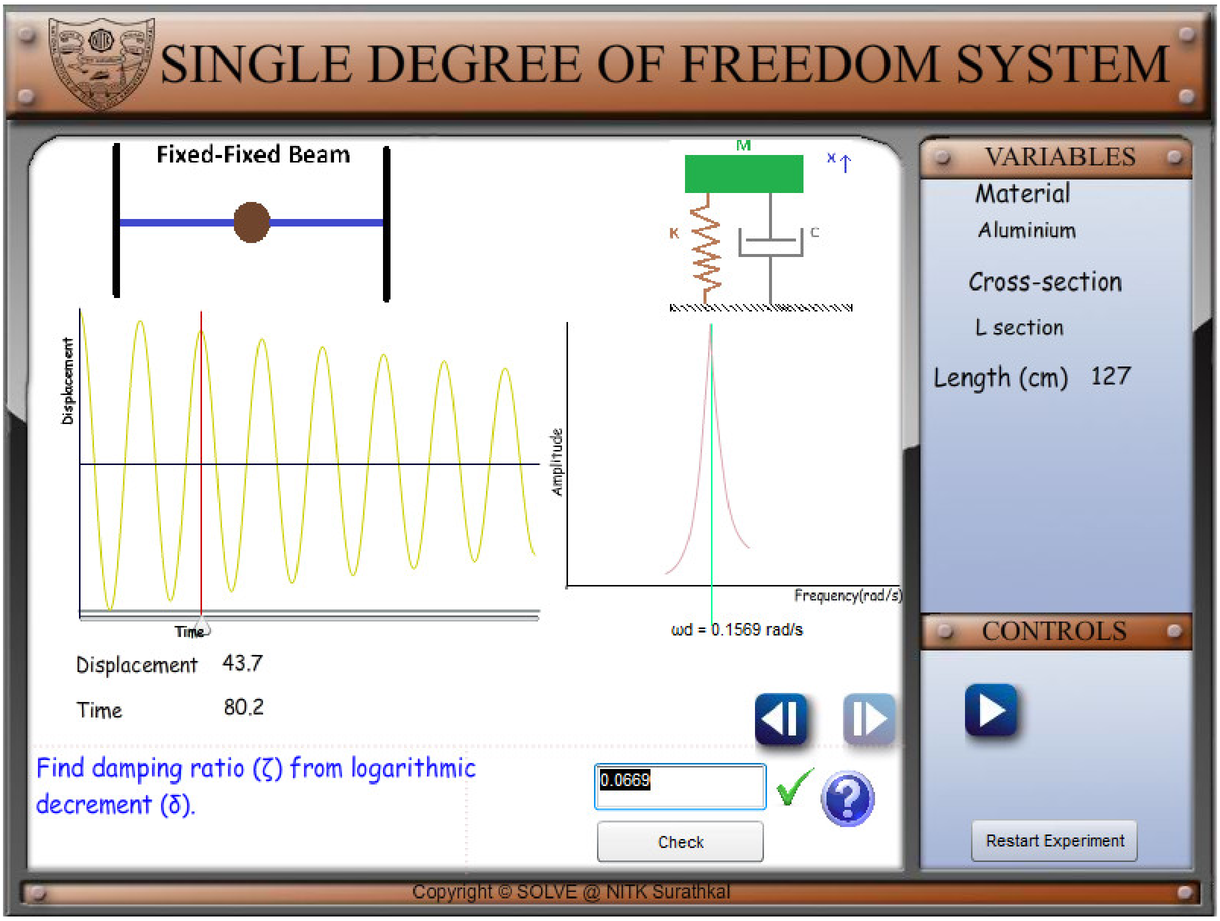
2. Find the damping ratio (ζ) from the logarithmic decrement (δ). The damping ratio is given by

$$\zeta = \frac{1}{\sqrt{1+\left(\frac{2\pi}{\delta}\right)^2}}$$



3. Find beam stiffness (k) N/m from Young's modulus (E), area moment of inertia (I) and length (L). The stiffness for different beams is given below.

Cantilever beam	$k = \frac{3EI}{L^3}$
Simply supported beam	$k = \frac{48EI}{L^3}$
Fixed Fixed beam	$k = \frac{192EI}{L^3}$

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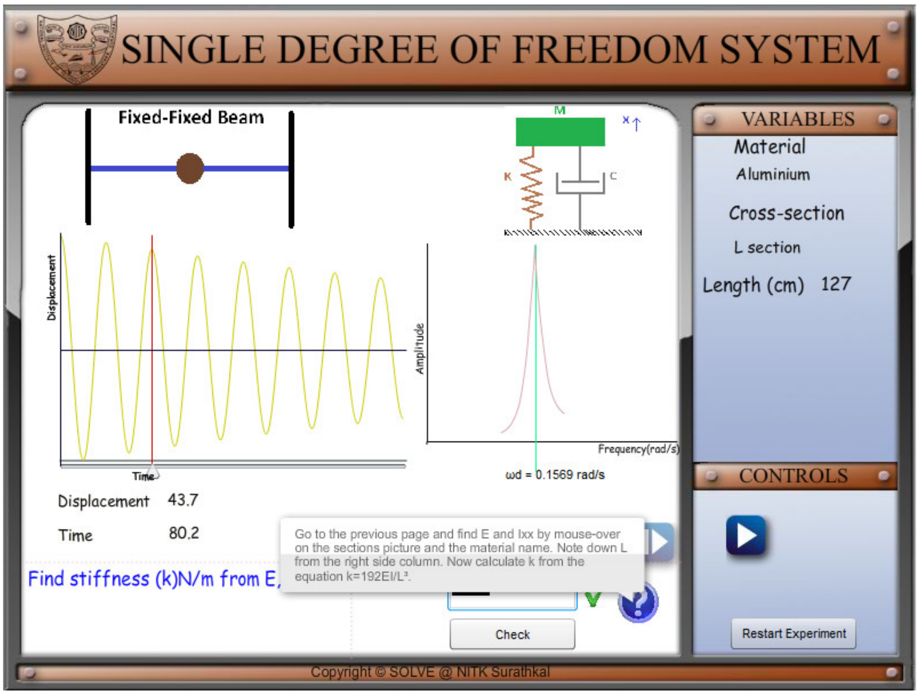
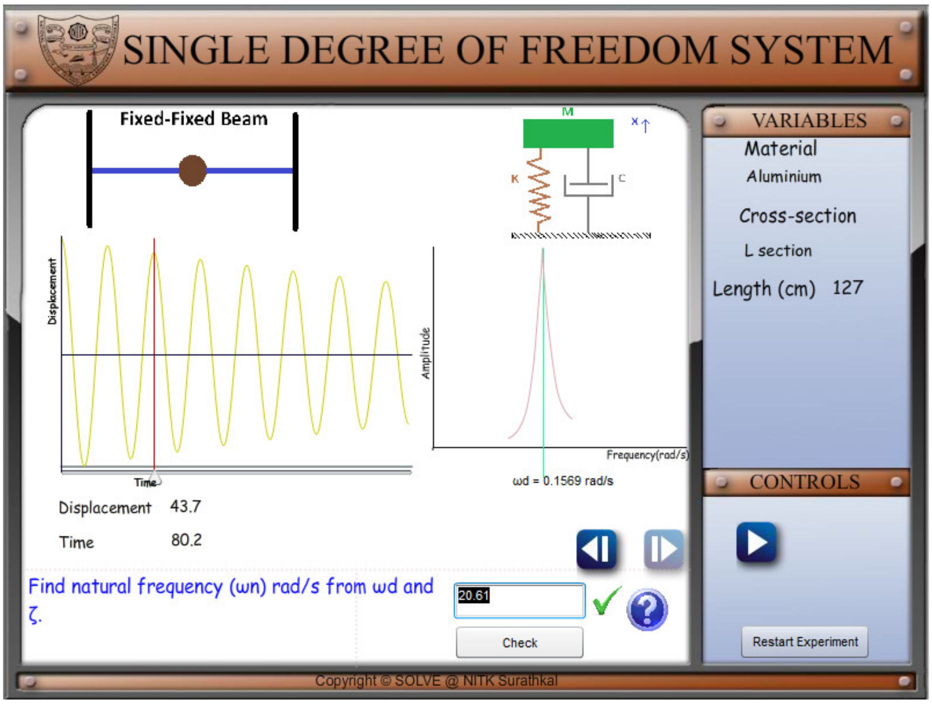


4. Find natural frequency (ω_n) rad/s from ω_d and ζ . ω_d can found from the FFT in the graph window.

$$\omega_n = \frac{\omega_d}{\sqrt{1-\zeta^2}}$$



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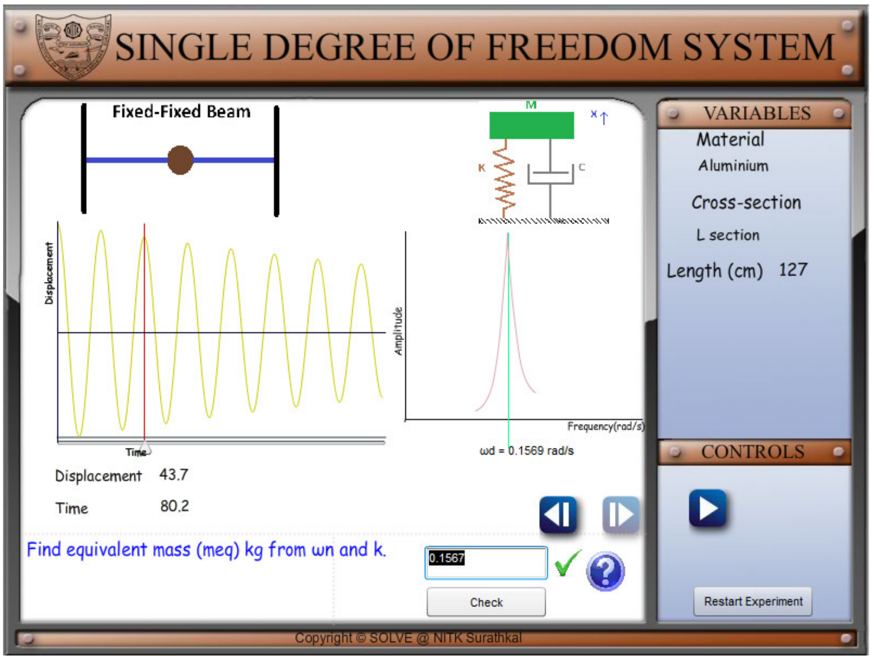
5. Find equivalent mass (m_{eq}) kg from ω_n and k.

$$m_{eq} = \frac{k}{{\omega_n}^2}$$

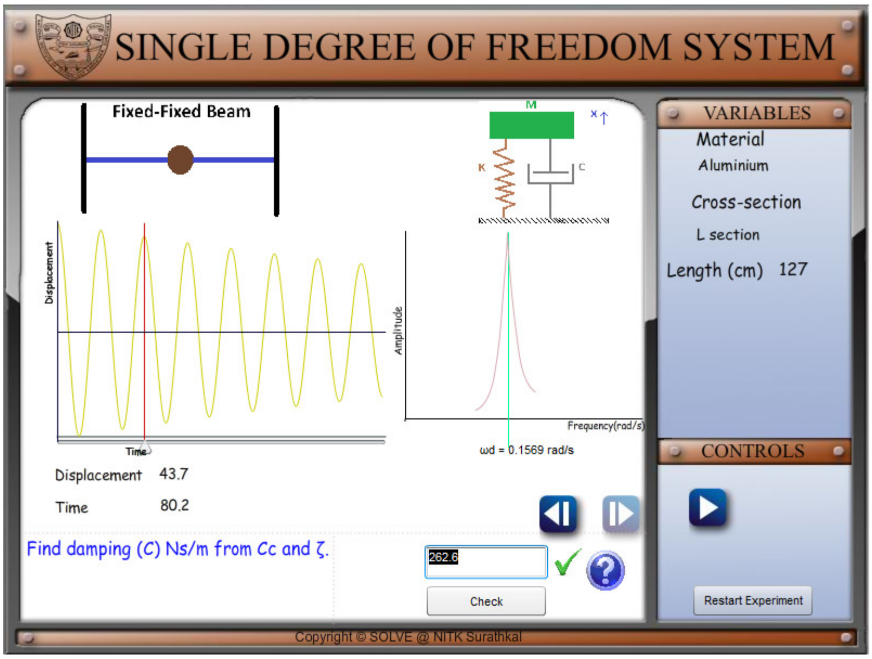


6. Find critical damping (c_c) Ns/m from m_{eq} and k.

$$c_c = 2\sqrt{km}$$

7. Find damping (c) Ns/m from Cc and ζ.

$$c = c_c\zeta$$



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RESULT:

System damping ‘c’ has been found. The basic concepts in free vibration of SDOF systems are covered.