GLASGOW CALEDONIAN UNIVERSITY

School of Engineering & Built Environment

ENGINEERING DESIGN & ANALYSIS 2 (M2H721926)

Tutorial: Damped Free Vibration

1. A mass of 1.0 kg is suspended from a vertical spring of stiffness 100 N/m and is provided with a viscous damping force of 2.5 N when the velocity of the mass is 0.25 m/s. Determine:

i) the frequency of the undamped (free) motion;
ii) the damping coefficient;
iii) the damping ratio;
iv) the frequency of the damped motion.

2. A vibrating system has the following components: a spring of stiffness 4 kN/m, viscous damping of 18 Ns/m, a mass of 20 kg. Determine:

i) the natural frequency of the system;
ii) the damping ratio;
iii) the damped natural frequency the system;
iv) the logarithmic decrement;
v) the ratio of two successive amplitudes of vibration.

3. The ratio between successive amplitudes of a viscously damped system is found to be 1.8. Determine:

i) the damping ratio;
ii) the magnitude of the viscous damping if the mass of the system is 100 kg and the mass is supported on 4 springs arranged in parallel each of stiffness 20 kN/m.

4. A motor of mass 10 kg is suspended from a spring of stiffness 200 N/m. Viscous damping is present in the system and is 8 Ns/m. Determine the amplitude of the mass 10 cycles after it is released from an initial displacement of 20 mm.

Tutorial : Damped Free Vibration: Answers

1. i) 10 rad/s; ii) 10 Ns/m; iii) 0.5; iv) 8.66 rad/s
2. i) 14.14 rad/s; ii) 0.032; iii) 14.13 rad/s; iv) 0.201; v) 1.223
3. i) 0.0932; ii) 527.14 Ns/m
4. 0.0703 mm