

- P1.91** Calculate the natural frequency and damping ratio for the system in Figure P1.91 given the values $m = 10 \text{ kg}$, $c = 100 \text{ kg/s}$, $k_1 = 4000 \text{ N/m}$, $k_2 = 200 \text{ N/m}$ and $k_3 = 1000 \text{ N/m}$. Assume that no friction acts on the rollers. Is the system overdamped, critically damped or underdamped?



Figure P1.91

Solution: Following the procedure of Example 1.5.4, the equivalent spring constant is:

$$k_{eq} = k_1 + \frac{k_2 k_3}{k_2 + k_3} = 4000 + \frac{(200)(1000)}{1200} = 4167 \text{ N/m}$$

Then using the standard formulas for frequency and damping ratio:

$$\omega_n = \sqrt{\frac{k_{eq}}{m}} = \sqrt{\frac{4167}{10}} = 20.412 \text{ rad/s}$$

$$\zeta = \frac{c}{2m\omega_n} = \frac{100}{2(10)(20.412)} = 0.245$$

Thus the system is underdamped.

- P1.92** Calculate the natural frequency and damping ratio for the system in Figure P1.92. Assume that no friction acts on the rollers. Is the system overdamped, critically damped or underdamped?



Figure P1.92

Solution: Again using the procedure of Example 1.5.4, the equivalent spring constant is:

$$k_{eq} = k_1 + k_2 + k_3 + \frac{k_4 k_5}{k_4 + k_5} = (10 + 1 + 4 + \frac{2 \times 3}{2 + 3}) \text{ kN/m} = 16.2 \text{ kN/m}$$

Then using the standard formulas for frequency and damping ratio:

Solution Manual Of Fundamentals Of Mechanical Vibration

J Dewey



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Fundamentals of Mechanical Vibrations Liang-Wu Cai, 2016-04-25 This introductory book covers the most fundamental aspects of linear vibration analysis for mechanical engineering students and engineers. Consisting of five major topics, each has its own chapter and is aligned with five major objectives of the book. It starts from a concise, rigorous, and yet accessible introduction to Lagrangian dynamics as a tool for obtaining the governing equations for a system, the starting point of vibration analysis. The second topic introduces mathematical tools for vibration analyses for single degree of freedom systems. In the process, every example includes a section Exploring the Solution with MATLAB. This is intended to develop students' affinity to symbolic calculations and to encourage curiosity-driven explorations. The third topic introduces the lumped parameter modeling to convert simple engineering structures into models of equivalent masses and springs. The fourth topic introduces mathematical tools for general multiple degrees of freedom systems with many examples suitable for hand calculation and a few computer-aided examples that bridge the lumped parameter models and continuous systems. The last topic introduces the finite element method as a jumping point for students to understand the theory and the use of commercial software for vibration analysis of real world structures.

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Materials with Complex Behaviour II Andreas Öchsner, Lucas F. M. da Silva, Holm Altenbach, 2012-01-04 This volume highlights the latest developments and trends in advanced materials and their properties, the modeling and simulation of non-classical materials and structures, and new technologies for joining materials. It presents the developments of advanced materials and respective tools to characterize and predict the material properties and behavior.

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