

# MECH 463: ASSIGNMENT 1

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Requires course text book: MECHANICAL VIBRATIONS BY S.S. RAO (4TH/5TH EDITIONS). Solutions will appear approximately a week after the assignment is posted on VISTA.

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## Q1. Degrees of Freedom and Constraints.

What do you understand by the degrees of freedom of a mechanical system? Why is it important to recognise constraints on motion?

## Q2. Superposition Principle.

A mechanical system's response or "output"  $x$  is governed by the ordinary differential equation  $m\ddot{x} + c\dot{x} + kx = f$  where  $f$  can be considered as "input". The system can also be subjected to initial disturbances that can act as "inputs". Using the principle of superposition, show that the total response is given by  $x = x_h + x_p$ , where  $x_h$  is the homogeneous solution, or, complementary function, obtained by solving the homogeneous differential equation  $m\ddot{x}_h + c\dot{x}_h + kx_h = 0$ ;  $x_p$  is the particular solution or particular integral that depends on the function  $f$ . Over dot denotes differentiation with respect to time:  $\dot{x} = \frac{dx}{dt}$  and  $\ddot{x} = \frac{d^2x}{dt^2}$ . You may want to review your MECH2 mathematics or your course in differential equations.

## Q3. Spring-Mass-Damper Modelling.

Solve exercise problem 1.5 from the course text book (note: same problem in both editions).