BRUFACE
MA1 Civil Engineering

Dynamics of Structures
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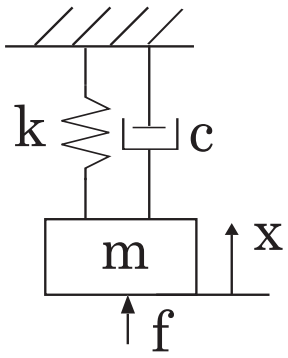
Session 1 : One DOF systems

Exercise 1

Consider the following one-degree-of-freedom (1 DOF) system



- Write the equation of motion in the time domain. Give the expression of ω_n and of ξ
- For this system
  a) Give the expression of the impulse response and represent it using the following numerical values: $m = 1\,kg$, $k = 16\,N/m$, $c = 0.1\,Ns/m$)
  b) Give the expression of the harmonic forced response and represent it using the Bode diagram
  c) Plot the Nyquist diagram and indicate the resonant frequency as well as some intermediary frequencies on the diagram. Comment.
  d) Repeats points a),b) and c) with the following successive values of damping: $c = 0.1\,Ns/m$, $c = 0.5\,Ns/m$, $c = 10\,Ns/m$. What are the corresponding values of ξ? Plot the respective responses on the same Bode diagram (both amplitude and phase)

Exercise 2

Consider the same 1-DOF system as in the previous exercise and a value of $c = 0.1\,Ns/m$. Use Duhamel's integral to compute the response of the system to:

a) A harmonic force of the form $f(t) = sin(\omega t)$ where $\omega = \omega_n$

b) A harmonic force of the form $f(t) = sin(\omega t)$ where $\omega = 0.95\omega_n$

c) A random force generated from a gaussian distribution of mean 0 and variance $\sigma = 1$