BRUFACE
MA1 Mechanical Engineering

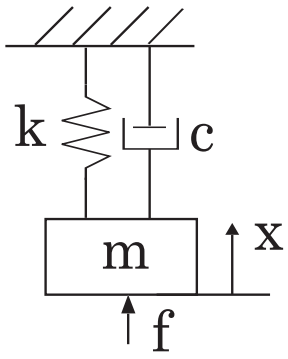
Vibrations and Acoustics
Academic year 2021-2022

Arnaud Deraemaeker (Arnaud.Deraemaeker@ulb.be)
Jean-Louis Migeot (jean-louis@migeot.eu)
Jonathan Jacqmot (Jonathan.Jacqmot@hexagon.com)

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) 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 $\sigma = 1$