



## Tutorial 2 Time Domain Systems Analysis

### Question 1

Using only time domain based analysis (i.e. convolution integral in the time domain):

- Deduce the impulse response of an R-C circuit i.e. output is  $v_c(t)$  with  $C=1\text{F}$ ,  $R=1\text{Ohm}$  for source voltage as the system input.
- Find the unit step response of the circuit
- Find the response to a *sine* input

### Question 2

Using only time domain based analysis (i.e. convolution integral in the time domain):

- Deduce the impulse response of a typical linear time invariant mass spring damper system i.e  $x(t)$  is the system output with  $m, k_s, k_{\text{damp}}$  are such that the system is under-damped; the applied force is the system input.
- Find the unit step response of the system
- Find the response to a *sine* input

### Question 3

Show that if a second order system is not over-damped then the magnitude of the poles are  $\omega_n$

### Question 4

For an under-damped system Show that  $\xi = \cos \Theta$ .

### Question 5

Derive the function of  $\xi$  in terms of the %overshoot.

$$\text{overshoot \%} = 100 e^{-\pi\xi/\sqrt{1-\xi^2}}$$