## Tutorial 4, EE210 : Signals and Systems (Minor), Sept 2019

1. (a) Find the transfer functions of the following systems:



Figure 1: (1) A parallel RC circuit with a current source I. (2) A spring-damper system with force F acting on it. (3) A spring-damper system with their corresponding velocities and  $v_X$  as the input

(b) For high-pass and low-pass filter plot |H(jw)| and  $\angle H(jw)$  w.r.t  $w \in (-\infty, +\infty)$ 

- 2. Prove all four Parseval's Theorems. (Assume signals are (square) summable/integrable and that they have finite energy/power as appropriate. Be careful about scaling.)
- 3. Obtain Fourier Transform of Gaussian pulse  $e^{-x^2}$  and  $e^{-ax^2}$  in two different ways. Find product of variance in time domain and frequency domain.
- 4. Show that IDFT is same as interpolating a polynomial p(x) with values of p(x) specified at roots of unity.
- 5. Prove that for the Discrete Time Fourier Transform (DTFT)  $x[n] \leftrightarrow X(e^{j\omega})$ , the DTFT of nx[n] is  $j\frac{d}{dw}X(e^{j\omega})$ ,