3C1 Signals and Systems **Homework No.1**

1. Let $r(t)$ and $u(t)$ denote the unit-ramp and unit-step signals respectively. Sketch and label each of the following signals:

   (a) $x_1(t) = r(-t)$

   (b) $x_2(t) = 3\,r(2-t)$

   (c) $x_3(t) = 2\,u(t-1) - u(t-2)$

   (d) $x_4(t) = \dfrac{dx_3(t)}{dt}$

   (e) $x_5(t) = t\,[u(t+1) - u(t-3)]$

   (f) $x_6(t) = \dfrac{dx_5(t)}{dt}$

   (g) $x_7(t) = \displaystyle\sum_{n=-\infty}^{\infty} \delta(t-nT)$

2. Determine whether each of the following systems is (i) linear and (ii) time-invariant:

   (a) $y(t) = t\,x(t)$

   (b) $y(t) = x^2(t)$

   (c) $y(t) = x(t) + 1$

3. The following are impulse responses of continuous-time LTI systems. Determine whether each system is (i) causal and (ii) stable. Justify your answers.

   (a) $h(t) = e^{-2t}\,u(t-1)$

   (b) $h(t) = e^{t}\,u(-1-t)$

   (c) $h(t) = u(t)$

4. Consider an LTI system whose input $x(t)$ and output $y(t)$ are related by

   $$y(t) = x(t - t_0),$$

   where t_0 is a constant. Determine the impulse response of the system.

5. Consider an LTI system with impulse response $h(t) = \delta(t-1) - \delta(t-3)$. Determine and sketch the step-response, $s(t)$, of the system.