# EC5.101 – Network, Signals and Systems
## Assignment 3
### Total Marks – 40

Release date: 9th Sep 2023 — Due date: 16th Sep 2023

Instructions:

1. The handwritten assignment must be submitted individually.

2. Students are free to refer to class notes and textbooks. Discussions are allowed but copying and plagiarism will attract strict penalty.

3. Late submission: 10 % penalty per day (up to at most 3 days after deadline).

4. Mention any additional assumptions you make that is not given in the question.

5. Clearly show the steps used to arrive at the solutions.

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1. [12 marks] Consider the signals $x(t)$ and $h(t)$ given by

$$x(t) = u(t) - u(t - 3)$$

$$h(t) = \begin{cases} 1, & 0 \le t \le 1 \\ 2 - t, & 1 < t \le 2 \\ 0, & \text{otherwise.} \end{cases}$$

   (a) [3] Sketch $x(t)$ and $h(t)$.

   (b) [9] Find the convolution between $x(t)$ and $h(t)$. Derive the expression and sketch it.


2. [6 marks] It is known that convolution of the signals $x_1(t)$, $x_2(t)$, and $x_3(t)$ is given by the signal $y(t) = x_1(t) * x_2(t) * x_3(t)$. For some real constant $a \in \mathbb{R}$, express the convolution $x_1(at) * x_2(at) * x_3(at)$ in terms of $y(t)$ and $a$.


3. [8 marks] Consider the signal $x(t) = e^{-3|t|} + e^{-|t|}$.

   (a) [6] Find the Laplace transform of $x(t)$. On the $s$-plane, indicate its poles and zeros and ROC.

   (b) [2] Without performing explicit integration, evaluate the following:

$$(i) \int_{-\infty}^{\infty} x(t)e^{-\frac{t}{3}} dt \qquad (ii) \int_{-\infty}^{\infty} x(t)e^{-j2t} dt.$$

4. [8 marks] Consider the following description for a system S1:

*For any input signal, the system output is same as input signal for $t \leq 10$ seconds and always gives zero for $t > 10$ seconds.*

Based on this information, what can you say about linearity, time-invariance, causality, and stability of the system. Give reasons or examples to justify your answer.

5. [6 marks] Solve question 1.37 from the SAS text book.