

# Assignment - 1

Gautam Singh

**Abstract**—This document contains the solution to Exercise 2.23 (b) of Oppenheim.

**Problem 1.** Using the definition of linearity, show that the moving average system is linear.

**Solution:** The moving average system is given by

$$y[n] = \frac{1}{M_1 + M_2 + 1} \sum_{k=-M_1}^{M_2} x[n-k] \quad (1)$$

Hence, for inputs  $x_1[n]$  and  $x_2[n]$ , we get

$$x_1[n] \xrightarrow{\mathcal{H}} \frac{1}{M_1 + M_2 + 1} \sum_{k=-M_1}^{M_2} x_1[n-k] = y_1[n] \quad (2)$$

$$x_2[n] \xrightarrow{\mathcal{H}} \frac{1}{M_1 + M_2 + 1} \sum_{k=-M_1}^{M_2} x_2[n-k] = y_2[n] \quad (3)$$

and therefore, for any reals  $a_1$  and  $a_2$ ,

$$\begin{aligned} & a_1 x_1[n] + a_2 x_2[n] \\ & \xrightarrow{\mathcal{H}} \frac{1}{M_1 + M_2 + 1} \sum_{k=-M_1}^{M_2} (a_1 x_1[n-k] + a_2 x_2[n-k]) \end{aligned} \quad (4)$$

$$= a_1 y_1[n] + a_2 y_2[n] \quad (5)$$

Hence, the moving average system is linear.