

# Applied Linear Algebra

## MAT3004

Due Date: 18/11/2022

1. The equation  $x - 3y - 4z = 0$  describes a plane  $P$  in  $\mathbb{R}^3$  (actually a subspace). Find a  $1 \times 3$  matrix  $A$  such that the plane  $P$  is null space of  $(A)$ . Also find the basis and dimension of row space and null space of  $A$ .
2. Given a system of equations

$$\begin{aligned}2x + 3y &= 5 \\ -x + y &= 6 \\ x + 4y &= a.\end{aligned}$$

Find the value of  $a$  such that the system is inconsistent. Also, find the least square solution and the squared error for that value of  $a$ .

3. The plain text message is encrypted with the mapping  $A \leftrightarrow 25, B \leftrightarrow 24, \dots, Z \leftrightarrow 0$ .
  - (a) Find the encrypted Hill cipher text for the message **CHENNAI** using a suitable key matrix among the matrices given below:
    - (i)  $k_1 = \begin{bmatrix} 4 & 4 \\ 3 & 6 \end{bmatrix}$ , (ii)  $k_2 = \begin{bmatrix} 5 & 4 \\ 1 & 6 \end{bmatrix}$  (iii)  $k_3 = \begin{bmatrix} 3 & 2 \\ 1 & 3 \end{bmatrix}$ .
    - (b) Find the original message form the cipher text message **OFGUIH** by using the key  $k = \begin{bmatrix} 7 & 1 \\ 2 & 1 \end{bmatrix}$ .
4. Using the Haar wavelet find the transformed trend and fluctuation sub-signals corresponding to the signal  $f = [5, 9, 4, 6, 3, 7, 8, 8, 5, 9, 3, 0, 2, 2, 4, 5]$ . Also retrieve the original signal by using inverse transformation.