0. Your Instructor’s name and TA’s name.
1. The imaginary part of \( z = (3 + i)(2 - i) \) is ___________________________
The real and imaginary parts of \( \ln(-2) \) are _______ and that of \( e^{2i} \) are _______
The complex conjugate of \( z = 10 \) is ___________________________
The complex number \( z = (1 + i)/(1 - i) \) can be written as simple as __________
The exponential form of \( z = -1 - i \) is ___________________________

2. (a) Find all the roots to \( z^6 - z = 0 \). Also plot all the roots on the complex plane.
(b) Factorize the polynomial \( x^3 - 3x^2 + 4x - 2 \).

3. Let \( A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \end{bmatrix} \). Calculate \( A^2 - 2A - I \) where \( I = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \).

4. Let \( A = \begin{bmatrix} 1 & 2 & 3 & 4 \\ 0 & 1 & 2 & 3 \\ 0 & 0 & 2 & 3 \\ 0 & 0 & 2 & 4 \end{bmatrix} \)
(a) Find the determinant of \( A \).
(b) Find the inverse of \( A \) (if it exists)

5. Find a basis for the solution space to the homogeneous system
\[
\begin{align*}
x_2 + x_3 &= 0 \\
x_1 + 2x_2 + x_3 &= 0 \\
2x_1 + 6x_2 + 4x_3 &= 0
\end{align*}
\]

6. Find the general solution to
\[
\begin{align*}
3x_3 + x_5 &= 1 \\
x_1 + 2x_2 + 3x_3 + 4x_4 + 5x_5 &= 2 \\
x_1 + 2x_2 + 6x_3 + 4x_4 + 6x_5 &= 3 \\
x_4 + x_5 &= 2
\end{align*}
\]

7. Find \( k \) so that the following vectors are linearly dependent:
\[
\begin{bmatrix} k \\ -1 \\ 1 \end{bmatrix}, \quad \begin{bmatrix} 1 \\ k \\ -1 \end{bmatrix}, \quad \begin{bmatrix} -1 \\ 1 \\ k \end{bmatrix}
\]

8. Consider the initial value problem \( u' = u + t, \quad u(0) = 0 \)
(a) Use Euler’s method with \( h = 1/3 \) to find \( u(1) \).
(b) Plot the Euler’s approximate solution for \( t \) on \([0, 1]\).

9. Solve the following
(a) \( \frac{dy}{dx} = xy + x + y + 1 \) \hspace{1cm} (b) \( \frac{du}{dt} = u \) \hspace{1cm} (c) \( \frac{du}{dt} = u + t \).