# Lab 1 Prelab

**Prelab Assignments**

Complete these assignments before the lab. Show all work for credit.

1. By hand and, if necessary, using a calculator, determine the real and imaginary parts of the complex number $-\mathrm{j}3+3$.
2. By hand and, if necessary, using a calculator, determine the complex conjugate of the complex number $4+\mathrm{j}$.
3. By hand and, if necessary, using a calculator, convert the complex number $\mathrm{j}/5-1/2$ to polar form.
4. By hand and, if necessary, using a calculator, write the complex number $-2\mathrm{j}\cdot e^{\mathrm{j}\pi/12}$ in rectangular form.
5. By hand and, if necessary, using a calculator, determine the magnitude of the complex number $12-\mathrm{j}3$.
6. By hand and, if necessary, using a calculator, determine the phase of the complex number $(-2+\mathrm{j}\sqrt{2})/\sqrt{3}$.
7. By hand and, if necessary, using a calculator, compute the inverse $(-3+2\mathrm{j})^{-1}$.
8. By hand and, if necessary, using a calculator, evaluate the ratio $(1+\mathrm{j})\div(2-\mathrm{j})$.
9. By hand and, if necessary, using a calculator, express

$$\frac{s-1}{s^2+3s+2}$$

as a sum of terms of the form $a/(s-\sigma)$.

10. By hand and, if necessary, using a calculator, compute the determinant of the matrix

$$\begin{pmatrix} 6 & -1/2 \\ 1/2 & -1 \end{pmatrix}$$

1). $Re\{z\} = 3 \quad Im\{z\} = -3$

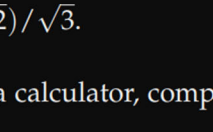
2). $z = 4j$

3). $-\frac{1}{2} + \frac{j}{5} = \frac{\sqrt{29}}{10} \cdot e^{j \cdot 2.761}$

4). $-2j \cdot \left[\cos\frac{\pi}{12} + j \cdot \sin\frac{\pi}{12}\right]$

$= 2\sin\frac{\pi}{12} - 2j\cos\frac{\pi}{12}$

5). $|z| = \sqrt{12^2+3^2} = \sqrt{153}$

6). 

$\phi = \tan^{-1}\frac{5}{-2} = 2.526$

7). $\frac{1}{-3+2j} = \frac{-3-2j}{9+4} = \frac{1}{13}(-3-2j)$

8). $\frac{1+j}{2-j} = \frac{(1+j)(2+j)}{5} = \frac{3}{5} + \frac{1}{5}j$

9). $\frac{s-1}{(s+1)(s+2)} = \frac{-2}{s+1} + \frac{3}{s+2}$

10) $-6 - \frac{1}{4} = -\frac{25}{4}$

11. By hand and, if necessary, using a calculator, find a nullvector for the singular matrix

$$\begin{pmatrix} 2 & 18 \\ -2/3 & -6 \end{pmatrix}.$$

12. By hand and, if necessary, using a calculator, determine all eigenvalues of the matrix

$$\begin{pmatrix} -9 & 5 \\ -24 & 11 \end{pmatrix}$$

13. By hand and, if necessary, using a calculator, determine the left and right eigenvectors of the matrix

$$\begin{pmatrix} 9 & 1 \\ -5 & 15 \end{pmatrix}$$

(1) $\begin{vmatrix} 2-\lambda & 18 \\ -\frac{2}{3} & -6-\lambda \end{vmatrix} = 0$

$-12 + 4\lambda + \lambda^2 + 12 = 0$

$\lambda(\lambda+4) = 0$

$\therefore \lambda_1 = 0,\ \lambda_2 = -4$

$\therefore \begin{pmatrix} 2 & 18 \\ -\frac{2}{3} & -6 \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = -4 \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$

$\begin{cases} 2x_1 + 18x_2 = -4x_1 \\ -\frac{2}{3}x_1 - 6x_2 = -4x_2 \end{cases}$

$\therefore x_1 = -3x_2 \quad \therefore \vec{v} = \begin{pmatrix} -3 \\ 1 \end{pmatrix}$

(2). $\because \det \begin{pmatrix} -9-\lambda & 5 \\ -24 & 11-\lambda \end{pmatrix} = 0$

$\therefore \lambda^2 - 2\lambda + 21 = 0$

$\therefore \lambda = 1 \pm \sqrt{-2\sqrt{5}}$

(3). $\begin{vmatrix} 9-\lambda & 1 \\ -5 & 15-\lambda \end{vmatrix} = (\lambda-10)(\lambda-14)$

$\therefore \lambda_1 = 10,\ \lambda_2 = 14$

$\because A \cdot \vec{x} = \lambda \cdot \vec{x}$ right

$\therefore \lambda_1 = 10 \Rightarrow \vec{x}_1 = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$

$\lambda_2 = 14 \Rightarrow \vec{x}_2 = \begin{pmatrix} 1 \\ 5 \end{pmatrix}$

$\because \begin{pmatrix} 9-\lambda & -5 \\ 1 & 15-\lambda \end{pmatrix} \cdot \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \lambda \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$

$\therefore \lambda_1 = 10 \Rightarrow \vec{x}_3 = \begin{pmatrix} 1 \\ -\frac{1}{5} \end{pmatrix}$ left.

$\lambda_2 = 14 \Rightarrow \vec{x}_4 = \begin{pmatrix} 1 \\ -1 \end{pmatrix}$