

Name: \_\_\_\_\_ UIN: \_\_\_\_\_ Section: \_\_\_\_\_ Score: \_\_\_\_\_

Consider a system of two non-linear equations with the variables  $\theta$  and  $V$ ,

$$\begin{aligned} f_1(\theta, V) &= 10 V \sin \theta + 2 = 0 \\ f_2(\theta, V) &= -10 V \cos \theta + 10 V^2 + 0.5 = 0 \end{aligned}$$

- In preparation for the Newton-Raphson method, write the Jacobian matrix in terms of  $\theta$  and  $V$ .
- Suppose our initial guess was  $\theta^{(0)} = 0$  and  $V^{(0)} = 1$ ; what are the values of  $f^{(0)}$  and  $J^{(0)}$ ?
- Find the first Newton-Raphson iteration values of  $\theta^{(1)}$  and  $V^{(1)}$ . (Hint: To take the inverse of a diagonal matrix, just take the reciprocal of each element.)

- $J = \begin{bmatrix} 10 V \cos \theta & 10 \sin \theta \\ 10 V \sin \theta & -10 \cos \theta + 20 V \end{bmatrix}$
- $f^{(0)} = \begin{bmatrix} 2 \\ 0.5 \end{bmatrix}; J^{(0)} = \begin{bmatrix} 10 & 0 \\ 0 & 10 \end{bmatrix}$
- $\begin{bmatrix} \theta^{(1)} \\ V^{(1)} \end{bmatrix} = \begin{bmatrix} 0 \\ 1 \end{bmatrix} - \begin{bmatrix} 0.1 & 0 \\ 0 & 0.1 \end{bmatrix} \begin{bmatrix} 2 \\ 0.5 \end{bmatrix} = \begin{bmatrix} -0.2 \\ 0.95 \end{bmatrix}$