## SHEET (3)

1) Plot $y = cosh\, x$ and $y = 0.5e^x$ on the same plot for 0 ≤ $x$ ≤ 2. Use different line types and a legend to distinguish the curves. Label the plot axes appropriately.

2) Pick a suitable spacing for $t$ and $v$, and use the subplot command to plot the function $z = e^{-0.5t} cos(20t - 6)$ for $0 \leq t \leq 8$ and the function $u = 6\, log_{10}\, (v^2 + 20)$ for $-8 \leq v \leq 8$. Label each axis.

3) The following functions describe the oscillations in electric circuits and the vibrations of machines and structures. Plot these functions on the same plot. Because they are similar, decide how best to plot and label them to avoid confusion.

$$\boldsymbol{x}(t) = 10e^{-0.5t}\, sin(3t + 2)$$

$$y(t) = 7e^{-0.4t}\, cos(5t - 3)$$

4) Estimate the roots of the equation:

$$x^3 - 3x^2 + 5xsin\left(\frac{\pi x}{4} - \frac{5\pi}{4}\right) + 3 = 0$$

by plotting the equation.

5) The perfect gas law relates the pressure $p$, absolute temperature $T$, mass $m$, and volume $V$ of a gas. It states that $pV = mRT$. The constant $R$ is the *gas constant*. The value of $R$ for air is 286.7 $(N \cdot m)/(kg \cdot K)$. Suppose air is contained in a chamber at room temperature $(20^o\, C = 293\, K)$. Create a plot having three curves of the gas pressure in $\frac{N}{m^2}$ versus the container volume $V$ in $m^3$ for $20 \leq V \leq 100$. The three curves correspond to the following masses of air in the container: $m = 1\, kg, m = 3\, kg, and\ m = 7\, kg$.

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6) The *spiral of Archimedes* is described by the polar coordinates (θ, *r*), where $r = a\theta$. Obtain a polar plot of this spiral for $0 \leq \theta \leq 4\pi$, with the parameter $a = 2$.

7) The position as a function of time of a squirrel running on a grass field is given in polar coordinates by:

$$r(t) = 25 + 30[1 - e^{\sin(0.07t)}] \text{ m}$$

$$\theta(t) = 2\pi(1 - e^{-0.2t})$$

Plot the trajectory (position) of the squirrel for $0 \leq t \leq 20\ s$.

8) The following table shows the average temperature for each year in a certain city. Plot the data as a bar plot.

| Year | 2000 | 2001 | 2002 | 2003 | 2004 |
|---|---|---|---|---|---|
| Temperature (°C) | 21 | 18 | 19 | 20 | 17 |

9) A robot rotates about its base at $2\ rpm$ while lowering its arm and extending its hand. It lowers its arm at the rate of $120^{\circ}$ per minute and extends its hand at the rate of $5\ m/min$. The arm is $0.5\ m$ long. The *xyz* coordinates of the hand are given by:

$$x = (0.5 + 5t)\sin\left(\frac{2\pi}{3}t\right)\cos(4\pi t)$$

$$y = (0.5 + 5t)\sin\left(\frac{2\pi}{3}t\right)\sin(4\pi t)$$

$$z = (0.5 + 5t)\cos\left(\frac{2\pi}{3}t\right)$$

where $t$ is time in minutes. Obtain the three-dimensional plot of the
path of the hand for $0 \le t \le 0.2\ min.$

10) A square metal plate is heated to $80^o\,C$ at the corner corresponding to $x=y=1.$ The temperature distribution in the plate is described by

$$T = 80e^{-(x-1)^2}\,e^{-3(y-1)^2}$$

Obtain the surface and contour plots for the temperature. Label each axis. What is the temperature at the corner corresponding to $x = y = 0$?

11) A free vortex plane potential flow has the velocity vector:

$$V = \left(\frac{-0.5y}{x^2+y^2}\right)i + \left(\frac{0.5x}{x^2+y^2}\right)j$$

Plot the velocity vector over the range: $-1 \le x \le 1\ \&\ -1 \le y \le 1$

12) The following data are the measured temperature T of water owing from a hot water faucet after it is turned on at time t = 0.

| $t$ (sec) | $T$ (°F) | $t$ (sec) | $T$ (°F) |
|---|---|---|---|
| 0 | 72.5 | 6 | 109.3 |
| 1 | 78.1 | 7 | 110.2 |
| 2 | 86.4 | 8 | 110.5 |
| 3 | 92.3 | 9 | 109.9 |
| 4 | 110.6 | 10 | 110.2 |
| 5 | 111.5 | | |

a) Plot the data, connecting them first with straight lines and then with the polyfit function.
b) Estimate the temperature values at the following times, $t = 0.6$, $2.5$, $4.7$, $8.9$.