<u>Laboratory 1</u>

1. Plot all the scalar and vector field functions given/used in tutorial 1.

2. Using MATLAB, plot a vector field, defined by ***A***= y^2***i*** - *x**j*** in the region *-2 < x < +2*, *-2 < y < +2*. Find the magnitude of this vector at the point *(3, 2).*

3. Using MATLAB, carefully plot a vector field ' defined by ***A*** = *sin x **i**, - sin y **j*** in the region *O < x < pi, 0 < y < pi*. Find the magnitude of this vector at the point *(pi / 2, pi / 2)*.

4. Assume that there exists a surface that can be modeled with the equation z = e $^{-(x\wedge 2 + Y\wedge 2)}$. Calculate gradient of z at the point (x = 0, y = 0).

   In addition, use MATLAB to illustrate the profile and to calculate and plot these scalar field functions.

   (a) $f(x, y, z) = x^2 + y^3 + z^4$.

   (b) $f(x, y, z) = x^2 y^3 z^4$.

   (c) $f(x, y, z) = e^x \sin(y) \ln(z)$.

   Further, plot the above scalar field's gradient.

5. Calculate the divergence of the following vector functions:
   (a) $\mathbf{v}_a = x^2\,\hat{\mathbf{x}} + 3xz^2\,\hat{\mathbf{y}} - 2xz\,\hat{\mathbf{z}}$. (b) $\mathbf{v}_b = xy\,\hat{\mathbf{x}} + 2yz\,\hat{\mathbf{y}} + 3zx\,\hat{\mathbf{z}}$. (c) $\mathbf{v}_c = y^2\,\hat{\mathbf{x}} + (2xy + z^2)\,\hat{\mathbf{y}} + 2yz\,\hat{\mathbf{z}}$.

   Plot the above vector field and their divergence in MATLAB.

6. For the above set of vector fields, calculate the curl and plot them.

7. Construct and plot a vector function that has zero divergence and zero curl everywhere. (A constant will do the job, of course, but make it something a little more interesting than that!)