<u>Laboratory 1</u>

1. Using MATLAB, plot a vector field, defined by A= y^2**i** - x**j** in the region -2 < x < +2, -2 < y < +2. The length of the vectors in the field should be proportional to the field at that point. Find the magnitude of this vector at the point (3, 2).

2. 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. The length of the vectors in the field should be proportional to the field at that point. Find the magnitude of this vector at the point (pi / 2, pi / 2) .

3. Assume that there exists a surface that can be modeled with the equation z = e $^{-(x\text{^}2 + Y\text{^}2)}$. Calculate gradient of z at the point (x = 0, y = 0). In addition, use MATLAB to illustrate the profile and to calculate and plot this scalar field.

   (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 fields and do their gradient plots.

4. 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. Also, do the contour plots of divergence.

5. For the above set of vector fields, calculate the curl and plot their contour.

6. 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!)

7. In above given vector fields, check which has divergence or curl is zero.