Fourth Year B.S. (Honors) 2020-2021
Math Lab Assignment 01
Course: AMT 450
Department of Applied Mathematics
University of Dhaka

Name: **Roll No:** **Group:**

1.	a. Use **PolarPlot** and **ParametricPlot** to sketch the curve: $r = e^{cos\theta} - 2cos4\theta + sin^5\frac{\theta}{12}$, $0 \le \theta \le 24\pi$, which is known as 'butterfly'. b. Sketch the intersection of the paraboloid $z = x^2 + y^2$ with the plane $y + z = 12$. Obtain two different views. Use **Plot3D.** c. Let $f(x, y, z) = 5x^2 + y^2 + z^2$. Draw the level surfaces $f(x, y, z) = k$ for $k = 1,4,9,16,25$. Sketch only for $y \ge 0$ so all the surfaces will be visible. Use **ContourPlot3D.**
2.	Consider the function $(x, y) = \frac{x^2y}{x^4+4y^2}$. Draw the three dimensional figure and the level curves using **Plot3D, DensityPlot** in the neighbourhood of the origin. Also try to use **Axes, PlotPoints, PlotStyle, ColorFunction** options to get a better graph.
3.	a. A parametrization of "umbillic torus NC" is given by $r(s,t) = x(s,t)i + y(s,t)j + z(s,t)k, -\pi \le s \le \pi, -\pi \le t \le \pi$, where $x(s,t) = \left(7 + \cos\left(\frac{1}{3}s - 2t\right) + 2\cos\left(\frac{1}{3}s + t\right)\right)\sin s$ $y(s,t) = \left(7 + \cos\left(\frac{1}{3}s - 2t\right) + 2\cos\left(\frac{1}{3}s + t\right)\right)\cos s$ $z(s,t) = \sin\left(\frac{1}{3}s - 2t\right) + 2\sin(\frac{1}{3}s + t)$ Graph the torus. Use **ParametricPlot3D, DensityPlot and ContourPlot**. In the plot use **Mesh, MeshFunctions, PlotPoints** and **PlotRange** options. b. The equations $r = sinn\theta$, where n is a positive integer, represent a family of polar curves called roses. Investigate the behavior of this family and form a conjecture about how the number of loops is related to n.
4.	a. The Cornu spiral has parametric equations $x = \int_0^t \sin\left(\frac{1}{2}u^2\right) du$ $y = \int_0^t \cos\frac{1}{2}u^2\, du$ Graph the Cornu spiral. Use **AspectRatio, PlotLabel, Frame, FrameLabel** and **ColorFunction** options to get better graph. b. Let $g(x) = xsin^2x$. Find the volume of the solid obtained by revolving the region bounded by the graph of $y = g(x), x = 0, x = \pi$ and x-axis about (i) the x-axis and (ii) the y-axis.
5.	Let $f(x, y) = e^x \sin\pi y$. Find the equation of the tangent plane and normal line to $f(x, y)$ at the point $P(0, 1, 0)$. Confirm your result graphically.
6.	An electric charge is spread over the half-disk described by $x^2 + y^2 = 4, y \ge 0$. Draw the region graphically and calculate the total charge on if the charge density at any point in (measured in coulombs per square meter) is $\sigma(x, y) = \sqrt{x^2 + y^2}$.

7	a. Calculate and draw the volume of the solid bounded between the surfaces $z = 4(x^2 + y^2)$ and $z = 16 - 4(x^2 + y^2)$ on the rectangular domain $[-1,1] \times [-1,1]$. b. Calculate the mass of the solid region W bounded between the planes $z = 1 - x - y$ and $z = 1 + x + y$ situated over the triangular domain D bounded by $x = 0$, $y = 0$ and $y = 1 - x$. Assume the density of W is given by $\rho(x, y, z) = 1 + x^2 + y^2$. c. Find the volume of the solid lying under the graph of the surface $z = x^3 + 4y$ and above the region in the xy -plane bounded by the line $y = 2x$ and the parabola $y = x^2$. Also draw the solid region.