

MATH 2221B Mathematics Laboratory II

Lab Assignment 4

Name: _____ Student ID.: _____

In this assignment, you are asked to run **MATLAB** demos to see **MATLAB** at work. The color version of this assignment can be found in your own H:\ drive.

Instructions

1. Start **MATLAB**, until you see a window with the **MATLAB** prompt “»”. This window is called the Command Window.
2. After you started have **MATLAB**, you will automatically be in the directory H:\. Please enter “**diary on**” after the **MATLAB** prompt » only once to record all your work in H:\diary. No marks will be given if no diary is found.
3. Enter “demo” after the prompt ». You will see a new window with many things to play with. This is the Demo Window.
4. In the Demo Window, try to locate figures or problems similar to those in the exercises below. Then locate the commands that generate these figures or problems. Try them in the Command Window. Just enter (or cut and paste) the commands after » to see what happens.
5. You should write your results on the lab sheet provided, and save the figures in the H: drive, in your personal drive.
6. Please read and sign the following declaration before handing in your assignment. Otherwise, no marks will be given.

I declare that the assignment here submitted is original except for source material explicitly acknowledged. I also acknowledge that I am aware of University policy and regulations on honesty in academic work, and of the disciplinary guidelines and procedures applicable to breaches of such policy and regulations, as contained in the website

<http://www.cuhk.edu.hk/policy/academichonesty/>

Signature

Date

1 (25 marks)			
2 (25 marks)			
3 (25 marks)			
4 (25 marks)			

Please read the following carefully:
 General Guidelines for Lab Assignment Submission.

- Please sign and date the statement of Academic Honesty.
- Please go to the class and lab indicated by your registered course code via the CUSIS system. If you go to a different lab than the one you are registered for, you will not receive credit for the assignment even if you completed it.
- Write your COMPLETE name and student ID number legibly on the cover sheet (otherwise we will not take any responsibility for your lab). Please write your answers using a black or blue pen, NOT any other color or a pencil.
- Write your solutions on a double-sided printout of this pdf file. Try to fit your answers inside the available space.
- The use of computers/cellular phones/graphing calculators/iPads will NOT be permitted during tests and lab assignments. Please do not use our lab computer to recharge your cellar phone battery. No photo taking is allowed in the lab.
- In order to make it fair for all students, during the labs and tests, if you touch/press any icons on your cellular phone, our TA will check your phone to determine whether or not you are exchanging messages with another student. If you are found cheating (in the tests or in the lab or on homework assignments), you will automatically get an F grade in this course and your act will be reported to the Department for necessary disciplinary actions.

Exercises

1. (25 marks) A spiral curve on the surface of the unit sphere is given by the parametric equations:

$$\begin{aligned}
 x &= \cos(\omega t) \cos(t) \\
 y &= \sin(\omega t) \cos(t) \\
 z &= \sin(t)
 \end{aligned}$$

where $\omega \in \mathbb{R}$ and $t \in [-\frac{\pi}{2}, \frac{\pi}{2}]$ is the parameter.

Following the instructions provided below, plot the spiral curve with $\omega = 30$.

- Define a vector $t \in [-\frac{\pi}{2}, \frac{\pi}{2}]$, with step length 0.01.
- Use `plot3` to draw the curve in black solid line with line width 3.
- Change the `view` azimuth to -30 and elevation to 20.

Your figure should show like Figure 1.

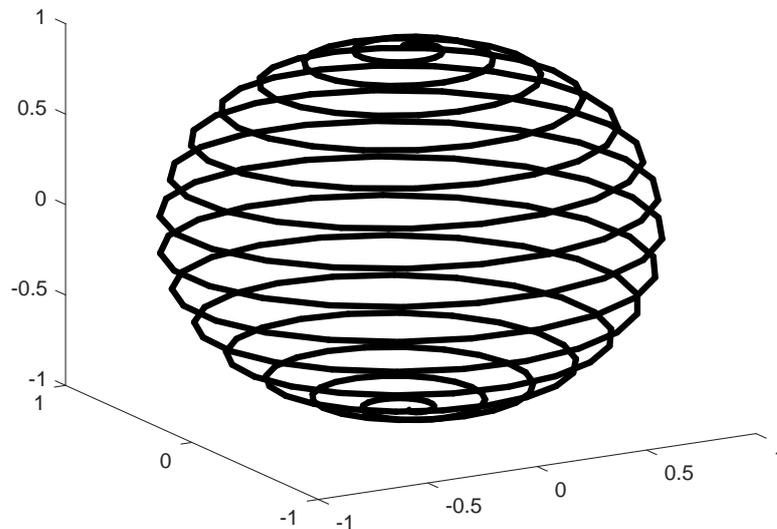


Figure 1: spiral.eps

Save the figure as 'spiral.eps' with MATLAB command (for example, type `print -depsc spiral.eps`) and write down all your codes. To view your eps file, double click it in window explorer rather than in MATLAB.

```
t = -pi/2:0.01:pi/2;
b = 30;
x = cos(b.*t).*cos(t);
y = sin(b.*t).*cos(t);
z = sin(t);

plot3(x,y,z, 'k-', 'Linewidth', 3);
view([-30, 20]);

print -depsc spiral.eps
```

2. (25 marks) The monkey saddle is the surface defined by the equation

$$z = x^3 - 3xy^2$$

Following the instructions below, plot four figures of the surface in one single graph by using subplot (2 rows and 2 columns).

- use MATLAB function `meshgrid` to generate the grid of x from -5π to 5π with step length 1, y from -4π to 4π , with step length 2.
- use `mesh` to plot the surface of z .
- use `surf` to plot the surface of z . Set view from azimuth -18 and elevation 38 and show the color bar;
- plot the 3-D contour of the surface with 25 contour lines;
- For the last figure, show the gradient vector field of the surface.

Your figure should show like Figure 2.

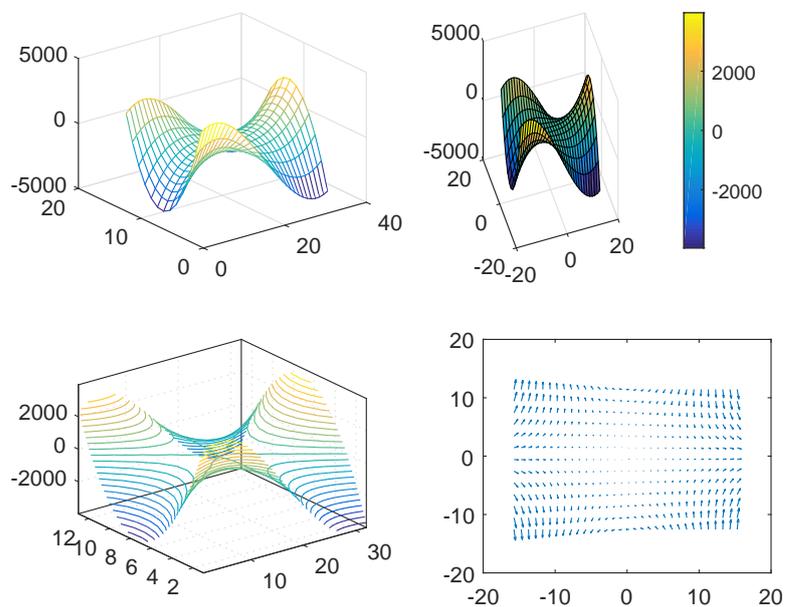


Figure 2: saddle.eps

Use MATLAB command to save the figure as 'saddle.eps' and write down your codes.

```
[X,Y]= meshgrid(-5*pi:1:5*pi, -4*pi:2:4*pi);
Z = X.^3 - 3*X.*Y.^2;

figure;
subplot(2,2,1); mesh(Z);
subplot(2,2,2); surf(X,Y,Z); view(-18,38); colorbar;
subplot(2,2,3); contour3(Z, 25);
subplot(2,2,4); [gx,gy] = gradient(Z); quiver(X,Y,gx,gy);

print -depsc saddle.eps
```

3. (25 marks) A cylinder is generated by defining a generating curve and revolving it around the z-axis by one complete revolution to sweep the desired cylindrical surface. Consider a generating curve defined by

$$r(z) = 1.5 + \cos(3\pi z), \quad 0 \leq z \leq 1.$$

Please make the following plot:

- (a) Use `cylinder` to generate the surface data (matrices **X**, **Y** and **Z**) for the cylinder. The step length of z is 0.01.
- (b) Use `surf` to plot the cylinder with the approximate matrices **X**, **Y**, and **Z**.
- (c) Set the axes to be square and change the `view` azimuth to -38.6 and elevation to 26.
- (d) Create a light source from position $[-2, -2, 0.1]$ with parallel light rays. Hint: Use function `light`.
- (e) Remove the axes and the frame.
Hint: The `set` function can be used to set graphics object properties. For instance,
`set(gca, 'PropertyName', PropertyValue)`
sets the property of the current figure specified by `'PropertyName'` with the value specified by `PropertyValue`.

Your figure should show like Figure 3.

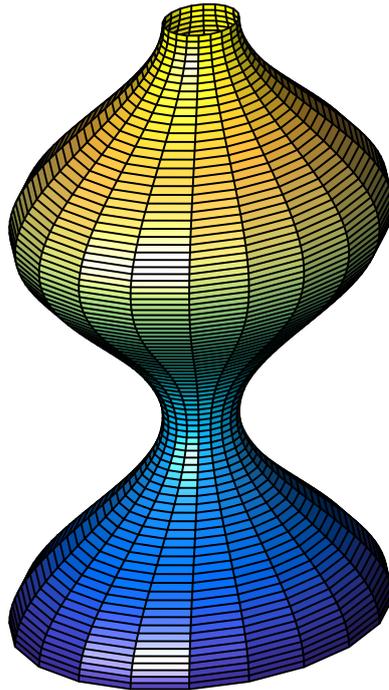


Figure 3: cylinder.eps

Use MATLAB command to save your graph as 'cylinder.eps' and write down your codes.

```

z = linspace(0,1, 101);
r = cos(3*pi*z) + 1.5;
[X, Y, Z] = cylinder(r);

c = surf(X, Y, Z);

axis square;
view( -38.5, 26 );

light('position', [-2 -2 0.1], 'Style', 'infinite' );

set( gca, 'visible', 'off');

print -depsc  cylinder.eps

```

4. (25 marks) Let's consider the function of three variables

$$f(x, y, z) = \frac{2xyz}{x^2 + y^2 + z^2}.$$

Follow the instructions to visualize the function. The figures should be plotted in one single graph by using `subplot`.

- Use `meshgrid` to generate mesh grid x , y and z from -2 to 2 , with step length 0.1 , respectively.
- Create slices at planes $x = -0.75, 0.75$, $y = -0.75, 0.75$, $z = -0.75, 0.75$. Show the colorbar. Label x -axis, y -axis and z -axis with x , y and z respectively.
- Draw the surface where $f = 0.4$. Set the view from the direction $[-2, -4, -8]$ and set the axis equal.
- Plot the contour slice on the plane $z = 0.5$ with 20 contour lines. Show the colorbar.

Your figure should show like Figure 4.

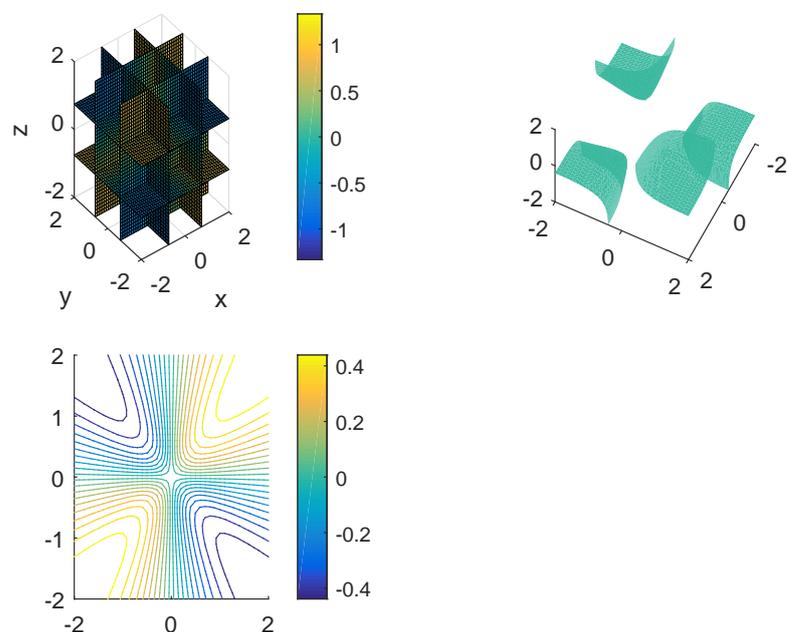


Figure 4: fourdplot.eps

Use MATLAB command to save your graph as 'fourdplot.eps' and write down all your codes.

```
[x, y, z]=meshgrid(-2:0.1:2,-2:0.1:2,-2:0.1:2);
f = 2*x.*y.*z ./ ( x.^2 + y.^2 + z.^2 );
subplot(2,2,1);
slice(x,y,z,f,[-1,1]/4*3,[-1,1]/4*3,[-1, 1]/4*3)
xlabel('x'); ylabel('y'); zlabel('z');
colorbar

subplot(2,2,2);
isosurface(x,y,z,f,0.4)
view([-2,-4,-8])
axis equal
```

```
subplot(2,2,3);  
contourslice(x,y,z,f,[0],[0],[0.5],20)  
colorbar  
  
print -depsc fourdplot.eps
```