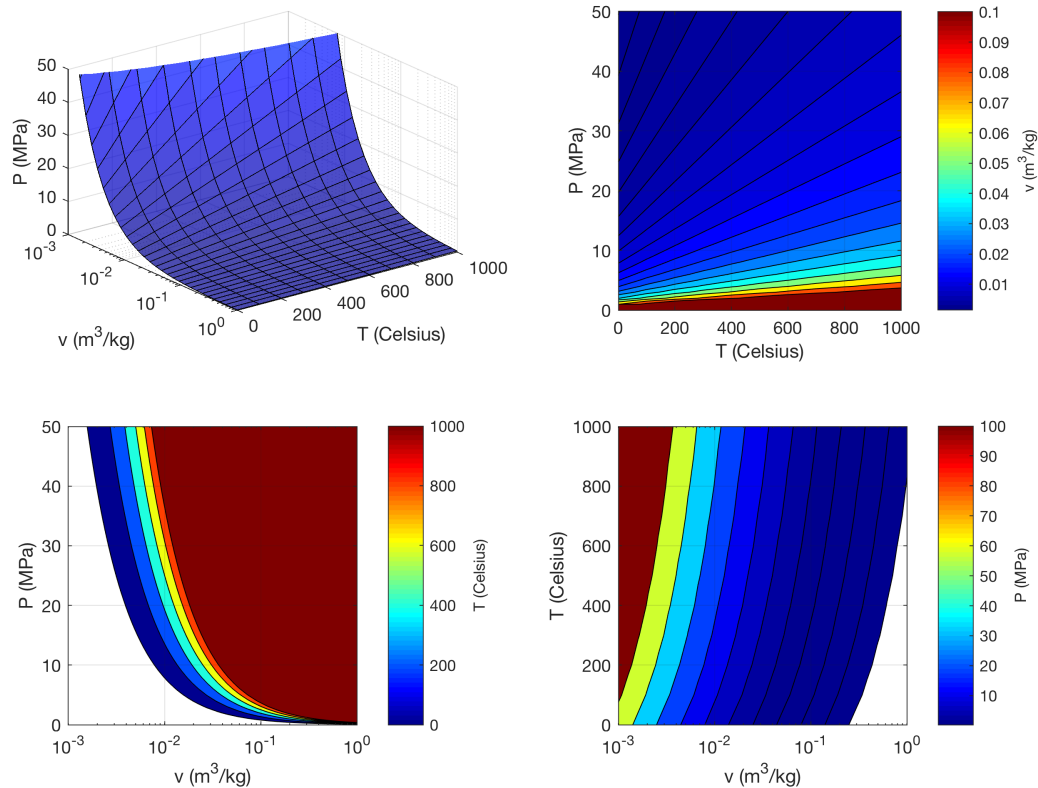# UBC MECH 222: MATLAB Computer Lab 1

3D Plotting: Ideal Gas Law

Instructions

The ideal gas law states:

$$P = \frac{R_s T}{v}$$

where P is pressure (Pa), T is temperature (K), v is specific volume (m^3/kg) and R_s is a specific gas constant (J/kg K). The figure above presents the ideal gas law for dry air ($R_s = 287$ J/kg K).

Write a MATLAB script which creates the figure above and saves the figure as a .png file (with adequate resolution). When you are satisfied with your script, submit your M-file to Connect. (**Do not** use the functions `fsurf` and `fcontour`. You must construct arrays, use array operations and use the functions `surf` or `contourf`.)

Hints

1. The general layout of the script is:

```
% Setup the figure
h = 7; % Height in inches
w = 10; % Width in inches
figure('Units','Inches','Position',[ 0 0 w h ]);
set(gcf,'PaperSize', [ w h ],'PaperPositionMode', 'auto');


colormap(jet);

% Plot P-v-T
subplot(2,2,1)
...

% Plot T-P
subplot(2,2,2)
...

% Plot v-P
subplot(2,2,3)
...

% Plot v-T
subplot(2,2,4)
...

% Print the figure
print('ideal_gas.png','-dpng','-r300')
```
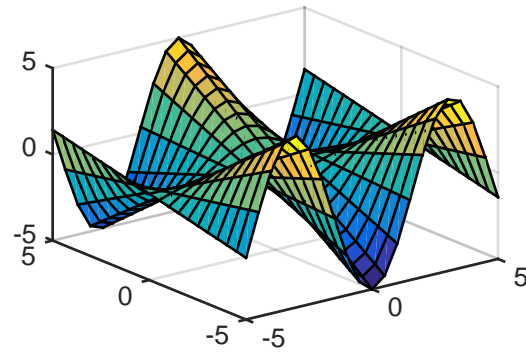
2. Plotting in 3D in MATLAB requires constructing 2D arrays using the function `meshgrid`. It's difficult to understand when you see it for the first time but the procedure is simple. For example, plot $z = y\cos(x)$ over the rectangle $-5 \le x, y \le 5$:

```
x = -5:0.5:5;
y = -5:0.5:5;
[X,Y] = meshgrid(x,y);
Z = Y .* cos(X);
surf(X,Y,Z);
```

3. The script which created the ideal gas law figure presented at the beginning of the document used the MATLAB commands summarized in the table below. Search the MATLAB documentation (`mathworks.com/help/matlab`) for more information about any of these commands.

`log10`	compute $\log_{10}$
`logspace`	generate a logarithmically spaced vector
`subplot`	create grid of subplots
`meshgrid`	create 2D grid coordinates
`surf`	plot a surface
`set(gca,'XScale','log')`	set x-axis to log scale in current axes
`set(gca,'XDir','reverse')`	reverse direction of x-axis in current axes
`xlim, ylim, zlim`	set display limits of plot
`xticks, yticks, zticks`	set ticks along axes
`xlabel, ylabel, zlabel`	add labels to axes
`contourf(X,Y,Z,levels);`	plot filled contour plot
`grid('on')`	add grid lines
`c = colorbar;`	add color bar (and save in variable `c`)
`c.Label.String = 'v (m^3/kg)';`	add label to color bar (assigned to variabel `c`)
`print`	save current figure to file