Simutech Winter Project

Modelling Of IC Engine Using MATLAB

Week-1 Assignment
(Deadline 16th Dec)

Problem Statement-1

An ideal gas undergoes the following sequence of mechanically reversible processes in a closed system:

1. From an initial state of 70°C and 1 bar, it is compressed adiabatically to 150°C.
2. It is then cooled from 150°C to 70° at constant pressure.
3. Finally, it is expanded isothermally to its original state.

Write a **MATLAB** and/or **OCTAVE** code to calculate work done, heat transferred, and the changes in internal energy and enthalpy of the gas for each process and overall (entire cycle). Take $C_v = 1.5R$ and $C_p = 2.5R$. Also, plot (PV, PT, and TV) curves for each processes and also calculate the work done using the area under the PV curve, and compare the values with what you get using thermodynamic formulas.
Note: For calculating area under the curve, you can use any of the functions named **integral** and/or **trapz**.
Now, comes the twist :)
If the processes are carried out irreversibly but so as to accomplish exactly the same changes of state– the same changes in pressure, temperature, internal energy and enthalpy, then different values of heat transferred and work done should emerge. Write a **MATLAB** and/or **OCTAVE** to calculate heat transferred and work done if each step is carried out with a work efficiency of 75 % . Also, plot the process diagram (PV ,PT, TV) curve for each process.

Problem Statement-2

Now, this problem is related to performing more complex integration. Consider the following functions:

$$y_1(x) = 2x + 1$$

$$y_2(x) = 2x/(1 + 0.2x)$$

Your task is to evaluate the following integrals:

$$\int_0^{15} \frac{1}{y_1 + y_2}\, dy_1$$

and

$$\int_0^{15} \frac{1}{y_1 - y_2}\, dy_1$$

Problem Statement-3

Where do the following circle and the parabola intersect:

$$x^2 + y^2 = 4$$

$$x^2 - y = 1$$

You have to solve this problem using the concept of **fsolve**.

Problem Statement-4

Write a **MATLAB** and/or **OCTAVE** to determine the equation of a tangent from point A(0,1) to the curve $y = \frac{2x}{1+x}$. Remember, at the point of tangency, the slope of the tangent is equal to the derivative of the curve. This means, if the point of tangency is $B(x_t, y_t)$ then:

$$\frac{y_t - 1}{x_t} = \left.\frac{dy}{dx}\right|_{x=x_t} = \frac{2}{(1+x_t)^2}$$

Additionaly, since the tangent point lies on the curve, we also have

$$y_t = \frac{2x_t}{1+x_t}$$

Now, solving the above system of non-linear equations will provide you the point of tangency. Your task is to find out the slope of the tangent and plot the tangent along with y.
Hint: Form equations and use **fsolve**.

Deliverables and Submission

Note: Keep the solutions of all the problem statements in one folder. Your **MATLAB** and/or **OCTAVE script** files should be of the type **.m** file, otherwise, it will not be accepted. Finally, convert that folder into a **zip** file and submit to the link that I will share on **16th Dec**.

For the **Problem-1** firstly, you have to use a pen and paper to solve the problem in a notebook and make rough plots based on your insights and/or intuition. You have to submit this as well :).
After solving the problem by hand, now code it as well, and you have to submit the **MATLAB** and/or **OCTAVE** running **script files**, with all plots clearly labeled and titled. Additionally, you have to download all the figures and submit them.

For the **Problem-2**, your submitted **script** should contain the proper steps and comments on your approach to solve this problem. I would suggest first trying to form the equation in your notebook, then start coding it in the editor. Grading will be based on your approach to this problem.

For the **Problem-3** you only have to submit a running script file clearly displaying the final results. Additionally, you can solve it manually and verify whether your answer is correct or not :).

For the **Problem-4** again you have to solve this problem using pen and paper in your notebook and calculate your final answer. After solving it by hand, you have solve it in the **MATLAB** and/or **OCTAVE** editor, and your submitted **script file** should be running and producing the desired results. Your submission should contain your hand-written notebook solution as well as the running script file. Again, marks will be given based on your approach to the problem.

ALL THE BEST!