ENG1060: COMPUTING FOR ENGINEERS

PASS 3 – Week 5

2020 OCT NOV

TASK 1

A snowflake-like pattern can be described by the following equation.

$$r = \sin^2(1.2\theta) + \cos^3(6\theta)$$

Where r represents the radius and θ represents the angle. Note that the x and y Cartesian coordinates can be calculated through

$$x = r\cos(\theta)$$
$$y = r\sin(\theta)$$

Create an equally-spaced vector for θ with 1000 values ranging from -4π to 4π. Create a 2-by-1 subplot figure with the following specifications:

- [Top subplot] Plot y against θ and x against θ on the same subplot. Remember to provide a legend.
- [Bottom subplot] Plot y against x as a continuous line coloured with the following RGB (red-green-blue) colours [0.0353, 0.6941, 0.8588]. Make the axis of this subplot square in size. Provide a title.

Note: check the axis() documentation for information on how to make the axis box square in size
Note: check the plot() documentation for information on how to use RGB colours

TASK 2

The butterfly curve is given by the following parametric equations:

$$x = \sin(t)\left(e^{\cos(t)} - 2\cos(4t) - \sin^5\left(\frac{t}{12}\right)\right)$$
$$y = \cos(t)\left(e^{\cos(t)} - 2\cos(4t) - \sin^5\left(\frac{t}{12}\right)\right)$$

Prompt the user for a minimum value of t and a maximum value of t. Then create a vector for t with values increments of 0.01. Create **subplots** in a 2x1 arrangement (stacked vertically) with

A. The top panel plotting the position (both x and y) against t.
B. The bottom panel plotting y against x, as a magenta line.
C. Title the bottom subplot as “The Butterfly”

TASK 3

The volume V and paper surface A of a conical paper cup are given by

$$V = \frac{1}{3}\pi r^2 h \qquad\qquad A = \pi r\sqrt{r^2 + h^2}$$

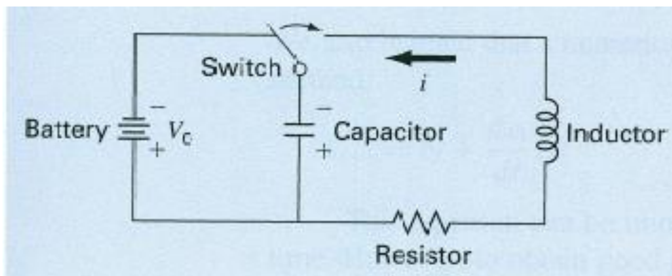
where r is the radius of the base of the cone and h is the height of the cone.

A. Write a **function** that accepts r and V as input arguments and computes A and h as outputs.
B. Write an m-file that uses the function in part A that determines the minimum A and the corresponding r and h values, given $V = 10\ \mathrm{m}^3$. Print a statement containing this information using fprintf().

Hint: Initially, you will need to guess the range of r values which incorporates the minimum area.

TASK 4

The following electrical circuit is used in a product that your company is developing.



When the switch is flipped to the right, the capacitor charge $q(t)$ is modelled by the following equation:

$$Rt = -2L\log_e\left(\frac{q(t)}{q_0\cos\left(t\sqrt{\frac{1}{LC} - \left(\frac{R}{2L}\right)^2}\right)}\right)$$

Where t is time, q_0 is the initial charge, R is the resistance, L is the inductance and C is the capacitance. All variables are dimensionless.

A. Use MATLAB to generate a plot of $q(t)$ between t=0 to 2 with a resolution of t=0.0001. Use the following parameter values: q_0=20, R=22, L=10, C=10^{-5}.
B. Determine the minimum and maximum charge values and the corresponding times. Mark these with different coloured asterisks. Remember to label your plot and have a legend.
C. Determine the charge at t=2.

TASK 5

The average daily temperature for an area can be approximated using the following equation:

$$T = T_{\mathrm{mean}} + \left(T_{\mathrm{peak}} - T_{\mathrm{mean}}\right)\cos\left(\omega\left(t - t_{\mathrm{peak}}\right)\right)$$

where T_{mean} is the mean temperature over a year, T_{peak} is the highest daily mean temperature, ω is the frequency of annual variation, t_{peak} is the day that the peak temperature occurs, and t represents the days 33 to 400 (inclusive, increments of 1). ω has the value 2π/365.

A. Write a **function** that takes T_{peak}, t_{peak}, T_{mean} and *t* as inputs (4 inputs) and outputs the following 3 return values:
   - The temperature for each day
   - The minimum temperature for the year
   - The day with the minimum temperature

B. In 2008, Melbourne's temperature statistics were: T_{peak} = 25.9°C, t_{peak} = 13 and T_{mean} = 19.8°C
   Use the function you wrote in part A to plot on a single figure the following:
   - Temperature for every day of the year as a black continuous line
   - Use fprintf() to print the minimum temperature and the day it occurred. Then use a red asterisk to mark it on the plot

C. In 2008, New York's temperature statistics were: T_{peak} = 24.8°C, t_{peak} = 185 and T_{mean} = 12.6°C
   Use the function you wrote in part A to plot on the previous figure:
   - Temperature for every day of the year as a black dashed line
   - Use fprintf() to print the minimum temperature and the day it occurred. Then use a blue asterisk to mark it on the plot