KALINGA INSTITUTE OF INDUSTRIAL TECHNOLOGY (KIIT)

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Activity Submission

Autumn Semester, 2021-22

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Roll Number: **2027001**

Branch: **Aerospace Engineering**

Subject: **Introductory Aerodynamics**

Subject Code: **AS – 2003**

Subject Faculty: **Prof. Dr. Sumanta Chaudhuri**

Title: **Mathematical Modelling of an experimental setup with seven attached Piezometers**

Question:

Write a code to draw the HGL and TEL for the following experiment -

Seven piezometers are connected in a duct through which water flows in an experiment for verification of Bernoulli's equation.

The piezometer readings are as follows:

H_1	H_2	H_3	H_4	H_5	H_6	H_7
20 cm	**18.5 cm**	**15.5 cm**	**6.7 cm**	**11.8 cm**	**15 cm**	**18 cm**

Diameter of the sections where piezometers are connected as follows:

D_1	D_2	D_3	D_4	D_5	D_6	D_7
30 cm	**24 cm**	**20 cm**	**16 cm**	**20 cm**	**24 cm**	**30 cm**

Reading of the measuring tank:

- Initial level of water: **8.5 cm**
- Final level of water: **19 cm**
- Time: **30 sec**
- Area of the measuring tank: **0.077 m^2**

The snippet of code from the application:

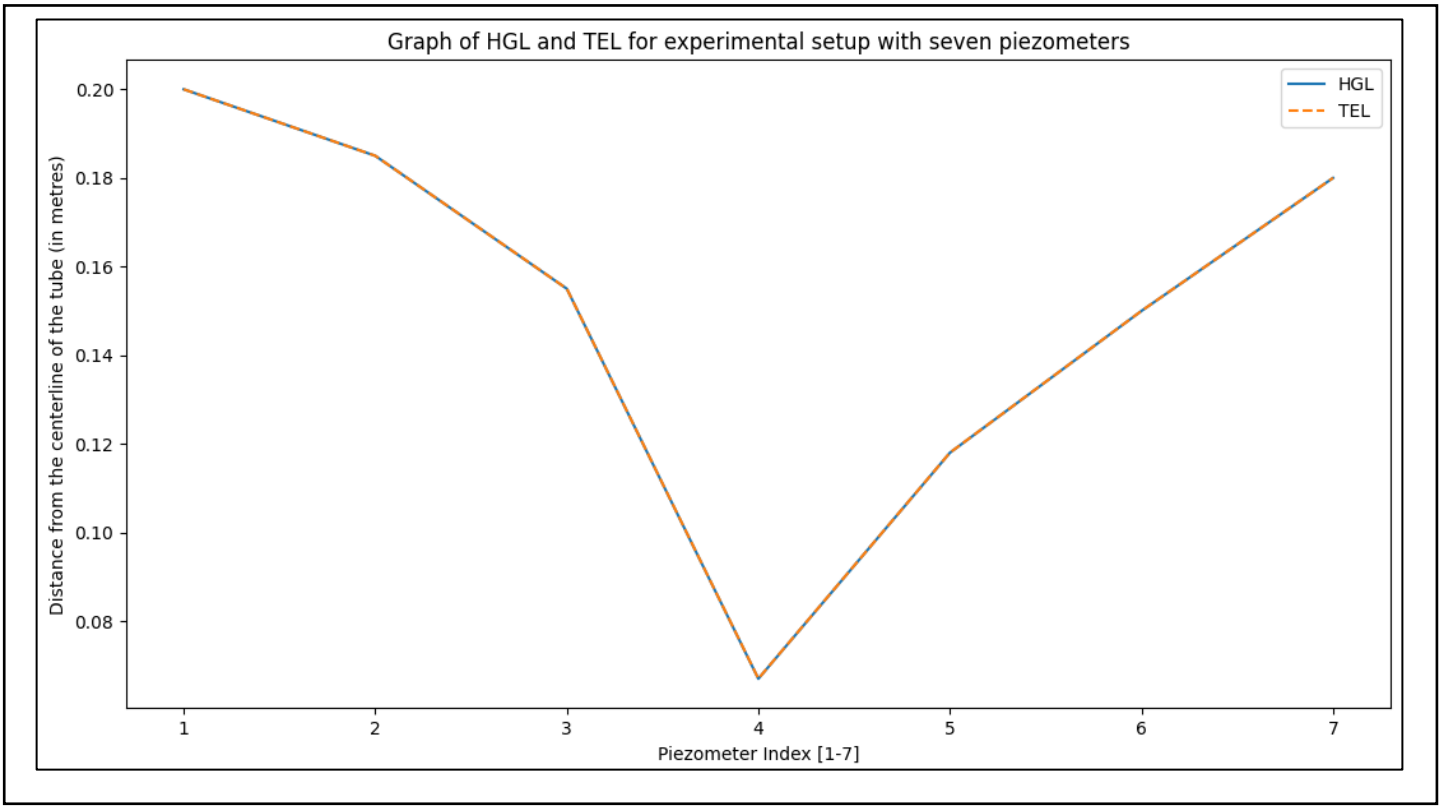
```
1.  import matplotlib.pyplot as plt
2.  import numpy as np
3.
4.  gravity = 9.81  # in m/s^2
5.  frMultiplier = 100  # in %
6.
7.  pzHeights = [20, 18.5, 15.5, 6.7, 11.8, 15, 18]  # in cm
8.  sectionDiameters = [30, 24, 20, 16, 20, 24, 30]  # in cm
9.
10. tankArea = 0.077  # in m^2
11. tankReadings = [8.5, 19]  # in cm
12. flowTime = 30  # in sec
13.
14. flowVolume = ((tankReadings[1]-tankReadings[0])/100)*tankArea  # in m^3
15. flowRate = flowVolume/flowTime  # in m^3/sec
16.
17. hgl = []
18. for reading in pzHeights:
19.     hgl.append(reading/100)
20.
21. tel = []
22. for i in range(0, 7):
23.     velocity = (((frMultiplier/100)+1) * flowRate) / \
24.         (np.pi*(sectionDiameters[i]/(2*100))**2)
25.     velhead = (velocity**2)/(2*gravity)
26.     tel.append(hgl[i]+velhead)
27.
28. plt.plot(range(1, 8), hgl, label="HGL")
29. plt.plot(range(1, 8), tel, "--", label="TEL")
30. plt.ylabel("Distance from the centerline of the tube (in metres)")
31. plt.xlabel("Piezometer Index [1-7]")
32. plt.legend()
33. plt.title("Graph of HGL and TEL for experimental setup with seven piezometers")
34. plt.show()
```

Prerequisites to run my application:

My application comprises of 100% portion of code written in Python 3.9, a non-native, high-level programming language and will not necessarily work on a particular system without installing some necessary packages. To know more about how to setup Python on your system, watch this video. Once the setup is done, you will also need to install the following packages through the 'PIP package manager', which already comes pre-installed with the Python Package. Just input the corresponding commands in your system's Command Prompt after installing the python package. Lastly, open the activity.py file in your preferred compiler (or PyCharm as suggested in the video) and execute

i. Matplotlib (command: pip install matplotlib)
ii. NumPy (command: pip install numpy)

Graph obtained from the application:



Conclusion:

The Hydraulic Grade Line (HGL) and Total Energy Line (TEL) were drawn using a self-made modelled application.