Scenario:
You have recently found a position at a company contracted by a law enforcement agency. The law enforcement agency would like your company to design a breath analyzer for field assessment of blood alcohol levels. Key features of the breath analyzer that the law enforcement agency have required are that

- the exhalation amount (volume) for a person being tested exceed some minimum value
- the exhalation rate (flow rate)
  - exceed some minimum value
  - be maintained at a relatively consistent value during the expiration (as an additional marker for physical/body control that may indicate inebriation)

You have been placed on the engineering team that will be working on these aspects of the breath analyzer instrument. Your team has decided that an impeller (looks like a fan blade) will be used in the measurement of the expired air flow through the instrument – when someone blows into the instrument, the impeller will spin.

You are required to provide a **written proposal** to your engineering team lead for a possible solution to the problem and sponsor constraints.

*Assume the instrument will be operated by an Arduino or similar microcontroller, and the impeller size has an ~0.5 inch diameter. Since your company is designing this instrument, you may use basic sensors that are commercially available, but not complete systems from other companies. You may address the flow in general terms (i.e., MEMT313 calculations not required), and expect to use another device for impeller rotation calibration, however, you must describe the data acquired as accurately as possible.*

Address/Discuss (thoroughly) the following:

1. **Introduction/Background/Problem Statement/Project Purpose**
   1. A summary of the proposed work
   2. Major objectives
   3. Broad overview of the technology

2. **Data acquisition of impeller rotation**
   a. Identify and describe at least one method along with a choice of a basic sensor(s) which could be used for measuring the rotation of the impeller.
      • attach a copy of a your selected sensor’s data sheet in an appendix
   b. Identify and describe the major components (e.g., bridge, amplification, data storage. . .) required to accomplish the data acquisition and discuss the effects of the component(s) on the data.
      • a drawing or schematic is required (include in main body of proposal)
   c. Identify and describe the resulting expected output data of the chosen method/basic sensor. Other things to describe include:
      • a sample plot of expected collected data is required (it can be “fictional data” but must be feasible for or relevant to the sensor chosen)
      • type of sensor output (e.g., voltage, current, etc.)
      • range of the output
• nature of the signal (e.g., cyclical, constant, n\textsuperscript{th}-order response, etc.)

d. Identify and describe if/how the collected data is stored or used
• discuss limitations for each case

3. Data analysis
a. Identify and describe at least one method (along with data analysis techniques you would employ and considerations/limitations) for measuring the flow rate based on your collected data.
• a sample plot will be helpful

b. Identify and describe at least one method (along with data analysis techniques you would employ and considerations/limitations) for insuring that a minimum amount of air is expelled from a tested person’s lungs.
• a sample plot will be helpful

c. Identify and describe at least one method (along with data analysis techniques you would employ and considerations/limitations) for insuring that the tested person is exhaling and not inhaling.
• a sample plot will be helpful

4. Conclusion
a. Any final remarks/considerations
b. Do not restate the introduction

5. Appendices

This is an individual assignment and should be approximately 800-1200 words or around 2 pages (for the main body, not including the Appendices) in length (Calibri/Times New Roman 12pt).