INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	Advanced Respiratory and Sleep Medicine, PLLC	**Date Submitted**	*06/21/2026*
Project Title	*Design of a CPAP tube management system (ADVANCED_TUBE)*	**Planned Starting Semester**	*Fall 2026*

Senior Design Project Description

Personnel

Typical teams will have 4-6 students, with engineering disciplines assigned based on the anticipated Scope of the Project.

Please provide your estimate of staffing in the table below. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical	5	Electrical	
Computer		Systems	

Company and Project Overview:

Advanced Respiratory and Sleep Medicine, PLLC is a private pulmonary and sleep medicine clinic and research center with offices in Huntersville and Hickory, NC. Since opening our doors in 2010, we have cared for more than 75,000 patients. Advanced Respiratory and Sleep Medicine (ARSM) partners with pharmaceutical and medical device companies to research new products and technologies that may someday impact peoples' lives. ARSM conducts research in many areas including:

- Sleep testing
- Pulmonary function testing
- Electrocardiography
- Clinical laboratory
- Psychological and psychometric testing

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ARSM diagnoses hundreds of new patients a year with sleep apnea. Sleep apnea, a condition where the upper airway collapses during sleep causing normal respiration to stop, is associated with increased risks of heart disease, stroke, and motor vehicle accidents. The most effective treatment for the treatment of sleep apnea is continuous positive airway pressure (CPAP). CPAP raises the pressure in the upper airway above atmospheric pressure creating an "air splint" to prevent upper airway collapse.

Project Requirements:

The main barrier to using CPAP is patient compliance. Studies have shown that persistent CPAP compliance is only approximately 50%. There are many side effects associated with CPAP that could explain poor compliance. Unfortunately, alternative treatments to CPAP for the treatment of sleep apnea have not shown comparable effectiveness in normalizing respiration.

New treatments are being developed to make CPAP more tolerable. Recently a new form of CPAP called Kairos Positive Airway Pressure (KPAP) was approved by the FDA. The goal of KPAP was to reduce airflow at unnecessary times during the respiratory cycle to make therapy more comfortable.

Another barrier to patients wearing CPAP therapy is mask comfort. Current CPAP masks require multiple straps on the head and face to keep the CPAP mask sealed to the face. These straps cause discomfort. The straps also leave marks on the users' face that can last for hours after the CPAP mask is taken off. If a large mask leak occurs, CPAP therapy is not effective because the pressure generated by the machine does not make it to the part of the airway that collapses.

The CPAP machine and CPAP mask are attached by a standard six-foot CPAP tube. The CPAP tube creates "tube drag" which applies force to the mask which can cause leaks. Masks must apply more force to account for CPAP tube drag. Proposed solutions to tube drag include using hardware to suspend the tube over the user, securing part of the tube under the user's pillow and using a CPAP mask that attaches at the top of the head. The goal of this senior design project is to analyze this problem and design a better CPAP tube management system that will reduce CPAP tube drag thus allowing masks with fewer straps while maintaining a good CPAP mask seal.

Expected Deliverables/Results:

- Analysis of problem of tube drag
- Develop creative concepts for reducing or eliminating the problem
- Select promising candidate ideas
- Design, build and test the selected ideas
- Provide complete drawing set for all solutions

Disposition of Deliverables at the End of the Project:

Students are graded based on their display and presentation of their team's work product. It is mandatory that they exhibit at the Expo, so if the work product was tested at the supporter's location, it must be returned to campus for the Expo. After the expo, the team and supporter should arrange the handover of the work product to the industry supporter. This handover must be concluded within 7 days of the Expo.

List here any specific skills, requirements, specific courses, knowledge needed or suggested (If none please state none):

- Interest in engineering design for healthcare applications