INDUSTRIAL SOLUTIONS LABORATORY

Company Information

Company Name	*Groninger USA*	**Date Submitted**	*04/06/2023*
Project Title	*Reliability Analysis and Design of Spare Part Kits for Integra Line* ***(GRON_PART)***	**Planned Starting Semester**	*Fall 2023*

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 below table. The Senior Design Committee will adjust as appropriate based on scope and discipline skills.

Discipline	Number	Discipline	Number
Mechanical	3	Electrical	2
Computer		Systems	1

Company and Project Overview:

Groninger is one of the leading international manufacturers of filling and closing machines for the pharmaceutical, consumer healthcare, and cosmetic industries. Groninger designs and builds these filling and closing machines in Germany, and Groninger USA takes care of the lifecycle of these machines at all customer sites across North America. Groninger USA's first-class service includes remote technical support, highly skilled field service, locally manufactured parts, mechanical engineering and automation engineering, innovative retrofits, and more.

The goal for this project is to develop a new service product for one of our blockbuster pharmaceutical machine lines called Integra. Integra is a bulk vial washing, sterilizing, filling, and finishing line integrated with isolator technology. This machine line processes vials in large batches from start to finish. The vials are washed, sterilized in a heating tunnel, filled with pharmaceutical product(s), closed with stoppers, and sealed with crimp caps to ensure quality. For more information, visit the link below:

https://www.groninger-group.com/en/pharma/aseptic-filling-machines/vial-filling-machines-bulk/integra/

Groninger USA currently has a service product called, “Preventative Inspections”, where field service technicians inspect the machines on an annual basis and recommend replacement of worn parts. This project is intended to create a new service product that is a more proactive alternative to “Preventative Inspections” and is regularly scheduled like an oil change on a car.

Project Requirements:

The project team will have to analyze each machine on the Integra Line. Groninger USA has access to the machine’s design documents, such as 3D models, drawings, videos, datasheets, etc. However, students will not have access to the actual machines here in Charlotte, as they are solely being constructed in Germany. Based on their research from the machine’s design documents, engineering analysis and part testing, the project team will specify any parts that need to be replaced regularly and create recommended spare part kits. These kits should include details on what needs to be replaced and after how many hours of operation should the part be replaced. These kits will allow the customers to *proactively* replace everything that *could* wear on their machines on a regularly scheduled basis, rather than *retroactively* replacing everything once a year after the parts have *already* undergone wear and tear. Changing this product offering to have a proactive service option will greatly improve the design and effectiveness of this machine.

During the design phase in the first semester, the project team will have to do engineering analysis and detective work to establish which parts of each machine are likely to see wear based on the operating parameters of the machine. The team will examine both the **mechanical and electrical** components of each machine. The team will also have to investigate the materials involved to see which materials are more likely to wear and how the material of construction helps determine the limit of each part. Another observation the team will need to consider would be how the cycling of the machine could cause excessive wear, i.e., if the parts are in a moving assembly, if the parts are located at a high-contact area, the function of the parts, product lifetime determined by manufacturer, etc. Lastly, the team will need to identify what other factors determine the limit of each part, perform calculations, and provide detailed reasoning to support their findings. The required calculations may include stress, strain, yield strength, etc. and can be computer-generated or calculated by hand. The desired output for the first semester is a list of possible mechanical and electrical spare parts for each machine in the Integra line with calculations to prove that these parts should be included in the recommended spare part kits.

During the production phase in the second semester, the project team will procure **mechanical and electrical** parts to do testing to validate their engineering analysis. The team will be able to use parts from the actual Integra machines, as well as construct test samples out of the same material to execute wear testing as validation. The end product of the second semester should be finalized recommended spare part kits for each machine in the Integra line with test data and calculations that establish a replacement schedule based on the hours of operation.

NOTE: This project is more of an analytical project. There are physical aspects to the project with the testing required, but this project does not require a functional prototype.

Expected Deliverables/Results:

The students on this project team are required to provide the following:

- Breakdown of assemblies more susceptible to wear for each Integra machine
- Detailed list of possible **mechanical and electrical** spare parts for each Integra machine
- Hand/computer-generated calculations, graphs, and test data from fatigue/stress/wear testing
- Analysis of results
- Finalized recommended spare part kits for each Integra machine
- Replacement schedule based on the hours of operation
- Recommendations for design changes based on results

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):

- Engineering materials
- Stress analysis
- Fatigue testing
- Electrical specifications / datasheet analysis
- Strengths of materials
- Dynamics
- Machine design
- SEGR 4141 - Engineering Experimental Design