UNC CHARLOTTE
The WILLIAM STATES LEE COLLEGE *of* ENGINEERING

UNC Charlotte – Lee College of Engineering Senior Design Program
Company Information

Company Name	MEES-Bio Engineering	**Date Submitted**	*12/7/2020*
Project Title	Temperature controlled whole organ perfusion system **(BIO_ORGAN)**	**Planned Starting Semester**	Spring 21

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	4	Electrical	
Computer		Systems	
Other ( )			

Project Overview and Requirements:

Currently there are ~120,000 people on the waitlist for a life-saving organ transplant, and many more could medically benefit, if more organs could be made available. A major challenge is the very short time (hours) that organs remain viable after donation, which prevents organs from being stored or 'banked' for future use. The Charlotte Banks initiative (www.charlottebanks.org), headquartered at UNC Charlotte, is focused on overcoming the technical hurdles to organ banking by developing preservation technologies that can extend the time during which tissues and organs can be preserved. This can be achieved by a number of means, including optimization of cold and warm storage for short-term storage, or by low temperature freezing or ice-free vitrification methods for long-term storage. The goal of the current project is to develop a method to cryopreserve whole organ (liver) in the rat model using vitrification methods, and in doing so, advance towards preservation of larger animal livers.

Requirements:

The project can be broken down into 4 sub-projects that are complementary and will be guided by an overall team vision but can progress in parallel; A) Development of a temperature control whole organ perfusion chamber or vessel. B) Development of a low-toxicity low viscosity preservation solution for livers. This sub-project will investigate which cryoprotectant solution has

the least toxicity on livers, while remaining within the viscosity limits that enable it to be delivered into the liver using peristaltic pumps. The outcome will be assessed by viability, and function. C) Development of a pumping system to enable delivery and wash-out of preservation solution under controlled temperature conditions. Optimized diffusion times will be determined using radiometry experimental data and mathematical simulations based on irreversible thermodynamics and mass transfer models. D) Development of vitrification methodology to enable ice-free preservation of whole livers. Optimization will be guided by heat transfer models and experimental data.

Expected Deliverables/Results:

• Project A:

1. Temperature controlled perfusion chamber or vessel for rat livers
2. A low-toxicity low viscosity vitrification solution for hepatocytes

• Project B:

1. A computer controlled dual pump system to deliver cryoprotectant to whole livers with verification from Radiometry
2. Mass transfer model to predict protection distribution in tissue

• Project D:

1. Experimental methodology to enable reproducible vitrification of whole livers.
2. eat transfer model to predict thermal profiles in treated samples

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

1. Proficient working with LabView
2. Numerical modeling and simulations
3. Comfortable working with solutions, chemicals, tissues