Ph.D. Student Qualifying Exam: Biomedical Microdevices

Available: 8am, December 16, 2024
Due: 8am, December 17, 2024

Overview:

One fundamental skill for independent research is designing effective experimental studies. Careful study design contributes to the development of rigorous research methods and the generation of robust and repeatable data. As you progress in your research career it will become increasingly important to develop experiments to test novel hypotheses, devices, or models. In this exam, students will exercise this skill by studying the background literature provided before the exam period and then designing a study to address a specific objective described in the exam prompt. The background reading includes a review article to provide context and 5 research articles with more detail about several relevant methods and results. The theme of this exam is vascular "microphysiological systems (MPS)", microfluidic models of human blood vessel structure and function. You don't need direct experience with any of these techniques or vascular biology beyond the reading material provided, but familiarity with basic fluid dynamics concepts may be helpful.

You will have 24 hours to prepare your response, beginning Monday morning, December 16, 2024, at 8am, so reading all the background literature in advance to allow time to understand and analyze it is strongly recommended.

Background reading:

1. Nahon et al. "Standardizing designed and emergent features in MPS", 2024
2. De Graff et al. "Scalable microphysiological system to model three-dimensional blood vessels". 2019
3. Hajal et al. "Engineered human blood brain barrier microfluidic model for vascular permeability analyses", 2022.
4. Sugiura et al. "Perfusion culture of endothelial cells under shear stress on microporous membranes in a pressure-driven MPS". 2022.
5. Lam et al. "Characterizing on-chip angiogenesis induction in a MPS as a functional measure of mesenchymal stem cell bioactivity", 2023.
6. Choi et al. "Analyzing angiogenesis on a chip using deep learning-based image processing", 2023.