Justification for *Wearable Robotics*

I joined the faculty in January 2023, and I taught 'Wearable Robotics' under the EE546A – Special Topics in Control Systems title in my first quarter. I designed the class from the ground up, choosing the topics and reading material and preparing all the lectures and assignments from scratch. The material in this course is based in my research expertise and teaches students to engage with the primary scientific literature and work with relevant biomechanical and mechatronics datasets. This course is designed to be broadly interesting to students in ECE who are interested in neural engineering and robotics and control systems. This course meets a need in the department by bridging these two core areas in ECE and bolstering the coursework available to students in our department in both areas. The material is designed such that students with expertise in one area or the other can still be successful in this course and expand their knowledge of both neuromotor physiology and robotic controls. This class is also highly interdisciplinary and will also be attractive to students from other departments, such as Mechanical Engineering or Human Centered Design and Engineering. This is important for promoting collaboration and interdisciplinary teamwork and problem solving. At steady state, I envision that this class could be offered every year if current enrollment trends hold or could be offered every other year.

Winter 2023: The first offering of the course enrolled 12 graduate students. The course reviews were overwhelmingly positive for the first offering (10/12 students responding), with the four summative evaluative items evaluated as:

	Excellent	Very Good	Good	Fair	Poor
The course as a whole was:	70%	30%			
The course content was:	80%	20%			
The instructor's contribution to the course was:	80%	20%			
The instructor's contribution to the course was:	70%	30%			

Student feedback also highlighted the strengths of the course and its value to student learning:

> *"This class was fantastic. A focused and in-depth approach to a broad range of control system perspectives."*

> *"This class really bridged content learned in engineering in general to actual applications."*

> *"The class was able to effectively cover so many different topics but did a great job tying them all together throughout."*

> *"Lectures were awesome. Homework was super well designed."*

Winter 2024: The second offering of this course enrolled 20 students, which is a significant increase in enrollment over the one-year period. The course reviews were similarly positive in the second offering with 19/20 students responding. The four summative evaluation items were:

	Excellent	Very Good	Good	Fair	Poor

The course as a whole was:	63%	26%	11%		
The course content was:	53%	32%	11%	5%	
The instructor's contribution to the course was:	58%	37%	5%		
The instructor's contribution to the course was:	58%	42%			

Student feedback also highlighted the strengths of the course and its value to student learning:

> *"It was quite intellectually stimulating. I needed to think a lot about most things. Although this may be because a lot of the content was new, the way of presenting was amazing as well."*

> *"This class was very intellectually stimulating. The lectures were very robust and full of great information that either expanded on what I already knew, or taught me something new and made me think and ask questions. The lectures were very engaging and the topics were not simple. The instructor had some really awesome power point presentations and was an enthusiastic lecturer who encouraged engagement in the class and obviously knew the material very well themselves and was genuinely excited to teach us."*

> *"This class was very intellectually stimulating. An awesome course on a highly relevant and topical sub-field of EE. The coursework was an excellent balance between assignments being challenging / applying learned content from lecture and providing enough structure to understand expectations and overall goal."*

Overlap with future courses offered by Yiyue Luo and Sam Burden: Sam, Yiyue, and I met to discuss our vision for our courses. From our discussion, we see no significant areas of overlap and instead see a future where we can develop three independent courses that complement each other nicely. We believe in the future at steady-state, our three courses could form a sort of 'series' for graduate students interested in these topics. Each class would offer significant depth in its own topic area, while the series would offer breadth in its coverage of the field at large. In the future, we think the graduate committee should consider this fact in planning when each class would be offered (for example, Sam (Autumn), Kim (Winter), Yiyue (Spring) so that interested students could take all three). Yiyue's and Sam's classes are still in their early planning stages, but here is a summary overview of the planned content for each course. There are no significant overlaps between these topic areas and those currently outlined in the MCD for Wearable Robotics.

Human-Machine Interfaces (Sam)	**Emerging Interactive Technology** (Yiyue)
- Conceptual/theoretical focus on algorithm design for physical human-machine interactions	- Presentation of material through a human-computer interaction lens - Focus on the interaction technologies

- Uses examples from robotics to frame the problems, focus is not on robotics itself - Emphasis on defining agents (human, machine, or robot) and their physical interactions - Explores topics from game theory, control theory, and machine learning - Equal focus on upper-limb and lower-limb applications	- Discussion of cutting-edge interaction modalities (e.g., touch screens, color changing textiles) - Inclusion of 'wearables' from a sensing and haptics perspective, not robotics - Includes a hands-on hardware lab component - Stronger focus on upper-limb and tactile interactions