Notice of Intent, PhD in Mechanical Engineering

University of Wisconsin-Milwaukee

Degree: Doctor of Philosophy

Major: Mechanical Engineering

Department: Mechanical Engineering (ME)

School/College: College of Engineering and Applied Science (CEAS)

Mode of Delivery: Face to face

Institutional Contact: Devarajan Venugopalan, Associate Vice Chancellor, Academic Affairs, dv@uwm.edu

Program Description

Mechanical engineering is concerned with the application of physical principles to the analysis, design, and development of mechanical technologies. It includes renewable energy, energy storage, bio nanotechnology, vibration, flow and transport in porous media, automotive engineering, steam and nuclear power plants, tribology, composite-materials processing, water sensing and filtration, combustion, energy conservation, heat exchangers, HVAC, MEMS, computational fluid dynamics, mechanical design, smart materials, robotics, controls, and mechatronics, imaging, among other areas. Mechanical engineering is one of the fundamental engineering disciplines, and mechanical engineer careers take a diversity of forms.

The undergraduate mechanical engineering program at UWM has been present (with some early changes in name) since the inception of the College of Engineering in the 1960s. The undergraduate mechanical engineering program has the second highest enrollment of the seven engineering programs at UWM (Biomedical, Civil & Environmental, Computer Science, Electrical, Materials, Industrial, and Mechanical), and graduates approximately 100 students each year. The department plays a key role in the college's mission to educate students to become creative problem solvers, and to act as a catalyst for improved economic development and quality of life in Wisconsin. With the fast paced changes in mechanical technology, the department is critical to the college and university to achieve the strategic goal of anticipating and responding to market demands in order to produce graduates who are prepared to address and adapt to the changing needs of the marketplace and society.

At the graduate level, currently there is a long-standing, college-wide PhD program, spanning all but one engineering disciplines of the college. (Recently, in the year 2020, the electrical engineering department was authorized to have its own PhD program.) In this college-wide program, each engineering discipline functions, essentially, as its own individual program. With this Notice of Intent, we plan to separate the ME portion of the remaining college-wide PhD program into its own program. The need for this action is detailed in the following section.

The proposed PhD program in Mechanical Engineering will essentially be the same as the ME portion of the remaining college-wide PhD program. Curricular areas will be unchanged (covering typical graduate-level mechanical engineering content). There is no planned change in research focus – current areas of strength include biorobotics, bioimaging, intelligent materials, computational fluid dynamics and power storage.

Our program serves graduate students that work full or part time in the Milwaukee area (place-bound), those that come to work with specific faculty on research, and those who have a desire to be in the Milwaukee area, as well as the foreign students. The PhD enrolment in the ME portion of the college-wide program for years 2016-2020 was 40, 41, 42, 38 and 40, for an average of 40 PhD students in the ME portion of the program. (The ME department awarded PhD degrees to 9 students in 2016, 6 students in 2017,8 students in 2018,5 students in 2019 and 5 students in 2020.)

Anticipated Program Outcomes: Typically, 5-9 PhD students graduate from the ME portion of the remaining CEAS PhD program. We do not expect any significant changes in that number after the ME program becomes a stand-alone program like the EE program. As stated below, the goal of this endeavor is to be able to attract higher-caliber students, and to greatly assist in data collection about the ME program.

Learning Outcomes of the ME PhD Program (same as the current remaining college-wide PhD program):

a. Apply advanced knowledge of mathematics, science, and engineering to solve complex problems.
b. Use modern tools or techniques to solve complex problems, conduct research, and analyze and interpret data.
c. Demonstrate proficiency and competency in the area of specialization.
d. Identify, formulate, and solve complex problems with an original and/or significant contribution to the field.
e. Demonstrate a familiarity with research in a related or complementary discipline.
f. Use quantitative methods appropriate to the field of research.
g. Understand academic, professional and ethical responsibility.
h. Communicate effectively via technical writing and oral presentations.

The minimum degree requirement is 66 graduate credits beyond the Bachelor's degree with minimum credit distribution as follows: 21 credits in the major area; 9 credits in an approved minor area; 6 credits in mathematics and/or quantitative methods; 9 credits of approved electives; 3 credit CEAS Graduate Seminar (Ethics and Engineering Communication); A minimum of 26 credits, excluding dissertation, must be at the 700 level or higher; 18 credits of doctoral thesis. A minimum of 33 credits (including thesis) must be completed in the Ph.D. program at UWM.

A maximum of 33 credits may be considered for transfer from prior graduate work, including a Master's degree earned at UWM or elsewhere provided the course work taken falls within the appropriate areas and has earned a grade of "B" or better. Students entering the program without an applicable Master's degree are limited to a maximum transfer of 9 credits for courses taken elsewhere.

Existing or anticipated resources required to deliver the program

Since this is essentially a splitting-off of an existing program, no additional resources are required. The college will still manage admissions processing, as occurs currently. Currently, there are 13 full-time faculties, two teaching staff, and several adjunct faculty supporting the program.

Alignment with Institutional Mission, Strategic Plan, and Existing Program Array

The current joint program, being focused on research and advanced education, clearly serves the broad UW-Milwaukee mission for discovery, research, and education, and supports the generation of new knowledge for the development and betterment of society. The new, split-off ME program will serve the same purpose.

Need for the Program, and Relationship to Existing Programs

There is a local and national need for PhDs in Mechanical Engineering. Our PhD graduates have been able to find jobs that is commensurate with this market demand. We have been able to gather data on 42 PhDs graduated by the ME Department in last two decades. (Note that this data has not been gathered by UWM since we do not have a separate PhD program in ME, and is based essentially on the feedback provided by ME faculty). Out of our 42 PhD graduates for which the data is available, 14 of them took their first job as university faculty (at assistant professor or lecturer levels) in various engineering departments, 5 started work at corporate R&D, 11 were absorbed as senior/principal engineers in industry, 11 joined various universities as post-docs, and 1 started work as an executive director.

As discussed above, at present there is a college-wide PhD program In Engineering and Applied Science. The mechanical engineering portion of that program has approximately 37 PhD. The proposed program is simply to split off the mechanical engineering portion of that existing program, to become a PhD in Mechanical Engineering. Department faculty feel that this is an appropriate move for several reasons. First, there is some student reluctance to have a PhD degree that is, officially, in Engineering, rather than in Mechanical Engineering. We feel that a more specific degree name would aid in attracting top PhD student candidates to the program. Second, department faculty would like more autonomy in administering the program, including scheduling and evaluation of the PhD Qualifying Exam. Third, having a combined college-wide program makes it difficult to collect data on our (ME) students and graduates, as all PhD students in the college are, officially, in Engineering rather than Electrical Engineering. Related

to data collection for our own internal purposes, the presence of a college-wide PhD program adversely affects us in rankings, such as US News and World Reports and similar venues. We do not appear in these rankings of mechanical engineering PhD programs simply because we do not have a PhD in mechanical engineering (despite the fact that we, essentially, do have such a program of longstanding nature).

Impact on other programs in the UW System: We do not expect that this program will have any effect on the ME PhD program in Madison. Our student pool is largely drawn from two groups. One is engineers working in industry in Milwaukee. They choose UWM because it is convenient, and for them, Madison is too far to commute. The creation of a stand-alone ME PhD program will not affect these students. The other main group is foreign students, but our program and the program at Madison have different admission criteria (which is the current situation, and which will not change in the proposed program). As such, it is clear that the proposed program will neither produce unnecessary duplication within the UW System, not impact the program at Madison.

Admission Requirements

Admission standards will be the same as current admission standards for Engineering PhD.