

## **Program Description—Master of Science in Mechanical Engineering—Purdue University Calumet**

Proposal to offer the Master of Science in Mechanical Engineering (MSME) at Purdue University Calumet. The objective is to establish a Master of Science in Mechanical Engineering (MSME) degree program at Purdue University Calumet (PUC). This will build on the existing Master of Science in Engineering (MSE) degree program in Interdisciplinary Engineering, where the ME designation will properly indicate what the students are specializing in at the graduate level.

### **1. Characteristics of the Program**

#### **a. Campuses offering Program**

Purdue University Calumet, Hammond, Indiana

**b. Scope of Delivery** The degree program will be offered in the Northwest Indiana region.

**c. Mode of Delivery** The program will primarily be offered on-campus in the traditional classroom format, although some courses may be offered in blended or distance formats to meet student needs.

#### **d. Other Delivery Aspects**

Distance education courses offered by other Purdue campuses provide expanded course choices and flexibility for students. Students have the option to pursue internship.

#### **e. Academic Unit Offering Program**

The program will be offered by the Department of Mechanical Engineering in the College of Engineering, Mathematics and Science. Although the Master of Science degree in Mechanical Engineering is offered on other Purdue campuses, those campuses do not serve the Northwest Indiana region. Purdue North Central, the closest Purdue campus, does not offer any engineering master's degree programs. No other institution offers this degree in the Northwest Indiana area.

### **2. Rationale for Program**

#### **a. Institutional Rationale**

This degree is proposed to meet the growing need for a comprehensive and advanced Mechanical Engineering (ME) program required by the high technology employment in Northwest Indiana (NWI). The proposed degree program will establish a graduate program in ME in NWI that nurtures discovery, synthesis and professional advancement for the students.

One of the missions of Purdue University Calumet is to "...selectively offer graduate education in areas of strong student interest and community need as well as faculty expertise" (Strategic plan 2013, p. 2-see Appendix E in full proposal for link). A full discussion of the campus mission is included in the full proposal.

Purdue University Calumet is committed to contributing to the economic well-being of the region and to preparing students to be active and responsible members of a global society and workplace. This commitment increasingly means post-baccalaureate study that includes an understanding of complex areas of modern technology. The proposed Master of Science degree in Mechanical Engineering will

provide a high-quality engineering program for the residents of Northwest Indiana. It will offer students the opportunity to obtain an accessible, affordable, quality graduate degree from a public institution of higher learning, and prepare students to work as professionals within the Mechanical engineering industry or to gain admission to Ph.D. programs.

Additionally, Purdue University Calumet has developed several research centers and institutes that promote engineering projects through faculty, graduate student, and visiting scientist and engineer participation. These centers, notably the Energy Center, the Center for Innovation in Visualization and Simulation (CIVS), and the Purdue Water Institute, promote research and development activities that include advancing technology in energy efficiency, reliability, utilization, and processes, virtual reality with simulation technologies, application of simulation and visualization technologies to business, healthcare, and industrial and community applications of water quality monitoring, analysis and treatment. In addition, each of the centers also emphasizes student education and training by bringing together applied research by faculty, regional partnerships and student learning through internships.

Also, as part of the Northwest Indiana Computational Grid, the Rosen Center for Advanced Computing has established the Miner Computer Cluster at Purdue University Calumet in December, 2009, to foster more local, cutting-edge research and application in high performance computing. This computer cluster is a high performance network of supercomputers and data storage facilities that partners Purdue University Calumet, Purdue University West Lafayette, Notre Dame University, and the U. S. Department of Energy at Argonne National Laboratory. These centers currently employ about 15 Purdue Calumet graduate engineering students, many of whom are pursuing their thesis research for their MSE degrees in Interdisciplinary Engineering with ME specialization.

The Purdue Technology Center of Northwest Indiana, which opened in January, 2005 has been an impetus for many high technology companies with close ties to Purdue University Calumet. These companies offer internships and full time jobs to Purdue University Calumet graduates, with most offers going to engineering seniors, graduate students, and graduates.

With no other university providing graduate engineering programs in Northwest Indiana, offering focused master's degrees in Mechanical Engineering at Purdue University Calumet will help reach the strategic goals for the campus and also fulfill the need for a technologically sophisticated workforce for the region.

**b. State Rationale**

**Reaching Higher, Achieving More:** the proposed degree program aligns with the Commission's policy as stated in the Reaching Higher, Achieving More statement. By providing needed technical degrees to meet regional workforce needs, the proposed degree meets the goal of a workforce-aligned higher education system, and helps to increase higher education attainment.

**Regional Campus Policy** The proposed degree program fits within the Regional Campus Policy of the Commission for Higher Education, which provides, as to the missions of Indiana's Regional Campuses, that Regional Campuses may offer select masters programs to meet state and regional needs. (Regional Campus Policy, 3.) The proposed degree program fits within the Regional Campus policy, and meets the state Higher Education mission by providing advanced degrees to regional students to supply the workforce with STEM educated graduates.

## **c. Evidence of Labor Market Need:**

### **i. National, State or Regional Need**

The name of the new degree emphasizing the ME specialization will create more employment opportunities and better admission prospects for doctoral degree programs for our engineering graduate students.

The proposed MSME degree program provides advanced degree opportunities that are needed to meet the growing high technology employment in northwestern Indiana and southern suburbs of Chicago. As stated in the Regional Campus Policy, the primary geographic responsibility for Purdue University Calumet is the Northwest Indiana/Great Chicago Area.

Northwest Indiana is experiencing engineering and technological growth in all aspects of design, testing, manufacturing, research and development. Additionally, with a significant majority of Purdue Calumet engineers working in the greater Chicago area, there is a great demand for highly skilled and specialized mechanical engineers in the region. Furthermore, the local industries have been modernizing their facilities in response to globalization and international competition. As a result, companies such as BP Products North America, Whiting, Indiana, S\TEC Group, Hammond, IN, and Arcelor Mittal, Burns Harbor, Indiana have expressed their need for specialized graduate engineers.

As these high-tech companies mature, and other start-up companies take up their place at the Purdue Technology Center, the need for engineering master's degree holders with focused Concentrations will also grow.

Northwest Indiana is experiencing engineering and technological growth in all aspects of design, manufacturing, research and development. As a result, in recent years the region has witnessed an increase in demand for highly skilled electrical, computer, and mechanical engineers. During this time period the Engineering Graduate Program at Purdue University Calumet (PUC) has also grown exponentially in terms of number of students, course offerings, and disciplines. In response to this growth and to accurately reflect our constituents' demands, the PUC Engineering Graduate Program is proposing a Master of Science degree in Mechanical Engineering (MSME degree) program. Appendix B lists the graduate course descriptions.

Additionally, graduates of our existing Interdisciplinary Engineering Master's program who wish to pursue Ph.D. degrees in Mechanical Engineering face difficulties in receiving admission due to the Master's degree not being specifically awarded in ME. Separate Master's degrees with specific specialization as Master of Science degree in Mechanical Engineering can alleviate this problem. Employment opportunities for our graduates in specialized fields of Mechanical Engineering can also improve.

### **ii. Preparation for Graduate Programs or Other Benefits**

The proposed Master of Science degree in Mechanical Engineering will prepare students to work as professionals within the Mechanical engineering industry or to gain admission to Ph.D. programs. The proposed degree program can provide the opportunity for a nationally recognized graduate program in ME at PUC through a combination of theoretical and practical education that develops professional expertise of Mechanical Engineering graduates.

The proposed program focuses on the latest advances in Mechanical Engineering which will enhance the opportunities for prospective doctoral degree students. Many of the graduates of the PUC engineering program who prefer to stay and work in Northwest Indiana are employed within commuting distances from the high technology companies in the Greater Chicago area. These graduates will benefit greatly with the availability of advanced ME courses that will contribute to the graduates' professional growth and enhance their career advancement prospects. MSME degree program will provide a focused, specialized degree for PUC ME graduates who are interested in advancing to a doctoral degree program. The proposed degree program will enhance the professional skills of ME graduates employed in the Mechanical engineering industry in the Northwest Indiana/Chicago region. The program will provide opportunities for faculty to be engaged in the state of the art technologies in Mechanical engineering. The program will offer an enhanced set of dual level electives for undergraduate students in Mechanical engineering. Students in a focused graduate program, with or without thesis option, can collaborate with faculty for increased research and scholarship activities.

### **iii. Summary of Indiana Department of Workforce Development and/or U.S. Department of Labor Data**

Projections indicate that the demand for jobs in high-tech industries will continue to increase and such businesses will have a growing need for employees with advanced degrees. The Bureau of Labor Statistics (BLS) reports in its April 19, 2012 Occupational Outlook Handbook an employment growth rate of six percent for Mechanical Engineers ([www.bls.gov/ooh/architecture-and-engineering/mechanical-engineering-technicians.htm#tab-6](http://www.bls.gov/ooh/architecture-and-engineering/mechanical-engineering-technicians.htm#tab-6)). Further, a report from Georgetown University Center for Education and Workforce forecasts lower unemployment rate and higher earnings for graduate mechanical engineering degree holders compared with undergraduate degree holders (3.5 % versus 3.8 %)¹ (Appendix D). Consistent with the BLS report, many technology companies are now moving into the Northwest Indiana–South Chicago area, including several at the new Purdue Technology Center in Merrillville, Indiana.

In response to globalization and international competition, local industries have modernized their facilities, and now require specialized graduate engineers. The need for focused graduate degrees has also been advocated by the Engineering Advisory Board members (30 members representing 22 companies) and the leaders of local industries. Eighty percent (80%) of the respondents to the survey (see Appendix E for sample survey) voiced their support for specialized MSME degree program for Mechanical Engineering, and the companion MSECE degree program for Electrical and Computer Engineering at PUC.

The needs of local employers in regards to hiring of Mechanical and Electrical Engineering graduates with separate MSME or MSECE degrees were assessed in the survey of Northwest Indiana - Chicago Area companies. A questionnaire was sent to 31 of the area companies that employ PUC engineering graduates. All of the 17 respondents indicated a strong preference for MSME or MSECE degrees for their current and future employees and agreed that a Master of Science degree offering in ME or ECE at Purdue University Calumet will benefit their companies. It must be noted that several of these companies, including Sargent & Lundy, Arcelor Mittal, BP and NIPSCO, have been hiring many of the engineering graduates from Purdue University Calumet and they have plans to hire more engineers in the next five years.

Another survey conducted with the Engineering alumni of Purdue University Calumet showed a strong response for the preference of MSME or MSECE degrees as opposed to general MSE degrees. With all of

the surveyed alumni currently employed, they also indicated a strong preference on their employers' part to hire MSECE or MSME degree holders over MSE graduates. When the same survey was conducted with the current junior and senior Mechanical Engineering and Electrical and Computer Engineering students, there was almost a unanimous choice for the separate MSME and MSECE degree programs from those students planning to go for graduate degrees.

In addition, we have fielded many inquiries from employed engineering graduates about getting a master's degree in Mechanical Engineering so that they will have better opportunities to pursue a Ph.D. degree later. This is another (informal) indicator of demand for the MSME.

Based on the workforce forecasts and employer and alumni surveys, we strongly believe that the proposed MSME degree program will attract many ME graduates from the Northwest Indiana region and the surrounding southern suburbs of the Chicago area.

#### **iv. National, State, or Regional Studies**

With technological growth in all fields of Mechanical Engineering, a master's degree is increasingly becoming a requirement for gainful employment. Based on long-term occupational projections, as stated in above, Mechanical Engineering jobs will continue to experience significant growth through 2018. Purdue University Calumet is situated in Economic Growth Region (EGR) 1 within Indiana and is adjacent to the Chicago-Naperville-Joliet, IL Metropolitan Statistical District. Most of our students live and work in these two regions.

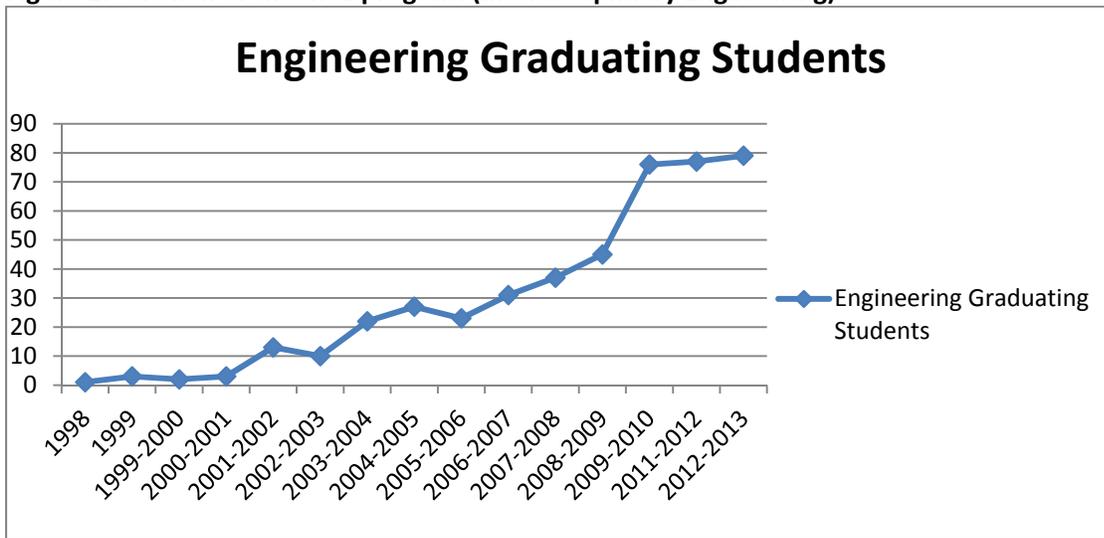
Based on enrollment data, from the growing enrollment in our MSE (IDE) program over the past 11 years and the preponderance of preference for the ME specialization by the MSE degree students, we expect the demand for MSME will continue to grow. Our proposed MSME degree is designed to broaden a student's knowledge in several fields of Mechanical Engineering. Our needs study and The Bureau of Labor Statistics report indicate that the demand for students with a graduate degree in ME will remain strong for a long time.

#### **v. Surveys of Employers or Students and Analysis of Job Postings**

Over the past 11 years, the number of engineering graduate students has grown from approximately 30 to 170 (see Fig. 1). The majority of these students have been interested in specialization in Mechanical Engineering or Electrical Engineering and, consequently, focused on taking courses and completing thesis work in ME or ECE within the interdisciplinary field of study offered at PUC. Fig. 2 shows this preference of students who graduated with the MSE degrees, with ME specialization noted on their diplomas, at PUC over the same 11 year period. As the figure indicates, only a handful of graduates opted to study general engineering and received their MSE (Interdisciplinary Engineering) degrees with no notation about their area of concentration.

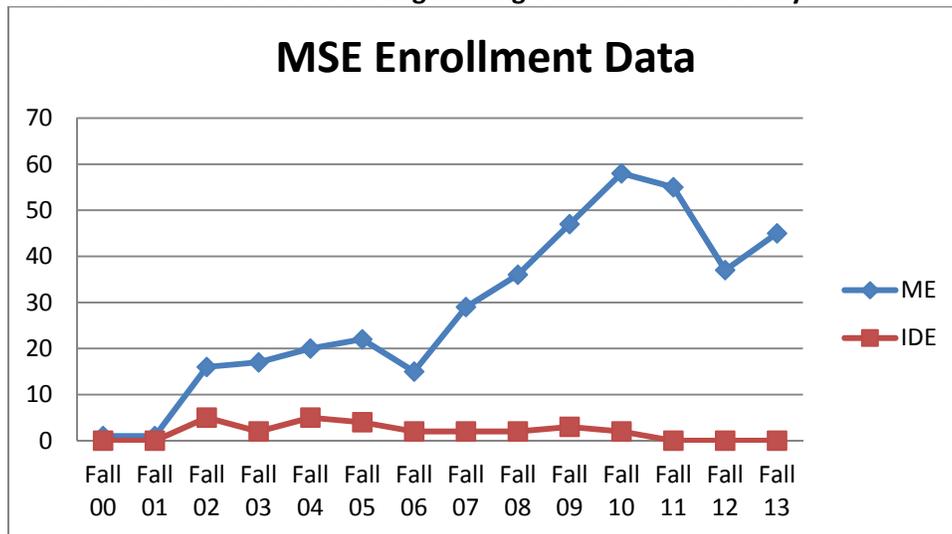
This focused MSME degree program will benefit the long-term growth of the Northwest Indiana community by enhancing its attractiveness to additional high technology corporations that rely on knowledge and innovation. The proposed program would also provide a pool of graduate students who can improve the research and funding opportunities for the PUC ME faculty.

**Figure 1. Growth of the MSE program (Interdisciplinary Engineering)\***



*\*Growth of PUC Engineering Graduate Program from Fall 2000 to Fall 2012 based on 'live' data*

**Figure 2: Preference of Enrolled Graduate Engineering Students for ME Study\***



*\*Preference of Enrolled Engineering Graduate Students who Focused in Completing Coursework and Thesis Options in ME over IDE from Fall 2000 to Fall 2013, based on 'live' data*

These charts are obtained from 'live' data based on Plan of Study (POS) information and the interest areas of enrolled students. Data showing headcounts and FTE for the ME concentration generated by the Office of Institutional Research are attached. (One of the possible reasons attributed to the decline

in graduate enrollment is the lack of MSME degree, which was cited by some students planning to pursue a Ph.D. degree after graduating with a BSME degree from Purdue University Calumet.)

**Table 2**  
**Data for Question # 6**  
**Projected Headcount and FTE Enrollment and Degrees Conferred**

	<b>Year #1</b> <b>FY 2014</b>	<b>Year # 2</b> <b>FY2015</b>	<b>Year # 3</b> <b>FY 2016</b>	<b>Year # 4</b> <b>FY 2017</b>	<b>Year # 5</b> <b>FY 2018</b>
Enrollment Projections (Headcount)	58	63	68	74	83
Enrollment Projections (FTE)	34.0	37.0	40.0	44.0	49.0
Degree Completions Projection	25	28	31	34	37

**vi. Letter of support.** Below are samples of support letters from Engineering Companies that hires PUC Engineering graduates:



**Charles J. Tilleman, P.E.**  
Site Engineering Authority



BP Products North America Inc.  
Whiting Refinery  
2815 Indianapolis Boulevard  
Whiting, Indiana 46394

February 3, 2011

Chenn Q. Zhou, Ph.D.  
Professor and Head of Mechanical Engineering Department  
Director of Center for Innovation through Visualization and Simulation (CIVS)  
Purdue University Calumet  
2200 169th Street  
Hammond, IN 46323

Dear Professor Zhou:

BP Whiting is proud to have 28 Purdue University - Calumet engineering graduates, including 5 with MS Engineering degrees, in our employ. We fully support your effort towards offering Master's degrees with focus and emphasis on ECE and ME. With more than 200 engineering graduates employed at Whiting, a local university offering discipline specific graduate degrees could be seen as desirable for advancing their engineering knowledge and career.

Best of luck in your efforts and please feel free to contact me if there is anything further that I can do to help you.

Charles J. Tilleman

Engineering Graduate programs  
PURDUE UNIVERSITY CALUMET

Company Name: ARCELORMITTAL BURNS HARBOR  
Address: 250 W. US HIGHWAY 12  
Telephone Number: 219 787 3081  
Email Address: dale.heinz@arcelormittal.com  
Your Name: DALE E. HEINZ

1. How many technical employees does your company have? ~ 100
2. How many employees have an engineering degree at the following levels?  
BS 15 MS 10 Ph.D. 2
3. For those with a BS degree, how many are working toward a general MS degree in engineering?  
NO ONE CURRENTLY.
4. How many of your employees might be interested in a separate MS degree in ECE or ME at Purdue Calumet, if available? SEVERAL
5. Would the existence of a separate MS degree in ECE or ME at Purdue Calumet make it easier for you to hire MS holders?  
Strongly yes \_\_\_\_\_ Yes  No \_\_\_\_\_ Don't Know \_\_\_\_\_
6. Would Purdue Calumet offering a separate Master of Science degree in ECE and ME benefit your company?  
Strongly yes \_\_\_\_\_ Yes  No \_\_\_\_\_ Don't Know \_\_\_\_\_
7. How many engineers with a graduate degree do you foresee to hire in the next five years? 25  
(ESTIMATED 5/YEAR)

Sample Survey Returned from an Engineering Company that hires PUC Engineering Graduates  
**Engineering Graduate programs**  
**PURDUE UNIVERSITY CALUMET**

Company Name: **S\TEC Group Inc. (Superior Engineering, LLC)**

Address: **2345 167<sup>th</sup> St.; Hammond, Indiana; 46323**\_\_\_\_\_

Telephone Number: **219 844 7030**\_\_\_\_\_

Email Address: **rlhunter@supereng.com**\_\_\_\_\_

Your Name: **Ronald Hunter**\_\_\_\_\_

1. How \_\_\_\_\_ many technical employees does your company have? **Approx 160** \_\_\_\_\_
2. How many employees have an engineering degree at the following levels?  
Estimate BS **40**\_\_\_\_ MS **10**\_\_\_\_ Ph.D. **0**\_\_\_\_\_
3. For those with a BS degree, how many are working toward a general MS degree in engineering?  
**Currently none**
4. How many of your employees might be interested in a separate MS degree in ECE or ME at Purdue Calumet, if available? Estimate 10 \_\_\_\_\_
5. Would the existence of a separate MS degree in ECE or ME at Purdue Calumet make it easier for you to hire MS holders?  
Strongly yes **\_\_X\_\_** Yes \_\_\_\_\_ No \_\_\_\_\_ Don't Know \_\_\_\_\_
6. Would Purdue Calumet offering a separate Master of Science degree in ECE and ME benefit your company? **I believe it would**  
Strongly yes **\_\_X\_\_** Yes \_\_\_\_\_ No \_\_\_\_\_ Don't Know \_\_\_\_\_
7. How many engineers with a graduate degree do you foresee to hire in the next five years? **8?**