PROPOSAL

GRADUATE CERTIFICATE

IN

TEACHING & LEARNING IN ENGINEERING

SUBMITTED BY:

SCHOOL OF ENGINEERING EDUCATION
COLLEGE OF ENGINEERING

PURDUE UNIVERSITY
WEST LAFAYETTE
Proposal for New Certificate Program
Teaching & Learning in Engineering

Graduate Certificate Title:
Teaching & Learning in Engineering

Name of Department and College/School Offering the Graduate Certificate:
Engineering Education
College of Engineering

Campus:
West Lafayette

APPROVALS:

David F. Radcliffe
Kamyar Haghighi Head, School of Engineering Education

Leah Jamieson
The John A. Edwardson Dean of Engineering, College of Engineering

See attached - signature page cont...

Mark J. T. Smith
Dean, Graduate School

Debasish Dutta
Executive Vice President for Academic Affairs and Provost

4/23/15
Date

7/2/15
Date
Signature Page Continued….  

Graduate School Dean  

9/25/15  

Date
Title of Certificate: Teaching & Learning in Engineering

Campus: PWL

Proposed Launch Date: Fall 2015 - Spring 2016

Level: Graduate

Method of Delivery: On Campus

CIP Code: 14.99
Overview

1. Overview

The graduate certificate program entitled Teaching and Learning in Engineering and to be offered by the School of Engineering Education (ENE) is designed to provide engineering graduate students with the theoretical underpinnings and practical experiences to be highly impactful college-level engineering educators. This certificate program entails 10 credit hours spread over four required courses: (1) a very practical course on best practices in engineering education [3 credit hours]; (2) a more theoretical course linking content, assessment and pedagogy in engineering education [3 credit hours]; (3) a course that puts teaching and learning in the context of the overall responsibilities of an engineering faculty member [3 credit hours]; (4) a mentored teaching experience in engineering [1 credit hour]; (5) attached completed Gainful Employment Certificate Worksheet); and (6) Description of the license – None.

Within ENE, this graduate certificate would extend and meaningfully package efforts to educate engineering graduate students about teaching in engineering. One element of the current effort is the Teaching Undergraduates for Learning Investment Program (TULIP) which is a Future Faculty Fellow program for advanced graduate students, selected for their demonstrated teaching and professional practice experiences, to lead sections of our first-year engineering (FYE) courses. In addition to their teaching responsibilities, which are supported by our FYE faculty and staff, the fellows attend monthly workshops on various teaching topics lead by an ENE faculty member. A second element of the current effort is ENE’s two 3-credit hour courses related to teaching practice, ENE 68500 – Educational Methods in Engineering and ENE 50600 - Content, Assessment And Pedagogy. These courses are targeted for inclusion in this graduate certificate program and are described below.

The graduate teaching certificate would significantly extend similar graduate teaching programs or requirements in the Schools of Engineering. For instance, in Chemical Engineering, all graduate students are required to serve as a Teaching Fellow and enroll in CHE 89700 Chemical Engineering Experience in Teaching, a 3-credit hour combination of practical teaching experience and a one-hour weekly class providing theory and reflection.

2. Justification

The purpose of this certificate program is to prepare engineering graduate students interested in academic careers for their future teaching responsibilities.

The need for this certificate stems from the fact that new engineering faculty, by and large, enter the academy underprepared for their roles as educators, as graduate programs in engineering focus primarily on research (Ambrose & Norman, 2006). The many national calls over the last 25 years for reform in engineering education speak to the need for faculty that are (1) equipped with research-informed strategies for teaching our near-future undergraduate and graduate engineering students and (2) enculturated to expand their skill set to teach our far-future undergraduate and graduate engineering students. Across all disciplines, not just engineering, it has been recognized that new faculty are not systematically prepared to employ powerful new strategies of teaching and learning, like cooperative learning, problem-based learning, and writing across the curriculum (Pruitt-Logan, Gaff, & Jentoft, 2002).
In addition, in response to national calls to increase the number of students educated in engineering, many institutions, such as Purdue University, are increasing the size of their undergraduate engineering programs. These institutions will need to hire additional engineering instructors. Purdue University will not only help the nation meet the need for well-prepared engineering instructors by offering the proposed graduate certificate program but will also give Purdue graduate students a competitive edge in faculty hiring processes.

The nature of this certificate is informed by the Preparing Future Faculty initiative. The lack of support graduate students receive in their preparation for academic careers led to the development of the Preparing Future Faculty (PFF) initiative in the early 1990s. The Council of Graduate Schools now supplies administrative support for over 300 existing PFF programs nationwide (http://www.preparing-faculty.org/PFFWeb.295.htm). “Increasingly independent and varied teaching responsibilities” is one of the three fundamental ideas of PFF (Pruitt-Logan, Gaff, & Jentoft, 2002, p. 4); the other two ideas are related to growth as a researcher and service experiences at the department, campus, and community levels. Within teaching preparation, the following are recommended: exposure to new teaching strategies and the changes going on in classrooms today, apprenticeship teaching experiences, and formal mentoring. A more recent recommendation is the inclusion of assessment of student learning (Council of Graduate Schools, 2011).

Ambrose and Norman (2006) suggest that faculty at a minimum must understand students, the basic principles of learning, and effective course design. Others suggest that effective teaching requires content (subject matter) knowledge, pedagogical (teaching strategies) knowledge, and pedagogical content (matching teaching strategies to subject matter) knowledge. Engineering students acquire content knowledge through their technical coursework and research. Pedagogical knowledge acquisition is possible through workshops and programs offered by university teaching excellence programs, like Purdue University’s Center for Instructional Excellence (CIE). What are often missing are mechanisms for graduate students to develop their pedagogical content knowledge. Inclusion of these mechanisms in a PFF program is recommended (Council of Graduate Schools, 2011).

A number of engineering education certificates of varying credit hours and focus exist at other universities. Among these are:


Education Research Methods; Practicum: Practicum in Engineering and Science Education; and Seminar: Engineering and Science Education Research Methods

- University of Cincinnati (UC), Preparing Future Faculty in Engineering & Applied Science, [http://www.ece.uc.edu/~ppfp/](http://www.ece.uc.edu/~ppfp/): Requirements (3 credit hours): Modern Teaching Techniques (seminar), Academic Profession (seminar), and Mentored Teaching (15+ hours). The certificate is for engineering and technology graduate students; 10-15 PhD students complete the certificate each year. The program claims to have increased number of UC graduate students pursuing academic career.


Teaching certificates specific to engineering are not offered by any of the 2014 top-ranked U.S. News & World Report Best Engineering Schools. A number of them do have engineering-specific teaching and learning programs or belong to the Center for the Integration of Research, Teaching and Learning (CIRTL) Network which offers various online courses focused on a wide variety of teaching topics (e.g. Cornell University, Michigan State University, and Texas A&M University). University of Texas – Austin has a workshop-based Teaching Assistant Certification Program. University of Michigan’s Center for Research on Learning and Teaching (CRLT) offers support for graduate student instructors and a certificate in engineering education research. A number of universities offer a single basic course in teaching engineering (e.g. Harvard University).

The target audience for Teaching and Learning in Engineering certificate program is doctoral students in the College of Engineering. Unlike the natural sciences, in which faculty candidates must generally complete postdocs before taking academic positions, in engineering, doctoral graduates often go directly to faculty positions. Therefore, programs to prepare future engineering faculty should be aimed at doctoral students rather than at postdocs. It is anticipated that 12 graduate students in the College of Engineering will complete the certificate each year.

While Purdue University’s Center for Instructional Excellence (CIE) provides a three-tiered non-course-based graduate teaching certificate program, it is not specific to engineering. The courses of this certificate program, and their assignments, can serve the dual purpose of fulfilling some of the requirements of a CIE Graduate Teacher Certificate. This has been discussed with CIE and meets with their approval.

3. Certificate Program Fit
The mission of the School of Engineering Education is nothing less than to ‘transform engineering education based on scholarship and research’. We aim to empower our own graduate students and those in other engineering disciplines to be agents of that transformation. The courses in the proposed certificate program provide students who wish to become faculty members with the tools they need to be change agents with respect to the employment of best teaching and learning practices in engineering. This certificate also helps us to realize the vision of the College of Engineering which says, in part, that we will empower our students to make a difference. As such, this certificate program fits in the School of Engineering Education’s plan to support the College of Engineering in preparing graduate students across the college with respect to the effective teaching of engineering. College of Engineering graduate students with this preparation will have an added edge in
the competitive market for assistant professor positions and will aid in their transition into academia. The successful placement and early careers of our students into academic positions reflects well on our students, their advisors, their departments, the College of Engineering, and Purdue University.

4. Nature of the Certificate

This is a course-based certificate for degree seeking graduate students in the College of Engineering. The four required courses will be offered by the School of Engineering Education in a face-to-face mode.

Admission Requirements

1. To be admitted into the certificate program, a student must have:

   - A bachelor’s degree from an accredited institution.
   - A minimum undergraduate GPA of 3.0/4.0 with the possibility of conditional admission for applicants who do not meet this requirement.
   - A Minimum TOEFL score of 550 or higher on the paper-based test, or 77 or higher on the Internet-based test (iBT) for applicants whose native language is not English. Applicants who take the TOEFL iBT must achieve the following minimum test scores, in addition to the overall required score of at least 77: reading, 19; listening, 14; speaking, 18, and writing, 18. Applicants taking the IELTS must score at least 6.5 on the Academic Module. Applicants taking the PTE must score at least 58.

2. A student must be enrolled in a graduate program in the College of Engineering to be admitted into and receive this certificate program. A graduate student majoring in Engineering Education or any other Engineering program at Purdue University may complete the certificate.

Completion Requirements

1. The certificate shall require a minimum of 10 credit hours.

2. A minimum of 10 credit hours must be taken for a letter grade.

3. The following courses are required for this certificate:

   ENE 68500 – Educational Methods in Engineering (3 credit hours)

   This course focuses on research-informed and very practical day-to-day aspects of teaching. The goals are to contribute to students’ preparation for the teaching aspect of the professorate and put them on path to being intellectually active in developing as a good teacher. Specifically, this course is designed to help students prepare for college teaching, expand students’ horizons about teaching, make students think about and reflect on teaching, and put students in touch with resources that can sustain their development as a good teacher. This course is also designed to provide a small amount of practice with a variety of teaching practices.

   This course has been offered since 1983 by Chemical Engineering and is now co-listed as ENE 69500 since 2013. The permanent ENE course number is now being sought from the Graduate Council. This course is not an ENE graduate requirement.
ENE 50600 - Content, Assessment And Pedagogy: An Integrated Engineering Design Approach (3 credit hours)

This course is designed to be a bridge between the student's previous experience with engineering (education, work, and teaching) and new engineering education research-based approaches. It is intended to help students apply an engineering design approach to the design of instruction. To meet this aim, the course involves an iterative project-based approach in a context (design site) that is chosen by the student for its relevance, interest and potential application.

This course has been offered since 2008 and is a requirement for graduate students in Engineering Education.

ENE 69500A – Succeeding as an Engineering Professor (3 credit hours)

This course is designed provide students with an opportunity to learn and practice the skills that complement and enhance teaching and learning in a tenure-track faculty position irrespective of the balance of research and teaching responsibilities. Teaching a course is only one aspect of helping students to learn. Obtaining funding for research, mentoring graduate and advanced undergraduate students, and building a network that continually provides new information related to doing the job well all contribute to a faculty member's ability to help students learn. In this course, students will learn how to prepare for and search for a faculty position, write proposals, mentor students, deal with many aspects of running a laboratory group or course, and build effective professional networks.

This course is being developed for the Teaching and Learning in Engineering graduate certificate program and is being offered under a temporary course number for the first time in Spring 2015. This course is not an ENE graduate requirement.

ENE 69500B – Mentored Teaching in Engineering (1 credit hour)

This course enables graduate students to deepen their understanding of college teaching and learning through a semester-long teaching experience with mentoring, feedback, and reflection. To enroll in this course, students must concurrently have a significant teaching responsibility for an engineering course. Teaching a section of one of the School of Engineering Education’s First Year Engineering Program courses is one possibility. Teaching a course in any of the College of Engineering schools is also possible.

This course is being developed for the Teaching and Learning in Engineering graduate certificate program and is being offered for the first time under a temporary course number in Spring 2015. This course is not an ENE graduate requirement.

4. Students must earn a minimum overall GPA of 3.0 for courses used to fulfill certificate requirements. A minimum grade of B- must be earned in each of the four required courses.

5. A maximum of 3 credits may be transferred from another institution for coursework determined by the School of Engineering Education to be equivalent to the required coursework for this certificate.
6. No credits may be used from undergraduate-level courses.

7. The certificate must be completed within 7 years of a student being admitted to the Graduate School.

8. Courses used to satisfy the requirements for this certificate may not be used towards the completion of another certificate.

9. A total of 10 credits may be taken prior to admission to the certificate program and counted towards completion of the certificate.

**Student Learning and Assessment Outcomes**

Students who complete this certificate will be prepared to:

- Access, critically evaluate, and integrate research-based best practices for teaching and learning in engineering (ENE 68500, ENE 69500B)
- Select, justify, and implement a variety of appropriate and research-based instructional methods (ENE 68500, ENE 69500B)
- Critically evaluate engineering classroom practices in terms of student differences, motivation, and intended learning (ENE 68500, ENE 69500B)
- Analyze evidence of student learning (69500B)
- Use reflection, mentoring, and student feedback to learn from teaching experiences (ENE 66500, 69500B)
- Develop and articulate an engineering design approach for content, assessment, and pedagogy (ENE 50600)
- Critically describe the research-based features of content, assessment, and pedagogy (ENE 50600)
- Apply the principles and theories to the design of a unit of instruction and course (ENE 50600, ENE 68500)
- Identify ethical issues in teaching situations (69500B)
- Reflect on one's own teaching practice (ENE 68500, ENE 69500B)
- Articulate a personal statement of teaching goals, methods, and philosophy (ENE 68500)
- Assemble a teaching portfolio that highlights the quality and scholarship of one's own teaching in a public form, for possible peer review (69500B)
- Write a personal development plan for preparing for a faculty position (ENE 69500A)
- Identify potential sources of funding for research and write a proposal (ENE 69500A)
- Comfortably and effectively work with, mentor, and teach individuals from a wide range of cultures and teach their students to do the same (ENE 69500A)
- Develop a laboratory course, including emphasis on effective presentation of the material, grading and providing feedback to students, and laboratory safety (ENE 69500A)
- Select and mentor graduate students - or undergraduates working in the research lab, as individuals and as a group (ENE 69500A)
- Make effective use of professional organizations and conferences to expand their professional network (ENE 69500A)

**Administration**

1. The admission process will parallel that for degree-seeking students at the graduate level.
2. To facilitate the tracking of students who are enrolled in the certificate program, the Office of the Registrar will establish a special admission status for each individual.

3. When a student completes requirements for a certificate, the School of Engineering Education will notify the Graduate School. The audit process for certifying completion of requirements is the responsibility of the School of Engineering Education, as we would be the academic unit awarding the certificate. The audit will include (a) the title of the certificate, (b) the department/school awarding the certificate, (c) the name of the student including PUID, (d) student status, i.e. degree or non-degree student including PUID, (e) the complete name of each course, including course prefix and number, (f) the grade in each course, and (g) the semester and year each course is completed. The Graduate School will then notify the Office of the Registrar.

4. Transcripting
   
a. Transcripting will be consistent with the other graduate certificate programs in the Purdue system.
   
b. Each certificate earned will be posted separately upon completion of the requirements.
   
c. The graduate certificate will be recorded in the following manner:

   | Awarded:          | Graduate Certificate          |
   | Program:          | Engineering Education – Grad Cert |
   | College:          | Graduate School                |
   | Campus:           | West Lafayette                 |
   | Major:            | Teaching & Learning in Engineering |

   d. Credits earned toward the certificate will be included in the computation of the overall GPA posted on the transcript.

5. The certificate will be printed by the Office of the Registrar and will share the common format and style as all certificates under the purview of the Graduate School.

6. The certificate will be awarded jointly by the School of Engineering Education and the Graduate School. It will bear the signature of the Head of Engineering Education and the Dean of the Graduate School.

7. The certificate will be awarded at the normal times when degrees are awarded. The Office of the Registrar will include the certificate with the diploma for degree seeking students.

8. The School of Engineering Education will submit an annual report to the Graduate Council containing the following information:

   a. The number of students currently admitted to the certificate program
   b. For each student admitted:
      • Date admitted
      • Whether or not the student is also currently admitted to a degree program at Purdue, and if so, which degree
      • Number of credits completed toward fulfillment of certificate requirements
c. The number of certificates awarded annually

The Office of the Registrar will assist in generating this information.


Purdue University Gainful Employment (GE) Certificate Worksheet

TO BE COMPLETED BY DEPARTMENT HEAD TO DETERMINE TITLE IV FEDERAL STUDENT AID ELIGIBILITY FOR CERTIFICATE PROGRAMS

NAME OF PROGRAM: Graduate Certificate Program: Teaching & Learning in Engineering

DEPARTMENT: School of Engineering Education  
SCHOOL/COLLEGE: Engineering

The following checklist includes the requirements of certificate programs at postsecondary institutions that could be considered Gainful Employment Programs. A program eligible to participate in Title IV federal student aid would be considered a Gainful Employment Program if it is a certificate only and prepares students for "gainful employment in a recognized occupation." A review and documentation of GE requirements for each certificate program is essential prior to awarding federal student aid. Failure to comply may jeopardize Purdue University's eligibility to award federal student financial aid or take part in other programs under the Higher Education Act. Final approval for eligibility is determined by the U.S. Department of Education.

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<tr>
<th>QUESTION</th>
<th>ELIGIBILITY CRITERIA</th>
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<tr>
<td>1. Is this a certificate program?</td>
<td><strong>Yes</strong> <em>No</em></td>
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<td><em><strong>If you answered &quot;No&quot; to this question, STOP HERE. Sign and return this document as instructed.</strong></em></td>
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<td>2. Would this certificate alone prepare a student for gainful employment in a recognized occupation?</td>
<td><strong>Yes</strong> <em>No</em></td>
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<td>(The Department of Labor's Standard Occupational Code (SOC) must be provided to show the occupation that the program prepares students to enter and can be found on the Department of Labor's O*NET website - <a href="http://www.onetonline.org">http://www.onetonline.org</a>)</td>
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<td><em><strong>If you answered &quot;No&quot; to No. 2 and do not have an SOC - STOP HERE. Sign and Return this document as instructed. Certificate is not considered Gainful Employment</strong></em></td>
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<tr>
<td>3. Is the program a one-year minimum training program that leads to a degree (or other recognized educational credential) and prepares students for gainful employment in a recognized occupation?</td>
<td><strong>Yes</strong> <em>No (Certificate only)</em></td>
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<td>Circle ONE: <em>Degree ONLY</em> <em>Degree PLUS Certificate</em></td>
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<td><em>Certificate ONLY</em></td>
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<td>If YES, describe how this program prepares the student for gainful employment:</td>
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<td>CIP Code of certificate program:</td>
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<td><em><strong>If you answered &quot;No&quot; to all of the above - STOP HERE. Sign and return document as instructed. Certificate is not eligible for Gainful Employment</strong></em></td>
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</table>
If you answered "Yes" to No. 2 on page one, please complete the detailed program eligibility information requested below. When completed, sign and return as instructed. If you have any questions, you may contact Stephanie Fiddler in the Division of Financial Aid by email at sfiddler@purdue.edu or by phone at 49-45090.

### Detailed Program Eligibility Information

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<th>AREA OF REVIEW</th>
<th>ELIGIBILITY CRITERIA</th>
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<tr>
<td>Academic Year Definition Requirements</td>
<td>Number of weeks of instructional time per academic year for this program: ___ In an academic year, a full-time student must complete at least ___ semester hours.</td>
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(NOTE: Federal regulations define academic year as a period of a minimum of 30 weeks of instructional time. In an academic year, a week of instructional time is any week in which at least one day of regularly scheduled instruction or examination occurs, or at least one day of study for exams for final exams if it occurs after the last scheduled day of classes for the semester. Instructional time does not include periods of orientation, counseling, vacation, or any other activity not related to class preparation or examinations. Internships, cooperative education, and independent study are forms of instruction that may be included in the definition of academic year. For an undergraduate educational program, an academic year is a period a full-time student must complete at least 24 semester hours.)

The length of the program is ___ academic years. (Federal regulations require that the program length is at least two academic years and provides an associate, baccalaureate, graduate, or professional degree or a one-year training program that leads to a degree or certificate (or other recognized educational credential) and prepares students for gainful employment in a recognized occupation.)

**Department Head (please attach a Program of Study documenting the following):**
- Each course within the program is acceptable for full credit toward Purdue University's associate, bachelor, graduate, or professional degree.
- **OR** -
- This program is a minimum of 9 credit hours (not to exceed 30 credit hours) and prepares students for gainful employment in the same or related recognized occupation as an educational program that has previously been designated as an eligible program at Purdue University, West Lafayette.

| Document(s) Required | Attach a copy of the program of study, the program's certificate approval by the Faculty Senate or Grad Council and Provost's Office, and the approval from the Indiana Commission for Higher Education (ICHE) and/or Higher Learning Commission (HLC), if applicable. (Approvals on file in the Office of the Provost, Dean of Graduate School, or Grad Council) |

*Signature: Department Head*

4/27/15

*Date*

*When Completed Return to:*

Executive Director
Division of Financial Aid, Purdue University
475 Stadium Mall Drive, Schollman Hall 305
West Lafayette, IN 47907-2050

*Office Use: This program is ___ eligible [ ] ineligible for Title IV funding as a GE Program.*

*Signature: Executive Director of Financial Aid*

7/16/15

*Date*