January 29, 2013

Ken Sauer, Ph.D.
Senior Associate Commissioner for Research and Academic Affairs
Indiana Commission for Higher Education
101 W. Ohio Street, Suite 550
Indianapolis, IN 47204-1984

Dear Ken,

I am pleased to request routine staff action for two Graduate Certificates submitted for Indiana University Purdue University Indianapolis. Both of these Graduate Certificates are constituted of courses from an existing, already-approved degree program. Both Certificate programs have been reviewed by Purdue's Graduate School.

The two Certificate Programs are:

Hybrid Electric Vehicle Technology – CIP 141901
Energy Management and Assessment – CIP 141901

Both Graduate Certificates are offered by the Department of Mechanical Engineering in the School of Engineering and Technology at Indiana University Purdue University Indianapolis.

Please let me know if you have any questions.

Best wishes,

Tim Sands
Executive Vice President for Academic Affairs and Provost
MEMO

TO: T. D. Sands, Executive Vice President for Academic Affairs and Provost
FROM: MJT Smith, Dean
DATE: January 17, 2013
SUBJECT: Graduate Certificate in Hybrid Electric Vehicle Technology, IUPUI

The enclosed proposal for a new Graduate Certificate in Hybrid Electric Vehicle Technology, to be administered by the Department of Mechanical Engineering, at Purdue University Indianapolis, was recommended for approval by the Graduate Council on November 15, 2012.

I am pleased to add my own endorsement to the proposal and hope that you can endorse it and transmit it to the president for approval by the Indiana Commission for Higher Education.

A few major points about the attached proposal:

- The Graduate Certificate in Hybrid Electric Vehicle Technology is designed to address industry's increased needs for engineers who have expertise in EV/HEV/PHEV. It will prepare today's engineers to be competitive in taking on the new challenges facing the industry so that our Indiana companies can compete globally.
- The purpose of this new graduate-certificate program in mechanical engineering is to enable engineers to become certified in EV/HEV/PHEV technology without formally pursuing a graduate degree.
- Development of the next generation of fuel-efficient and environmentally-responsible advanced electric drive vehicles is one of the nation’s top priorities. The State of Indiana plays a major role in the design, development, and manufacturing of these types of vehicles, such as electric vehicle (EV), hybrid electric vehicle (HEV) or plug-in hybrid electric vehicle (PHEV), or their components. Today there are numerous Indiana companies that participate in various aspects of vehicle electrification. This is a very technically intensive and competitive field that requires multidisciplinary approaches. It is imperative that Indiana has adequately trained workforce that can take up on this challenge and provide leadership in this growing technological field.

Please let me know if you have any questions about this recommendation for a Graduate Certificate in Hybrid Electric Vehicle Technology from the Department of Mechanical Engineering at Purdue University Indianapolis.

Enclosure

Copies: M. Razi Nalim, Candiss Vibbert, Diane Beaudoin, Phil Pope

MJTS/tlp

Young Hall, Room 160 • 155 S. Grant Street • West Lafayette, IN 47907-2114
(765) 494-2604 • Fax: (765) 494-0136 • mjts@purdue.edu • www.gradschool.purdue.edu
GRADUATE CERTIFICATE PROGRAM

HYBRID ELECTRIC VEHICLE TECHNOLOGY

SUBMITTED BY

DEPARTMENT OF MECHANICAL ENGINEERING

SCHOOL OF ENGINEERING AND TECHNOLOGY

PURDUE UNIVERSITY

INDIANAPOLIS CAMPUS

RECEIVED IN THE GRADUATE SCHOOL

4/26/12

WILL BE REVIEWED BY THE GRADUATE COUNCIL IN PARALLEL WITH NEW COURSE REQUESTS WHICH WERE RECEIVED IN OCTOBER 2012
Signature Page

Graduate Certificate Title: **Hybrid Electric Vehicle Technology Certificate**

Name of Department and College/School Offering the Graduate Certificate:
**Department of Mechanical Engineering**
**School of Engineering and Technology**

Campus: **IUPUI**

**REQUIRED APPROVALS:**

Jie Chen
Chair
Department of Mechanical Engineering

M. Razi Nalim
Associate Dean for Research and Graduate Programs
School of Engineering and Technology

David J. Russomanno
Dean
School of Engineering and Technology

Mark J. Smith
Dean
Purdue University Graduate School

Executive Vice President for Academic Affairs and Provost
Request for a New Graduate Certificate Program

Purdue School of Engineering and Technology, IUPUI

Hybrid Electric Vehicle Technology Certificate
To be offered as a Purdue Certificate at IUPUI

October 21, 2011
Rev: Dec.12, 2011
Rev Jan 11, 2012

Purpose of the program

Development of the next generation of fuel-efficient and environmentally-responsible advanced electric drive vehicles is one of the nation’s top priorities. The State of Indiana plays a major role in the design, development, and manufacturing of these types of vehicles, such as electric vehicle (EV), hybrid electric vehicle (HEV) or plug-in hybrid electric vehicle (PHEV), or their components. Today there are numerous Indiana companies that participate in various aspects of vehicle electrification. This is a very technically intensive and competitive field that requires multidisciplinary approaches. It is imperative that Indiana has adequately trained workforce that can take up on this challenge and provide leadership in this growing technological field.

The Departments of Mechanical Engineering and Electrical and Computer Engineering, Purdue School of Engineering and Technology, IUPUI have been developing and developed a number of courses that cover the fundamentals of advanced electric and hybrid electric drives as well as the key components. These graduate level courses aim at providing EV/HEV discipline specific training to existing engineers to make a smooth and effective transition to the new area. In this document, a curriculum for a Hybrid Electric Vehicle Technology Certificate (HEVTC) program is presented.

This certificate program is designed to address industry’s increased needs for engineers who have expertise in EV/HEV/PHEV. It will prepare today’s engineers to be competitive in taking on the new challenges facing the industry so that our Indiana companies can compete globally.

The purpose of this new graduate certificate program in mechanical engineering is to enable engineers to become certified in EV/HEV/PHEV technology without formally pursuing a graduate degree. The certificate will provide a core set of courses on HEV transportation, hybrid electric propulsion systems, energy storage devices and system, and powertrain integration. Also, the students are allowed to select two courses in related engineering disciplines. Students completing this certificate will be able to understand the foundations of the EV/HEV/PHEV and to use the knowledge combined with previous engineering training to serve the respective companies effectively.

The certificate is being proposed as a Purdue University certificate that would appear on a student’s transcript upon completion.
Relation to existing certificate programs

Currently, there is no certificate program in “Hybrid Electric Vehicle Technology” area available on the IUPUI campus. It is not anticipated that similar certificate programs would be developed by other disciplines in engineering and sciences.

The target audience

Indiana is a manufacturing state, which has significant amount of automotive/transportation related manufacturing companies such as Delphi, General Motor, Allison Transmission, Think City, Cummins, Chrysler, Remy International, EnerDel, Rolls-Royce Corporation, and their suppliers. The trend to have more fuel efficient powertrains has pushed these companies to consider hybrid drivetrain systems. It is anticipated that practicing engineers who joined the workforce after bachelor’s degree would be interested in obtaining training on these new technologies in order for them to be current in solving complex hybrid drive related problems. The proposed certificate program will provide them with the required technical skills.

After completing the certificate program, Students may choose the option of applying to the M.S. program in Mechanical Engineering (MSME) or M.S. program in Electrical and Computer Engineering (MSECE) with the courses taken during the certificate program transferred.

Plan for sustaining steady-state enrollment

In the first year starting Fall 2012, five to ten students will likely participate in the program. It is anticipated that this number will rise rapidly to 15 to 20 students per year in the next two to three years, as the awareness of the program increases. The potential exists for much greater growth beyond this in subsequent years.

New resources

The required infrastructure (computers and software) needed to support the certificate program is already in place in the Departments of Mechanical Engineering and Electrical and Computer Engineering. The graduate level courses will continue to be taught by the faculties in both Departments and can be used for the degree programs. Therefore, the certificate program can be offered with no additional demands for faculty or facilities.

Proposed date of the initiation of the certificate program

Proposed date of implementation is Fall 2012, assuming all necessary approvals have been obtained.

Persons designated as the certificate program head

Dr. Sohel Anwar, Associate Professor, Department of Mechanical Engineering will serve as the program director.

Dr. Jie Chen, Professor and Chair of Mechanical Engineering, Dr. Yaobin Chen, Professor and Chair of Electrical and Computer Engineering will provide the administrative oversight of the program.

Faculty initially involved in the program and their credentials
HEVTC Program

Dr. Jie Chen
Professor and Chair
Department of Mechanical Engineering
Research and Teaching Interests: System design and simulation, engineering design, energy storage, and solid mechanics.

Dr. Sohel Anwar
Associate Professor of Mechanical Engineering
Research and Teaching Interests: Hybrid and Electric Vehicle Design / Control, Mechatronics / Robotics, Vehicle active safety system design, Fault tolerant control, Drive-By-Wire, Autonomous vehicles

Dr. Yaobin Chen
Professor and Chair
Department of Electrical and Computer Engineering
Research and Teaching Interests: Modeling, simulation, optimization and control of advanced automotive systems, intelligent transportation and vehicle systems, computational intelligence applications.

Dr. Jian Xie
Assistant Professor of Mechanical Engineering

Dr. Maher Rizkalla
Professor and Associate Chair
Department of Electrical and Computer Engineering
Research and Teaching Interests: Applied superconductivity, solid state electronics, VLSI signal processing and electronics manufacturing.

Dr. Likun Zhu
Assistant Professor of Mechanical Engineering

Dr. Tamer Wasfy
Associate Professor of Mechanical Engineering
Research and Teaching Interests: Computational mechanics, Flexible multi-body dynamics, Computational fluid dynamics, Fluid-structure interaction, Virtual-reality for scientific visualization, Kinematics, Dynamics and Vibrations.

Admissions requirements and procedures

In order to be eligible to this certificate program, the students must have a bachelor’s degree in an area which provides the necessary mathematical preparation for an engineering degree with a recommended minimum GPA of 3.0 out of 4.0. Applicants with non-engineering degrees, including mathematics, physical sciences, and engineering technology, may be required to take undergraduate mechanical engineering courses before admission to the program. Appropriate work experience also will be taken into account in making decisions about admission. Students will be required to submit a statement of interest and three letters of recommendation.
Students admitted directly to the Purdue University graduate program can be considered for this certificate program, provided the student formally applies for the certificate program and receives admission. Courses completed under certificate program are not automatically transferred to a graduate degree program, unless the student makes a petition to the graduate committee in respective departments.

Completion requirements and audit and certification procedures

a. Requirements for the certificate program

Total requirement: 12 credit hours.

It is not necessary to be admitted to the Graduate School to earn the certificate. However, at most twelve hours of course work taken prior to admission to Graduate School can be counted towards a graduate degree provided that the admission requirements are met. Thus, decision to apply to Graduate School by qualified students should be made at an earlier time in order not to lose credits. Credits earned in the certificate program with a grade of B or better may be applied towards the Master's degree subject to approval by the Graduate Committee in the respective departments. After completion of the certificate, students are encouraged to apply to the Masters program of their respective disciplines and are encouraged to request the transfer of credits earned in the certificate to this Masters program.

To earn a certificate, the students admitted to this certificate program are required to complete twelve credit hours of graduate courses. There are courses in the primary and related areas. The certificate requires selection of at least two courses in the primary area and the rest in related area.

The primary area courses consist of:

- ME 59700 Hybrid and Electric Transportation
- ECE 59500 Advanced Electric and Hybrid Vehicle Systems
- ME 59700 Dynamics and Simulation of Hybrid-electric vehicles
- ME 59700 Energy Storage Devices and Systems
- ME 59700 Powertrain Integration
- ECE 61000 Energy Conversion (required for students in ECE)

The related courses include:

- ME 50400 Automotive Control
- ME 59700 Renewable Energy and Fuel Cells
- ECE 59500 Automotive Control (dual listed with ME 50400, cannot be taken with ME 50400)
- ECE 59500 Introduction to Smart Grid Theory and Implementation
- ECE 58000 Optimization Methods for Systems and Control

Substitutions to the above courses are possible with approval of the Graduate Committee of the Department.

Minimum overall GPA

Successful completion of the certificate requires at least a B average over all courses counting towards the certificate. Courses with a grade of C- or less must be taken again to count towards the certificate. The minimum grade that will be accepted in any single course is C.
Maximum number of credits that can be transferred from another institution

Applicants who have already earned credit for one or more of the equivalent courses from other institutions and other certificate programs may request to apply up to a maximum of three credits of these courses toward this certificate. Any waivers or substitutions have to be approved by the graduate committee that oversees the program.

Maximum number of undergraduate courses that can be applied

No undergraduate courses can be applied to this certificate program.

Maximum time for completion

All requirements for the certificate must be completed within three years. Most students enrolled in this program will be part-time students, employed full time. Thus two years may be needed for the completion of all courses if the participating student takes one course per semester.

Number of credit hours taken prior to admission to the certificate program that may be counted to completion of the degree

Up to 6 equivalent credit hours taken prior to admission to the certificate program, including 3 hours taken from another institution may be counted towards the certificate. The rest of the courses must be completed at IUPUI within three-year period from the time of admission.

Course lists for the program including course descriptions

The majority of the graduate courses are offered in late afternoon hours to accommodate the needs of part-time students. In addition, a number of course lectures may be available online via video streaming. The following list contains the catalog description of the courses.

**ME 59700 - Hybrid and electric transportation (3) Class: 3 Lab: 0 Rec: 0**

This course will cover fundamentals of hybrid electric and battery electric transportation systems with particular emphasis on automotive vehicles. It will cover basic powertrain configurations of Hybrid Electric Vehicle (HEV), Plug-in Hybrid Electric Vehicle (PHEV), and Battery Electric Vehicle (BEV). The principal elements of these powertrain will be discussed: Battery, Electric Motor, Engine, Transmission.

**ME 59700 Dynamics and Simulation of Hybrid-electric vehicles (3) Class: 3 Lab: 0**

The aim of this course is to teach students advanced multi-body dynamics and finite element computational techniques that can be used to predict the dynamic response of passenger cars with emphasis on hybrid electric vehicles. The vehicle geometry will be created using advanced solid modeling CAD software. The geometry will then be imported into high fidelity multi-body dynamics/finite element software to create computational models of the various vehicle components, including: chassis, tires, suspension system, steering system, drive-train, transmission system, electric drive (including motor and batteries), gas engine, regenerative braking system and electric generator system. The computational models consist of rigid bodies and flexible bodies that are connected using various types of joints. Flexible bodies can be modeled using solid, shell or beam elements. Joints include
spherical, revolute, cylindrical and prismatic joints. In addition, the rigid/flexible bodies can come into frictional contact.

ME 50400 Automotive Control (3) Class: 3 Lab: 0 Rec: 0

Concepts of automotive control. Electro-mechanical systems that are controlled by electronic control modules via an appropriate algorithm (such as fuel injection timing control, emission control, transmission clutch control, anti-lock brake control, traction control, stability control, etc.). In-depth coverage on modeling and control of these automotive systems. MATLAB/SIMULINK modeling and simulation.

ME 59700 Renewable Energy and Fuel Cells (3) Class: 3 Lab: 0 Rec: 0

This course intends to provide engineers and students with a comprehensive yet practical guide to the characteristics, principles of operation, and power potential of the most dominant renewable energy systems, including solar energy, wind turbines, battery and fuel cells, biomass, geothermal energy and hydropower. The course focuses on the engineering and design of alternative energy systems. Students will learn details of renewable energy storage devices, with special emphasis on batteries and fuel cells, through hands-on project assignments.

ME 59700 Powertrain Integration (3) Class: 3 Lab: 0 Rec: 0

The holistic view of powertrain development that includes engine, transmission, and driveline is now well accepted. Current trends indicate an increasing range of engines and transmissions in the future with, consequently, a greater diversity of combinations. Coupled with the increasing introduction of hybrid vehicles, the scope for research, novel developments and new products is clear. This course discusses engines, transmissions, and drivelines in relation to their interfaces with chassis systems. This course also explores the concept to market evolution as well as powertrain and chassis integration.

ME 59700 Energy Storage Devices and Systems (3) Class: 3 Lab: 0 Rec: 0

Fundamental principles of battery science and engineering (battery reactions, charge and mass transport in batteries, battery safety, battery management, and materials development in the batteries, battery system designs and integrations), current state-of-the-art battery technology and the current technical challenges on the development of batteries, codes and standards for safe handling of batteries.

ECE 58000 Optimization Methods for Systems and Control (3) Class: 3 Lab: 0 Rec: 0

Introduction to optimization theory and methods, with applications in systems and control. Nonlinear unconstrained optimization, linear programming, nonlinear constrained optimization, various algorithms and search methods for optimization, and their analysis. Advanced topics such as optimization using neural networks and genetic algorithms are included. Examples from various engineering applications are given.

ECE 59500 Advanced Electric and Hybrid Vehicle Systems (3) Class: 3 Lab: 0 Rec: 0

This course provides students with theoretical and design foundation to understand various aspects of operations and control of hybrid and electric vehicle (HEV) systems. The course covers dynamic modeling, simulation, control, and optimization of key HEV powertrain components and subsystems such as internal combustion engine, electric motor, energy storage devices and systems, batteries, and vehicle. Various design methods for HEV energy management systems and battery management modules are presented. Advanced control
techniques for electric motor/generator, battery system, regenerative braking and other subsystems are discussed.

**ECE 59500 Automotive Control (3) Class: 3 Lab: 0 Rec: 0**
This course is dual listed with ME 50400.

**ECE 59500 Introduction to Smart Grid Theory and Implementation (3) Class: 3 Lab: 0 Rec: 0**
Electrical power system infrastructure and American national electricity policy; electrical transmission system operations; power system reliability; electricity market design and operation; Smart grid technologies – distributed generation, demand response, advanced meter infrastructure; Smart grid standards development – interconnection, interoperability and cyber security; Smart grid impact on power system reliability and electricity market

**ECE 61000 Energy Conversion (3) Class: 3 Lab: 0**
Basic principles of static and electromechanical energy conversion. Control of static power converters. Reference frame theory applied to the analysis of rotating devices. Analysis and dynamic characteristics of induction and synchronous machines. State variable analysis of electromechanical devices and converter supplied electromechanical drive systems.

**Procedures for governing the program including construction of committees that will provide oversight**

A committee comprised of Dr. Jie Chen, Dr. Sohel Anwar, and Dr. Yaobin Chen will jointly oversee the program. All advising will be done by participating faculty members listed in this document. The Department of Mechanical Engineering will take responsibility for all record keeping and tracking of students.

**Procedures for program evaluation including the criteria for success**

Upon completion of the program, exit interviews will be conducted for all students to determine the effectiveness of the program in meeting their needs and to identify how they are using the skills and tools learned in the program in their professions. Follow-up interviews will be conducted after three and five years. Given the projected enrollment of this program, and the fact that many of the graduates will remain employed locally, it is anticipated that most students will be tracked this way.

Success of the program will be defined in terms of demand (enrollment) and the responses of the students surveyed upon completion of their degree and in the follow-up interviews.
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:  Hybrid Electric Vehicle Technology Certificate

DEPARTMENT:  Mechanical Engineering  SCHOOL/COLLEGE:  Purdue School of Engineering and Technology, IUPUI

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.

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>ELIGIBILITY CRITERIA</th>
</tr>
</thead>
</table>
| 1. Is this a certificate program? | _X_ Yes  _No  
***If you answered "No" to this question, STOP HERE. Sign and return this document as instructed. |
| 2. Would this certificate alone prepare a student for gainful employment in a recognized occupation? | _X_ Yes  _No  
If "Yes," list the Standard Occupation Code (SOC):  17-2141.02, 17-2199.05  
(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 - http://www.onetonline.org)  
***If you answered "No" to No. 2 and do not have an SOC - STOP HERE. Sign and Return this document as instructed. Certificate is not considered Gainful Employment*** |
| 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? | _Yes  _X_ No (Certificate only)  
Circle ONE: °Degree ONLY  °Certificate ONLY  °Degree PLUS Certificate  
If YES, describe how this program prepares the student for gainful employment:  
______________________________________________________________  
______________________________________________________________  
CIP Code of certificate program ____________________________  
***If you answered "No" to all of the above - STOP HERE. Sign and return document as instructed. Certificate is not eligible for Gainful Employment*** |
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

<table>
<thead>
<tr>
<th>AREA OF REVIEW</th>
<th>ELIGIBILITY CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Year Definition Requirements</td>
<td>Number of weeks of instructional time per academic year for this program: <strong>50</strong>. In an academic year, a full-time student must complete at least 5 semester hours.</td>
</tr>
</tbody>
</table>

(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 or 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, 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 **one** academic years. (Federal regulations require that the program length is at least two academic years and provides an associate, bachelors, 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, bachelors, 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 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

**Signature**: Department Head  
**Date**: 10/1/2012

When Completed Return to:  
**Executive Director**  
Division of Financial Aid, Purdue University  
475 Stadium Mall Drive, Sobeck Hall 355  
West Lafayette, IN 47907-2050

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

**Signature**: Executive Director of Financial Aid  
**Date**: [Signature]
TO: T. D. Sands, Executive Vice President for Academic Affairs and Provost
FROM: MJT Smith, Dean
DATE: January 16, 2013
SUBJECT: Graduate Certificate in Energy Management and Assessment, IUPUI

The enclosed proposal for a new Graduate Certificate in Energy Management and Assessment, to be administered by the Department of Mechanical Engineering, at Purdue University Indianapolis, was recommended for approval by the Graduate Council on November 15, 2012.

I am pleased to add my own endorsement to the proposal and hope that you can endorse it and transmit it to the president for approval by the Indiana Commission for Higher Education.

A few major points about the attached proposal:

- The Graduate Certificate in Energy Management and Assessment is designed to address industry's increased needs for engineers who have expertise in energy management and efficiency. It will prepare today's engineers to be competitive in taking on the new challenges of energy efficiency facing industry so that our Indiana companies can compete globally.
- The purpose of this new graduate-certificate program in mechanical engineering is to enable engineers to become certified in energy assessment without formally pursuing a graduate degree. The certificate will provide a core set of courses on energy management, industrial process, and energy assessment tools.
- Experts in energy efficiency will be greatly needed for improving energy efficiency, energy auditing, and Superior Energy Performance (SEP) certification. There is an urgency to train our engineering workforce to be industrial energy efficiency experts and to educate our industrial leaders to be more energy conscious.

Please let me know if you have any questions about this recommendation for a Graduate Certificate in Energy Management and Assessment from the Department of Mechanical Engineering at Purdue University Indianapolis.

Enclosure

Copies: M. Razi Nalim, Candiss Vibbert, Diane Beaudoin, Phil Pope

MJTS/tlp
GRADUATE CERTIFICATE PROGRAM

ENERGY MANAGEMENT AND ASSESSMENT

SUBMITTED BY

DEPARTMENT OF MECHANICAL ENGINEERING

SCHOOL OF ENGINEERING AND TECHNOLOGY

PURDUE UNIVERSITY

INDIANAPOLIS CAMPUS

RECEIVED IN THE GRADUATE SCHOOL

4/26/12
Signature Page

Graduate Certificate Title: Energy Management and Assessment Certificate

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

Campus: IUPUI

REQUIRED APPROVALS:

Jie Chen
Chair
Department of Mechanical Engineering

M. Razi Nalim
Associate Dean for Research and Graduate Programs
School of Engineering and Technology

David J. Russomanno
Dean
School of Engineering and Technology

Mark J. Smith
Dean
Purdue University Graduate School

Executive Vice President for Academic Affairs and Provost
Request for a New Graduate Certificate Program

Purdue School of Engineering and Technology, IUPUI

Energy Management and Assessment Certificate

To be offered as a Purdue Certificate at IUPUI

Jan. 7, 2012

Purpose of the program

The potential benefits of energy efficiency are tremendous. According to the National Action Plan for Energy Efficiency, more than half of expected growth in demand for electricity and natural gas can be avoided over the next 15 years. Globally, new energy efficiency standard, ISO 50001, has been established and implemented. Accordingly, the Department of Energy (DOE) has developed Superior Energy Performance (SEP) criteria. The companies certified by the ISO 50001 may be granted with the SEP status, which will give the companies tremendous advantages to do business globally. The implementation of this new standard and concept requires a workforce with an expertise in energy management and efficiency. Experts in energy efficiency will be greatly needed for improving energy efficiency, energy auditing, and SEP certification. There is an urgency to train our engineering workforce to be industrial energy efficiency experts and to educate our industrial leaders to be more energy conscious.

The Departments of Mechanical Engineering, Purdue School of Engineering and Technology, IUPUI has established a Bachelor of Science in Energy Engineering (BSEEN) program. Recently, an Industrial Assessment Center (IAC) sponsored by DOE has been established at IUPUI aimed at creating the next generation energy engineers possessing a unique mixture of engineering and energy management expertise, combined with hands-on experience obtained by working directly with small and medium sized industrial and manufacturing facilities. The center has been developing a number of courses that cover the fundamentals of energy management and energy assessment. These graduate level courses provide discipline specific training to existing undergraduate/graduate students and engineers to make a smooth and effective transition to the new area. In this document, a curriculum for an Energy Management and Assessment Certificate (EMAC) program is presented. This program is in partial fulfillment of the IAC’s objectives.

This certificate program is designed to address industry’s increased needs for engineers who have expertise in energy management and efficiency. It will prepare today’s engineers to be competitive in taking on the new challenges of energy efficiency facing industry so that our Indiana companies can compete globally.

The purpose of this new graduate-certificate program in mechanical engineering is to enable engineers to become certified in energy assessment without formally pursuing a graduate degree. The certificate will provide a core set of courses on energy management, industrial process, and energy assessment tools. Also, the students are required to do real world energy assessments for companies. Students completing this certificate will be able to understand the foundations of energy assessment, standards, and
EMAC Program

management and to use the knowledge combined with previous engineering training to serve the respective companies effectively.

The certificate is being proposed as a Purdue University certificate that would appear on a student’s transcript upon completion.

Relation to existing certificate programs

Currently, there is no certificate program in “Energy Management and Assessment” area available on the IUPUI campus. It is not anticipated that similar certificate programs would be developed by other disciplines in engineering and sciences.

The target audience

Indiana is a manufacturing state, which has significant amount of various sized manufacturing companies such as Delphi, General Motor, Allison Transmission, Think City, Cummins, Chrysler, Remy International, EnerDel, Rolls-Royce Corporation, Eli Lilly and Company, and their suppliers. The new ISO 50001 standard and SEP status require these companies to develop energy management plans and processes for energy efficiency, which require engineers trained in energy management and assessment. It is anticipated that both our students and practicing engineers who joined the workforce after bachelor’s degree would be interested in obtaining training on these new technologies. The proposed certificate program will provide them with the required technical skills.

After completing the certificate program, Students may choose the option of applying to the M.S. program in Mechanical Engineering (MSME) with the courses taken during the certificate program transferred.

Plan for sustaining steady-state enrollment

In the first year starting Fall 2012, five to ten students will likely participate in the program. It is anticipated that this number will rise rapidly to 15 students per year in the next five years, as the awareness of the program increases. The potential exists for much greater growth beyond this in subsequent years.

New resources

The required infrastructure (energy assessment equipment, computers and software) needed to support the certificate program is already in place in the DOE Industrial Assessment Center in the Departments of Mechanical Engineering. The graduate level courses will be taught by the faculties in the School of Engineering and Technology and can be used for other degree programs. Therefore, the certificate program can be offered with no additional demands for faculty or facilities.

Proposed date of the initiation of the certificate program

Proposed date of implementation is Fall 2012, assuming all necessary approvals have been obtained.

Person designated as the certificate program head

Dr. Jie Chen, Professor and Chair of Mechanical Engineering will serve as the program director.
EMAC Program

Faculty initially involved in the program and their credentials

Dr. Jie Chen
Professor and Chair
Department of Mechanical Engineering
Research and Teaching Interests: System design and simulation, engineering design, energy storage, and solid mechanics.

Dr. Ali Razban
Senior Lecturer
Department of Mechanical Engineering

Dr. David Goodman
Assistant Professor of Electrical & Computer Engineering Technology
Research and Teaching interests: Energy Assessment, Renewable Energy.

Dr. Sohel Anwar
Associate Professor of Mechanical Engineering
Research and Teaching Interests: Hybrid and Electric Vehicle Design / Control, Mechatronics / Robotics, Vehicle active safety system design, Fault tolerant control, Drive-By-Wire, Autonomous vehicles

Dr. Jian Xie
Assistant Professor of Mechanical Engineering

Admissions requirements and procedures

In order to be eligible to this certificate program, the students must have a bachelor's degree in an area which provides the necessary mathematical preparation for an engineering degree with a recommended minimum GPA of 3.0 out of 4.0. Students who are seniors in the BSME program or enrolled in the MSME degree program with a cumulative GPA above 3.0 may also join the program. Appropriate work experience also will be taken into account in making decisions about admission. Students will be required to submit a statement of interest and two letters of recommendation.

Students admitted directly to the Purdue University graduate program can be considered for this certificate program, provided the student formally applies for the certificate program and receives admission. Courses completed under certificate program are not automatically transferred to a graduate degree program, unless the student makes a petition to the graduate committee of the department.

Completion requirements, audit and certification procedures

a. Requirements for the certificate program

Total requirement: 12 credit hours.
It is not necessary to be admitted to the Graduate School to earn the certificate. However, at most twelve hours of course work taken prior to admission to Graduate School can be counted towards a graduate degree provided that the admission requirements are met. Thus, decision to apply to Graduate School by qualified students should be made at an earlier time in order not to lose credits. Credits earned in the certificate program with a grade of B or better may be applied towards the Master’s degree subject to approval by the Graduate Education and Research Committee in the department.

To earn a certificate, the students admitted to this certificate program are required to complete twelve credit hours of graduate courses. There are four courses specifically designed for the program.

The courses consist of:

- ME59700 Fundamentals of energy assessment tools
- ME59700 Energy assessment industrial processes
- ME59700 Energy Management Principles
- ME59700 Assessment projects

Substitutions to the above courses are possible with approval of the Graduate Education and Research Committee of the Department.

**Minimum overall GPA**

Successful completion of the certificate requires at least a B average over all courses counting towards the certificate. Courses with a grade of C- or less must be taken again to count towards the certificate. The minimum grade that will be accepted in any single course is C.

**Maximum number of credits that can be transferred from another institution**

Applicants who have already earned credit for one or more of the equivalent courses from other institutions and other certificate programs may request to apply up to a maximum of three credits of these courses toward this certificate. Any waivers or substitutions have to be approved by the graduate committee that oversees the program.

**Maximum number of undergraduate courses that can be applied**

No undergraduate courses can be applied to this certificate program.

**Maximum time for completion**

All requirements for the certificate must be completed within three years. Two years may be needed for a part-time student to complete the courses if the participating student takes one course per semester.

**Number of credit hours taken prior to admission to the certificate program that may be counted to completion of the degree**

Up to 6 equivalent credit hours taken prior to admission to the certificate program including 3 hours taken from another institution may be counted towards the certificate. The rest of the courses must be completed at IUPUI within two-year period from the time of admission.
Course lists for the program including course descriptions

The majority of the graduate courses are offered in late afternoon hours to accommodate the needs of part-time students. In addition, a number of course lectures may be available online via video streaming. The following list contains the catalog description of the courses.

ME 59700 – Fundamentals of energy assessment (3) Class: 3 Lab: 0 Rec: 0
This course is a comprehensive course in energy assessment and covers the wide-range of available energy assessment tools and theoretical foundation (or underlying principles/theory). Tools include assessment tools used by DOE, industry and other Industrial Assessment Centers.

ME 59700 - Energy Assessment Industrial Processes (3) Class: 3 Lab: 0
This course covers common industrial and energy assessment processes. It teaches the skills for auditing and analyzing the efficiency of a company’s energy usage, cost savings, and other prevalent industrial systems.

ME 59700 - Energy Management Principles (3) Class: 3 Lab: 0 Rec: 0
This course covers energy management principles and their real world applications including: understanding utility billing and identifying costs; identifying and quantifying energy savings opportunities at industrial facilities; determining investment payback scenarios and considerations.

ME 59700 Assessment projects (3) Class: 0 Lab: 3 Rec: 0
This is a project-based course in energy assessment and audit. Students are trained to go through the entire energy assessment process by participating in real-world company energy assessments. Energy analyses, assessment recommendations, site visits, and audit report are performed.

Procedures for governing the program including construction of committees that will provide oversight

A committee comprised of Dr. Jie Chen, Dr. Ali Razban, and Dr. David Goodman will jointly oversee the program. All advising will be done by participating faculty members listed in this document. The Department of Mechanical Engineering will take responsibility for all record keeping and tracking of students.

Procedures for program evaluation including the criteria for success

Upon completion of the program, exit interviews will be conducted for all students to determine the effectiveness of the program in meeting their needs and to identify how they are using the skills and tools learned in the program in their professions. Follow-up interviews will be conducted after three and five years. Given the projected enrollment of this program, and the fact that many of the graduates will remain employed locally, it is anticipated that most students will be tracked this way.

Success of the program will be defined in terms of demand (enrollment) and the responses of the students surveyed upon completion of their degree and in the follow-up interviews.
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: Energy Management and Assessment Certificate

DEPARTMENT: Mechanical Engineering SCHOOL/COLLEGE: Purdue School of Engineering and Technology, IUPUI

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.

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>ELIGIBILITY CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Is this a certificate program?</td>
<td><strong>X</strong> Yes  _ _ No</td>
</tr>
<tr>
<td>2. Would this certificate alone prepare a student for gainful employment in a recognized occupation?</td>
<td><strong>X</strong> Yes  _ _ No</td>
</tr>
</tbody>
</table>

If "Yes," list the Standard Occupation Code (SOC): _13-1199.01________

(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 - http://www.onetonline.org)

***If you answered "No" to No. 2 and do not have an SOC - STOP HERE. Sign and Return this document as instructed. Certificate is not considered Gainful Employment***

| 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? | **_**Yes  **X** No (Certificate only) |
| Circle ONE: -- Degree ONLY  -- Degree PLUS Certificate  -- Certificate ONLY |
| If YES, describe how this program prepares the student for gainful employment: |
|                                                                                         |
|                                                                                         |
| CIP Code of certificate program _____________________________________________________ |

***If you answered "No" to all of the above - STOP HERE. Sign and return document as instructed. Certificate is not eligible for Gainful Employment***
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

<table>
<thead>
<tr>
<th>AREA OF REVIEW</th>
<th>ELIGIBILITY CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic Year Definition Requirements</td>
<td>Number of weeks of instructional time per academic year for this program: 30</td>
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<tr>
<td></td>
<td>In an academic year, a full-time student must complete at least 2 semester hours.</td>
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<td>(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.)</td>
</tr>
<tr>
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<td>The length of the program is One academic years. (Federal regulations require that the program length is at least two academic years and provides an associate, bachelors, 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.)</td>
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<tr>
<td></td>
<td>Department Head (please attach a Program of Study documenting the following):</td>
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<tr>
<td></td>
<td>- Each course within the program is acceptable for full credit toward Purdue University's associate, bachelor, graduate, or professional degree.</td>
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<td>- OR -</td>
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<tr>
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<td>- 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.</td>
</tr>
</tbody>
</table>

**Document(s) Required**

Attach a copy of the program of study, the program 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)

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**Signature: Department Head**

10/1/2012  

**When Completed Return to:**

Executive Director  
Division of Financial Aid, Purdue University  
475 Stadium Mall Drive, Schliman Hall 303  
West Lafayette, IN 47907-2050

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

**Signature: Executive Director of Financial Aid**

10/4/12