

ENERGY AND MINERAL ENGINEERING (EME)

GRADUATE PROGRAM GUIDE

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COLLEGE OF EARTH AND MINERAL SCIENCES

THE PENNSYLVANIA STATE UNIVERSITY

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EDUCATIONAL MISSION STATEMENT

Cognizant of the unique mission of Penn State in the Commonwealth and the Nation, our program endeavors to produce graduates who are capable of becoming productive and responsible citizens in the modern globalized society. The education provided encompasses the full breadth of the discipline of Energy and Mineral Engineering and includes technical content, interactive and participatory learning, as well as a consistent reinforcement of the skills and virtues required of a successful professional.

The most important asset we bring to this mission is our faculty. We will leverage the rich background, the academic experience and the research accomplishments of our faculty by making appropriate use of research results in the classroom. In this endeavor, the primary focus is on the student. Through uniform admission standards, professional advising and mentoring, and consistent and high expectations, we lead the students, through lecture and example, toward our common goal of life as a professional in the globalized society of the 21st century.

EDUCATIONAL OBJECTIVES

As a result, our graduates will:

- I. Be able to apply fundamentals of science and engineering to energy and mineral engineering analysis and design in an efficient, economic and safe manner.
- II. Demonstrate the ability to operate in a modern, diverse job environment in which they will work in multidisciplinary teams on interdisciplinary problems, communicate effectively and recognize the global, social and ethical contexts of their work.
- III. Be able to apply their educational experience to a wide variety of career paths in industry, academia or government, recognizing that in any career path continuing education and learning are essential.
- IV. Exhibit the ability to use appropriate information technology for the solution of technological problems, presentations and communication.
- V. Be able to apply scientific and engineering principles to the safe, efficient, economic, and environmentally responsible recovery, processing, and utilization of earth resources.

REGULATIONS SUBJECT TO CHANGE

The educational process requires constant change. This manual must be considered as informational and not binding on the University. Each step of the educational process, from admission through graduation, requires continuous review and appropriate approval by University officials. The University, therefore, reserves the right to change the requirements and regulations contained in this guide, and to determine whether a student has satisfactorily met his/her requirements for admission or graduation.

YOUR ACADEMIC FILE

Upon your admission to the Energy and Mineral Engineering graduate program, an official file folder is established for you. The file contains all information concerning your academic progress in the Department. The file is kept up-to-date by the Department Graduate Program Office in 110 Hosler Bldg., and is considered an official document of the Department.

Graduate Program in
Energy and Mineral Engineering (EME)
College of Earth and Mineral Sciences

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Graduate Bulletin Copy

Graduate Program in
Energy and Mineral Engineering (EME)

1. OBJECTIVES

1.1 INTRODUCTION

The Energy and Mineral Engineering graduate program provides flexible education of students in energy and mineral sciences and engineering. The program is designed to resolve the sometimes competing goals of flexible education of requisite breadth while still providing in-depth study; students are required to follow a flexible curriculum of quantitative courses in the applied physical sciences, with an integrative learning experience. The curriculum thus combines the requisite rigor with flexibility in a rapidly changing field of endeavor. The program provides research concentration options in petroleum and natural gas engineering (PNGE), mining and mineral process engineering (MMPE), environmental health and safety engineering (EHSE), fuel science (FSC), and energy management and policy (EMP). Students are not required to choose an option.

1.2 OPPORTUNITIES FOR STUDENTS WITH VARIED BACKGROUNDS

This program adds to current graduate opportunities in the EMS College and at Penn State by enabling students to integrate coursework from a wide variety of science and engineering disciplines into an engineering degree that places particular emphasis on earth resources with particular focus on energy and minerals.

1.3 EMPLOYMENT OPPORTUNITIES

The de facto professional qualification for career advancement in the globalized economy of the 21st century is a graduate degree. A variety of career options exist for recipients of a graduate degree in Energy and Mineral Engineering with or without specialty options in petroleum and natural gas engineering, mining and mineral process engineering, environmental health and safety engineering, fuel science, and energy management and policy.

- They are employed by large multinational corporations to explore, produce, process and utilize energy and mineral resources; identify, monitor and reduce emissions and discharges to ensure compliance with environmental regulations; trouble-shoot problems; design and manage energy and mineral requirements in a safe, efficient and environmentally friendly manner; design or manage fuels and mineral processing and waste handling procedures; supervise recycling and multiple-use activities, and control health and safety hazards in the workplace.
- They are employed by consulting companies in planning and design associated with energy, and mineral utilization and conservation, environmental preservation and restoration and industrial health and safety. Included are companies specializing in energy and mineral

exploration, production, processing and utilization; energy efficiency, environmental protection, restoration and pollution monitoring, analysis and control, recycling and site restoration and industrial health and safety.

- They are employed by government agencies at federal, state, regional and urban levels to provide expertise in the development, implementation and enforcement of energy and mineral and occupational health and safety policies.
- They are employed as professors in engineering and applied science programs, and as researchers in government or corporate labs.

1.4 ACQUIRED SKILLS

Students completing this program will acquire capability in the following:

- Core competency in chemical and physical principles that are the foundation of energy and mineral engineering, and in their applications to practical engineering situations.
- Integrative skills derived from collaborative learning courses, including the completion of team projects and development of oral and visual communication skills.
- Broad understanding of how specific engineering disciplines fit within the broader context of energy and mineral engineering issues and their economic impact and evaluation.
- Practical qualification and state-of-the-art research methodology training of interest to employers in the energy and mineral and related fields.

1.5 WHAT IS UNIQUE ABOUT PENN STATE'S PROGRAM IN EME?

This Program provides a formal structure for a strong tradition of education and research in energy and mineral sciences and engineering in the Department of Energy & Mineral Engineering at Penn State. The Program is a merger between the existing programs in Petroleum and Mineral Engineering and Energy and Geo-Environmental Engineering under a unifying theme, and with common educational objectives and coursework. The Program's focus on the safe, sustainable, and efficient utilization of energy and minerals is unique to Penn State and the Nation.

Participating students take core program and required option courses and additional courses, in consultation with their advisor and committee, from a broad array of courses to meet the required total credits. Thus, the program is designed to be flexible to promote and result in the breadth and depth necessary to meet the needs and challenges of the energy and mineral industries. Some of these courses involve team-focused learning experience. Students are not required to choose an option. However, students who desire disciplinary identity of their research concentration area, may choose from the available five options - petroleum and natural gas engineering, mining and mineral process engineering, environmental health and safety engineering, fuel science, and energy management and policy.

Graduate Program in
Energy and Mineral Engineering (EME)

2. PROCEDURES

2.1 INTRODUCTION

Energy and Mineral Engineering graduate studies at Penn State are based on a flexible program designed to meet the diverse needs of students involved in a variety of research projects. The core requirements are kept to a minimum and the students are given a wide choice in developing their own program of study. To facilitate this process, this handbook contains a description of all the existing program requirements. Additional regulations and requirements of Penn State's Graduate School are described in the Graduate Bulletin, [http://www.psu.edu/bulletins/whitebook/\\$gradreqs.htm](http://www.psu.edu/bulletins/whitebook/$gradreqs.htm), and the Thesis Guide, <http://www.gradsch.psu.edu/enroll/thesisguide.html>.

Both M.S. and Ph.D. students are required to demonstrate competency in core areas, to undertake additional relevant coursework, and to complete a research thesis. A program outline is included in Figure 1. Core competency is established by taking core program and required option courses and a minimum number of required total credits from a broad array of courses.

The Graduate Program Officer provides preliminary advising to all entering students, if necessary. The Program Officer may assign this advising role to graduate faculty within the program. During their first semester, all students meet with their advisor, or with the Program Officer, to discuss their initial courses, thesis topic, and the composition of their thesis committee. Students entering the program with an M.S. degree obtained at another institution may request that their courses be evaluated for potential equivalence to Penn State courses. Once a student selects a thesis topic, his/her thesis advisor is primarily responsible for all the advising.

In designing their program of study, students should pay particular attention to the opportunities for teaching, participation in program and department seminars, and graduate student colloquia. International students should pay attention to any required English language tests or course requirements. Also, students should plan ahead their M.S. Thesis Defense, Ph.D. Candidacy Examination, English Competency Test, Oral Ph.D. Comprehensive Examination, Regular Reviews of Student Progress, and Final Ph.D. Thesis Defense Examination. Each one of these milestone events will have to be officially scheduled by the program (see attached forms starting on p.39)

The policies described in this booklet are those currently in force. They are subject to change as the EME discipline and our graduate programs continue to evolve. Students have to make sure they satisfy all the requirements in force at the time of their admission to the graduate program. Students should consult the Program Officer or Graduate Program Staff Assistant for additional information related to program requirements. Common policies and procedures are set at the program level for all students. Thus, there are no separate administrative structures, policies or guidelines for students in an option. An option only provides a research concentration area.

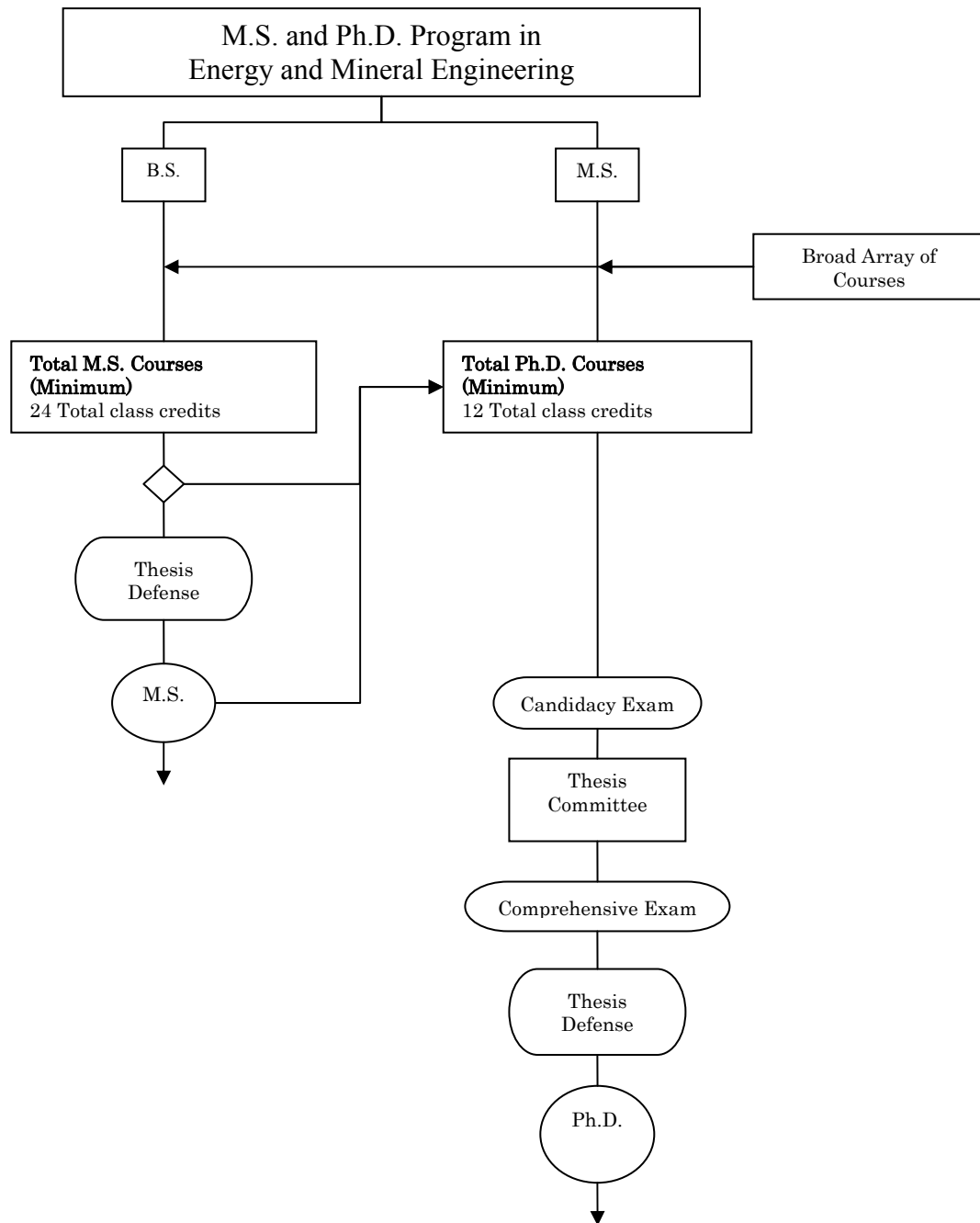


Figure 1: Course requirements and sequencing for the M.S. and Ph.D. degrees in Energy and Mineral Engineering. At least 18 of the required course credits for the M.S. and Ph.D. degrees must be at the 500-level.

2.2 ADMISSION REQUIREMENTS

Scores from the Graduate Record Examination (GRE) are required for admission, though this may be waived at the discretion of the Energy and Mineral Engineering graduate program. The best-qualified applicants will be accepted by the Energy and Mineral Engineering graduate program up to the number of spaces available for new students. At the discretion of the Energy and Mineral Engineering graduate program, a student may be granted provisional admission. Requirements listed here are in addition to general Graduate School requirements stated in the GENERAL INFORMATION section of the *Graduate Bulletin*. Admission to the Energy and Mineral Engineering graduate program in the Department of Energy and Mineral Engineering is competitive. Entering students must hold a bachelor's degree in a science or engineering discipline. Students with junior/senior cumulative grade-point average of 3.00 or better (out of 4.0) and appropriate course backgrounds will be considered for admission. Exceptions to the minimum 3.00 grade-point average may be made for students with special backgrounds, abilities and interests. Undergraduate students from the Department of Energy and Mineral Engineering with sixth semester standing, minimum grade-point average of 3.3, and excellent faculty recommendations may be admitted for a five-year B.S./M.S. dual degree. The language of instruction at Penn State is English. International applicants must take and submit scores for the TOEFL (Test of English as a Foreign Language) or the IELTS (International English Language Testing System), with the exceptions noted below. The minimum acceptable score for the TOEFL is 550 for the paper-based test, 213 for the computer-based test, or a total score of 80 with a 20 on the speaking section for the Internet-based test (iBT). Applicants with iBT speaking scores between 15 and 19 may be considered for provisional admission, which requires an institutional test of English proficiency upon first enrollment and, if necessary, remedial course work. The minimum composite score for the IELTS is 6.5. Specific graduate programs may have more stringent requirements. International applicants are exempt from the TOEFL/IELTS requirement who have received a baccalaureate or a master's degree from a college/university/institution in any of the following: Australia, Belize, British Caribbean and British West Indies, Canada (except Quebec), England, Guyana, Republic of Ireland, Liberia, New Zealand, Northern Ireland, Scotland, the United States, and Wales. Letters of recommendation and a statement of purpose written by the applicant are also required.

2.3 STUDENT'S THESIS COMMITTEE

The student's program of study will be guided by his/her advisor in consultation with the Thesis Committee. Following an initial period on campus, the student will select a research supervisor (thesis advisor). Incoming students may already have been in contact with a professor on the program faculty, and may have arranged to work with that person as a thesis advisor. Once selected, the thesis advisor and the student will select a Thesis Committee, which is then approved by the Program Officer. This should normally take place within the student's first year on campus. For M.S. students, it is recommended for this to be done in the student's first semester to enable completion of requirements in two years. In the case of Ph.D. students, a Thesis Committee should be formed only after passing the Candidacy Exam.

The committee will meet with the student by the end of the student's first year in the Program and approve the outline of the proposed research project prepared by the student in consultation

with the thesis advisor. Throughout the course of the graduate study, the student is encouraged to schedule meetings with individual members of the Thesis Committee to report progress and seek advice, as needed. Regular reviews of student progress will be conducted with the advisor at least once a year.

2.4 FINANCIAL SUPPORT AND APPOINTMENTS

Types of Appointments -- Graduate students may receive appointments as Research Assistants, Teaching Assistants, Fellows and/or Scholars. The normal appointment offered to new graduate students in the EME Program is a Graduate Assistantship. The Graduate Assistantship requires the student to carry out research that culminates in a thesis satisfying the requirements for a graduate degree. All graduate students are encouraged to acquire some teaching experience as part of their degree requirements, and they may, therefore, serve as Teaching Assistants for one or more semesters. Fellowships and Scholarships are also available. These are offered to continuing as well as incoming graduate students on a merit basis. Evaluation of graduate student credentials and Fellowship/Scholarship decisions are made by the Department or College. Students are encouraged to visit the following website to apply:

<http://www.gradsch.psu.edu/fellow/>

Graduate Assistantships -- Appointments are based on superior ability and promise of excellence. Reappointment to an assistantship is contingent upon availability of positions and funding, and demonstrated quality of the student's work.

Quarter-Time -- The student normally schedules 9-14 credits per semester, receives a stipend plus a grant-in-aid of resident education tuition, and performs tasks that, on average, occupy approximately ten hours per week.

Half-Time -- The student normally schedules 9-12 credits per semester, receives a stipend plus a grant-in-aid of resident education tuition, and performs tasks that, on average, occupy approximately twenty hours per week.

Three-Quarter-Time -- The student normally schedules 6-8 credits per semester, receives a stipend plus a grant-in-aid of resident education tuition, and performs tasks that, on average, occupy approximately thirty hours per week.

Fellowships/Scholarships -- These are awarded by the Graduate School, the College or the Department to a limited number of scholastically outstanding students. Fellows and Scholars receive a stipend plus payment of tuition. They are required to enroll as full-time students – please visit the following website for additional information:

<http://www.gradsch.psu.edu/fellow/fellowships.html>

Credit Load and Hours of Service -- The credit load allowed and hours of service required under various appointments as established by the Graduate School are tabulated below.

| Appointment | Credit Load Allowed per Semester | | Service Hours/Week |
|-------------------------------|-------------------------------------|--------------------|-----------------------|
| | <u>Summer</u> | <u>Fall/Spring</u> | |
| None (Full-Time Student) | 3 (min) | 9 (min) | 0 |
| ¼-Time Graduate Assistantship | 5-7 | 9-14 | 10 |
| ½-Time Graduate Assistantship | 4-6 | 9-12 | 20 |
| ¾-Time Graduate Assistantship | 3-5 | 6-8 | 30 |
| Fellowship/Scholarship | 3 (min) | 9 (min) | 0 |

It should be noted that, while the academic semester lasts 15 weeks, service under a graduate assistantship is required for 18 weeks or an equivalent number of hours. For example, a half-time graduate assistantship requires 360 hours of service in one semester. For a graduate student on a teaching assignment, this work will involve instructional activities in the program.

A graduate student who is required to register for a certain minimum number of credits is not permitted to count audited course credits toward the minimum credits needed. The student may register for credit or audit beyond the required minimum, but may not exceed the normal maximum without special permission (see Graduate Degree Programs Bulletin, Penn State University, 2002-04).

Vacation Time -- Graduate assistants are appointed for 18 weeks of work for each semester, and typically an additional 12 weeks during the summer. They are entitled to a total of four weeks of vacation during the calendar year.

Schedule of Stipend Payments -- Assistantship, Fellowship and Scholarship stipends are paid monthly. For the Fall semester, graduate assistants will be paid 1/5 of the semester stipend at the end of August, September, October, November and December. For the Spring semester, graduate assistants will receive 1/5 of the semester stipend at the end of January, February, March, April and May. For the Summer session, graduate assistants will be paid 1/2 of the stipend at the end of June and July.

Residence Time Limits on Stipends -- The EME Graduate Program has established upper limits for the time duration over which financial support will be awarded to graduate students. B.S. students entering the graduate program are expected to obtain their M.S. degree in two years and their Ph.D. degree after three additional years. Students entering the program with M.S. degrees are expected to obtain their Ph.D. degree in four years. The program may terminate the support of the graduate student after the prescribed number of years. In the case of special circumstances, a funding extension request can be approved at the discretion of the student's advisor.

Financial Aid for Self-Supporting Students -- All self-supporting graduate students desiring financial aid from the program may request such consideration at any time. Such financial support is contingent upon program resources, and is awarded on a competitive basis among all applicants. In the event financial aid is not granted to a self-supporting student, he/she may request review of his/her case tri-annually, at the end of each semester or summer session. In the latter case, the student's course grades will be considered, along with the advisor's recommendation.

The term "self-supporting" refers only to those students whose support comes from private individuals such as themselves, families, relatives, or friends. It does not include students who are supported by organizations such as companies, other universities, governments, or private scholarships or fellowships. These latter students will be included in the broader category of non-departmentally supported students.

If program resources permit, the applications of non-departmentally supported students for supplemental financial aid will be considered. These funds will be awarded on the basis of demonstrated need (in consultation with the Office of International Students in the case of foreign students) if the stipend being received is less than that obtained with the normal program mode of support. The awarding of such support will be according to the procedure outlined above for self-supporting students.

Students holding graduate assistantships may not accept any other employment without the concurrence of their advisor and the Program Officer.

Income Tax and Assistantships -- Graduate assistants are taxed by the borough or township in which they currently reside, at the rate applied to all local earned income. In addition, graduate assistant residents of some boroughs or townships may pay an annual occupation privilege and/or occupational assessment tax. There is also a Commonwealth of Pennsylvania tax on gross income that must be paid by all graduate assistants. Federal taxes are withheld by the University from assistantship paychecks. Students on assistantships will receive a W-2 form at the end of each calendar year summarizing funds received and taxes withheld. Some countries have tax exemption treaties with the United States, and it is the responsibility of each international student to inquire about the necessary arrangements (see <http://guru.psu.edu/cbb/payroll/treaty.html>).

A Tax Guide, prepared by the Graduate Student Association (111B Kern Building), provides helpful information about Federal, State, and Local tax issues (see <http://www.astro.psu.edu/users/gallsc/taxguide/index.html>). Additional information for international students is available from the Office of International Students, 410 Boucke Building (<http://www.international.psu.edu/default.htm>).

Health Insurance--Graduate assistants must have health insurance coverage that meets certain standards, as established by the University Student Health Insurance Administrative Council. Eighty percent of the individual annual premium will be paid by Penn State. The remaining twenty percent will be deducted from the student's assistantship stipend, a portion in the Fall semester and a portion in the Spring semester. For further information, contact the Student Health Insurance Office, University Health Services (<http://www1.sa.psu.edu/uhs/currentstudents/gains.cfm>).

Graduate Program in
Energy and Mineral Engineering (EME)

3. CURRICULUM

3.1 GENERAL TEACHING OPPORTUNITIES

Teaching experience is an opportunity provided as part of graduate education. Therefore, the program provides opportunity for all graduate students to serve as Teaching Assistants before they receive their graduate degree. Two semesters as a TA in the classroom and/or laboratory is considered to be sufficient to provide such experience. Students may however engage themselves for additional semesters of TA duty, upon mutual agreement with their advisor and the Program Officer.

The Program encourages all graduate students, particularly the Ph.D. degree candidates, to take courses on college teaching offered by the College of Earth and Mineral Sciences (EM SC 602, 1 credit) and by the Department (EGEE 602, 1 credit) under the common title of *Supervised Experience in College Teaching*. Taking both of these courses would satisfy four of the five requirements to receive the [Graduate School Teaching Certificate](#). The only remaining requirement to earn the certificate is to complete the Schreyer Institute Penn State Course in College Teaching.

[EM SC 602](#) is designed to introduce the fundamentals of course design, development, delivery, assessment, and evaluation. [Penn State Course in College Teaching](#) is a noncredit in-service course to all faculty, teaching assistants and instructors to explore issues of pedagogy, share teaching experiences and discuss some of the current literature on teaching. EGEE 602 will provide a supervised experience in the preparation and presentation of a block of lectures by teaching assistants, or taking total responsibility for a laboratory or recitation section.

Test of Spoken English for International Students -- All international students who have not completed an academic program in a U.S. university are required to take the Test of Spoken English (TSE) administered by the Center for English as a Second Language at Penn State per the Graduate School guidelines. The test is designed to evaluate graduate students before they can serve as Teaching Assistants and Instructors. The results from TSE are used to recommend remedial steps, if any, to be taken by the graduate student. The Center's evaluation is done in terms of the following proficiency codes:

NR = No Restrictions. This person should be allowed to teach with no restrictions based on ability to communicate in English, (TSE = 250-300).

WR = With Restrictions. This person should be allowed to teach while concurrently enrolled in SPCOM 118G, Advanced TA Training, (TSE = 230-249).

TC = Take TA Course. This person should not be allowed to teach before completing SPCOM 117G, Beginning TA Training, (TSE = 200-229).

SL = Speaking/Listening. This person should enroll in SPCOM 115G, Speaking/Listening, before taking SPCOM 117G (TSE = below 200).

The program expects international students to take the test at the first available opportunity. The test must have been satisfactorily completed before the student can receive an advanced degree from Penn State. Inquiries about test dates should be directed to the Center of English as a Second Language, 305 Sparks Building 865-7365. (See Section 5.6 for the English competency requirement for Ph.D. students).

3.2 COURSE REQUIREMENTS

EME graduate students are encouraged to design a course of study that suits their individual backgrounds, interests, and needs in consultation with their advisors. Therefore, the EME Graduate Program has a minimum core program and required option courses and an array of courses to be taken, in consultation with their advisor and thesis committee, to meet the total credit requirements. A minimum of 24 course credits are required for the M.S. degree. Six (6) core program and 8 required option course credits are specified out of the 24. A minimum of 12 course credits beyond the M.S. degree is required for the Ph.D. Three (3) core program and four (4) required option course credits are specified out of the 12. At least 18 of the required course credits for the graduate program must be at the 500 level. For students entering the program with an M.S. degree, 500-level courses already taken either at Penn State or other institutions may be accepted in partial fulfillment of the Ph.D. 18 credits of 500-level course requirements if they are found to be appropriate. In exceptional cases, the Graduate Program Officer may allow appropriate/equivalent substitutions of courses taken at Penn State or elsewhere for the core program or required option courses. Petitions for such course substitutions or exemptions will be considered by the program chair if the advisor and thesis committee support the petition and the student is held accountable for competency in the subject matter. Because each thesis research problem is unique, the need for taking additional courses varies from student to student, and the student's Thesis Advisor and Committee will make the final decision whether or not the additional courses should be part of a student's official course of study. Students are not required to choose an option. Students without an option only need to meet the total credit and core program course requirements.

The required minimum number of course credits for the EME M.S. degree is 30 including 6 credits of research. The required minimum number of course credits beyond the M.S. degree for the EME Ph.D. degree is 24 including 12 credits of research beyond the M.S. The actual number of course credits will depend on the advisor and Thesis Committee. Students should, through advisement, make sure they satisfy the prerequisites for courses taken as this may affect their ability to get into these courses.

A. Compulsory (Core) Courses in EME

M.S. Degree

| | |
|------------|--------------------|
| EME 590(1) | Colloquium |
| EME 580(5) | Integrative Design |

Ph.D.

| | |
|------------|------------------------------------|
| EME 500(3) | Project Investments and Evaluation |
|------------|------------------------------------|

B. Required Specialty Option Courses

B-1 Fuel Science (FSC) Option

M.S. Degree

FSc 504 (3) Problems in Fuels Engineering
EME 570 (3) Catalytic Materials
FSc 506 (3) Carbon Reactions

Ph.D.

FSC 503 (3) Analytical Methods in Fuel Science
FSC 590 (1) Colloquium

B-2 Environmental Health and Safety Engineering (EHSE)

M.S. Degree

EME-510(3) Health and Safety Engineering
STAT 511(3) Regression Analysis and modeling **or**
STAT 512(3) Design and analysis of experiments
BB H 503(3) Bio-behavioral Systems in Health and Development **or**
IE 553(3) Engineering of human work.

Ph.D.

STAT 51(3) Designs and Analysis of Experiments
IHS 590 (1) Colloquium

B-3 Mining and Mineral Process Engineering (MMPE) Option

M.S. Degree

MNG 515(3) Mine System Simulation **or** MNG 541(3) Surface Mine Equipment **or**
MNG 554(3) Rock Mechanics Design
MNPR 501(3) Interfacial Phenomena **or** MNPR 505(3) Colloid Phenomena **or**
MNPR 506(3) Mineral Process Plant Design
One course from the remaining four not selected above

Ph.D.

MNPR 506(3) Mineral Process Plant Design
MNG 590 (1) Colloquium

B-4 Petroleum and Natural Gas Engineering (PNGE) Option

M.S. Degree

- PNG 501(3) Steady State Flow in Porous **or**
PNG 502 (3) Unsteady State Flow in Porous Media
- PNG 511(3) Numerical Solutions of PDEs **or**
PNG 512 (3) Numerical Reservoir Simulation
- PNG 520(3) Phase Relations in Reservoir Engineering **or**
PNG 530 (3) Natural Gas Engineering

Ph.D.

- PNG 530 (3) Natural Gas Engineering
- PNG 590 (1) Colloquium

B-5 Energy Management and Policy (EMP) Option

M.S. Degree

- EME 525 (3) Policy Analysis for Engineers
- AEREC 597(3) Applied Microeconomic Theory
- ECON 490 (3) Introduction to Econometrics **or**
ENNEC 473 Risk Management in Energy Industries

Ph.D.

- ENNEC 540 (3) Economics Analysis of Energy Markets
- ENNEC 590 (1) Colloquium

B-6 Non-option Students

Ph.D.

- EME 590 (1) Colloquium

EME Colloquium (EME 590) -- This course consists of periodic lectures by graduate students, faculty or guest speakers. It involves the participation of both M.S. and Ph.D. graduate students. M.S. and Ph.D. graduate students are required to register for one credit of EME 590 during their tenure. The students who schedule EME 590, or one of the courses with which it is cross-listed, may be required to give a presentation on a topic of their choice during the semester. Also, all students registering for the course must attend all the lectures and, as a class, evaluate the lectures by the other graduate students. The evaluation of a student's performance in the course will be based on their oral presentation. The grading system is based on participation. The objective of the course is to give graduate students in the program the opportunity to develop their skills at giving research presentations, and evaluating such presentations. The presentations may be videotaped and the tape reviewed by the student and his/her advisor. Seminars presented by visitors from universities, industry, or research centers are a key part of graduate education, and all graduate students are strongly encouraged to attend the lectures and participate in the discussions. Hence, attendance at EME 590 colloquia is expected of all EME graduate students, including those who do not register for the course.

Graduate Program in
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4. SUMMARY OF M.S. COURSE REQUIREMENTS

4.1 GENERAL REQUIREMENTS

- | | |
|--|------------|
| (1) Minimum number (400 and 500 level): | 24 credits |
| (2) Mandatory program core courses: | 6 credits |
| (3) Required option courses: | 8 credits |
| (4) EME 600 or 800 level courses: | 6 credits |
| (5) Participation in Department and Program seminar series is required for one semester and strongly encouraged while the student is in residence. | |
| (6) Completion of a written M.S. thesis and its defense. | |
| (7) At least 18 of the total course credits must be at the 500 level | |

4.2 APPOINTMENT OF M.S. THESIS COMMITTEE

After a student selects the topic of his/her thesis and a research advisor, the student and the advisor will select the most appropriate Thesis Committee, consisting of the thesis advisor and at least two other graduate faculty members. In all cases, a majority of the Committee shall be members of the faculty of the EME Program.

If the research advisor is not a member of the EME Program faculty, the project must be approved by the Program Officer and student's Thesis Committee. The responsibility of the Thesis Committee includes periodic review of student's research progress when requested by the Advisor or the student. When the student is ready to write the first thesis draft, he/she may schedule a Committee meeting to present his/her results for discussion and feedback. As soon as the student completes the thesis draft and it is approved by the thesis advisor, a copy will be given to each of the Committee members. This should be done no later than two weeks prior to the scheduled thesis defense.

The appropriate form for appointment of M.S. Thesis Committee (see Appendix) should be completed and submitted by the student to the Program Officer before the end of his/her first semester on campus. A summary of the approved course schedule should also be submitted.

4.3 M.S. THESIS DEFENSE

A thesis defense is required for the M.S. degree. The student is responsible for scheduling the thesis defense by notifying his/her advisor and the Graduate Program Staff Assistant. The student will then schedule a thesis defense that is to be conducted under the following guidelines:

1. Prior to the M.S. Thesis Defense students should declare their intention to use or not use the M.S. thesis as a Candidacy Exam for the Ph.D. in the EME program.
2. If a Committee member has reservations about the student's readiness to defend the thesis, he/she should voice these concerns to the thesis advisor and the committee at least one week before the scheduled defense.

3. All parts of the defense are open to be public, except the final deliberations of the committee.
4. The student shall begin the defense with a 30-minute presentation of the highlights of the work which under no circumstances will exceed 35 minutes.
5. The general audience will then be invited to ask questions.
6. The committee will follow this with questions prepared on the basis of their study of the thesis.
7. The committee will then meet in closed session to determine pass/fail status. A student may pass, pass after additional modifications in the final draft without another presentation, or fail. In the case of failure, the committee may decide to give a candidate another attempt.
8. Upon successful completion of the defense, the student will make necessary corrections to the draft and prepare the final version.
9. The student will then submit the thesis to the Graduate School after obtaining the signatures of the advisor, the Committee members, and the Chair of the Program.

Note: Forms for committee use when voting on the thesis defense and approving thesis draft are provided in the Appendix.

4.4 CONTINUOUS REGISTRATION REQUIREMENT

EME 600 -- If the student does not need to maintain full-time student status, he/she should register for the appropriate number of thesis credits which accurately reflects the amount of research being done on the thesis (number of credits to be determined in consultation with student's advisor).

4.5 PROGRESS FROM M.S. TO Ph.D. PROGRAM

Students in the M.S. program who are planning to pursue a Ph.D. degree in EME should inform their advisor and the Graduate Staff Assistant at their earliest convenience. In such a case, their M.S. program may be tailored for an effective transition into the Ph.D. program. At the discretion of the advisor, the student may be given the option to "skip" the M.S. thesis defense and transfer to the Ph.D. program, subsequent to passing the Candidacy Examination (see Section 5.2 and 5.3).

Students desiring admission into the Ph.D. program must obtain a course grade point average of 3.0 or higher, based on 20 course credits. For students seeking admission into the Ph.D. program, the M.S. thesis defense may serve as the Candidacy Examination, and it will be structured as such.

4.6 REGULAR REVIEWS OF STUDENT PROGRESS

Regular written reviews accompanied by face-to-face meetings will be conducted between all M.S. students and their advisors or Program Officer (if no advisor has been selected) at least once a year. An annual progress review (see page 50) is required of all M.S. students. The reviews are to provide students needed feedback and allow students and advisors to share perspectives on the student's progress and goals. The reviews will allow the program to counsel students, set goals, and in the worst case prepare a student for a decision that could end in termination.

Graduate Program in
Energy and Mineral Engineering (EME)

5. SUMMARY OF PH.D. COURSE REQUIREMENTS

5.1 GENERAL REQUIREMENTS

- (1) M.S. degree in EME, or in a related field, is a prerequisite for the Ph.D. degree, except as noted in Section 4.5.
 - (2) Additional course credits (beyond M.S.): 12 credits
 - (3) Mandatory core program courses: 3 credits
 - (4) Required option courses 4 credits
 - (5) EME 600 level courses: 12 credits
- Students must register for research every semester until the completion of degree requirements. EME 600 is used until completion of the Comprehensive Examination; EME 601 is used after the Comprehensive Examination.
- (6) Participation in Department and Program seminar series is required for one semester and strongly encouraged each semester the student is in residence.
 - (7) Courses taken in the M.S. program in EME may be transferred to the Ph.D. program, with the exception of EME 590. Note, however, that EME 590 must be taken again in the Ph.D. program.
 - (8) At least 18 of the total course credits must be at the 500 level. For students entering the program with an M.S. degree, 500-level courses already taken either at Penn State or other institutions may be accepted in partial fulfillment of the Ph.D. 18 credits of 500-level course requirements if they are found to be appropriate.

5.2 PH.D. CANDIDACY EXAMINATION REQUIREMENTS

A Candidacy Examination is required for formal admission into the Ph.D. program. All Ph.D. students in the program must take the Candidacy Exam at the end of the student's first year of studies. The Candidacy Examination Committee is described in Section 5.3. The Candidacy Examination measures, among other things, the student's fundamental knowledge of subjects covered in the program. It is intended to determine whether a student has the preparation, intellectual capacity, and professional attitude to complete a Ph.D. program successfully.

It is recognized that potential Ph.D. candidates may come to this program with widely varying records of academic preparation and background. Since fundamental knowledge in the broad area of energy and mineral engineering is usually covered in undergraduate courses, a newly enrolled Ph.D. student in the Energy and Mineral Engineering program must consult with the advisor and/or Program Officer whether to take additional 400 level coursework to correct deficiencies. A minimum grade of B is required in these courses.

Part of the Candidacy Exam will involve the writing of a detailed research proposal. The student may choose their topic or choose from three provided by a candidacy sub-committee (chosen to reflect the interest area(s) of each individual candidate). Students will be given three weeks to write the proposal and turn it in to the Program office in electronic form. This proposal must be prepared and written by the candidate alone. The written proposal should include, as appropriate, the following:

- (a) Hypotheses, objectives and relevance of the research or problem. What problems motivate this research, what hypothesis, if any, will be tested, etc?
- (b) Critical survey and analysis of pertinent literature.
- (c) Discussion of theoretical aspects.
- (d) Proposed experimental approach.
- (e) Necessary experimental equipment and procedures.
- (f) Health and Safety precautions and hazards.
- (g) Preliminary economic analysis/benefits
- (h) Tentative timetable for completion of research.
- (i) The expected new and original body of knowledge the research will add to the literature.

The written research proposal is typically less than 15 double-spaced, printed pages and should represent entirely the original work of the student in concept, background literature research and in writing.

The examination involves a formal presentation and defense of the research proposal before the Candidacy Examination Committee. The examination will be scheduled at least two weeks after the submission of the written thesis proposal. Typically, the student will make a formal presentation of less than 30 minutes duration to the candidacy committee, whose members will ask questions about the proposal and other topics related to the student's prior coursework. In addition to its technical content, the presentation will also be judged for its clarity, adaptation to the audience, organization, appropriate use of visual aids and effectiveness of delivery. For students in the EME M.S. program, the M.S. thesis defense may serve as the Candidacy Examination. It is appropriate to explore deficiencies in the student's background and training in order to plan additional course work. Such exploration is not the primary purpose of the exam, however. Thus, the exam may include exploration of general questions unrelated to the proposal. At the conclusion of the exam, the Committee will vote on accepting the student as a Ph.D. candidate. The ballot should be self-explanatory with this exception: in exceptional circumstances, the committee may recommend, with a yes vote, an M.S. thesis before proceeding to the Ph.D.

5.3 CANDIDACY EXAMINATION COMMITTEE

The candidacy examination committee will be made up of graduate faculty in the program. The committee made up of at least three members will have at least two faculty from the student's research focus area (option) and one other faculty. The members and chair of the candidacy committee will be selected by the EME graduate Program Officer. The thesis advisor will only serve in an ex-officio role. A candidacy sub-committee may be appointed by the candidacy committee chair to select the topics from which a candidate may choose for the Candidacy Examination (see Section 5.2). If the exam is not passed on the first attempt, it may be taken once more, the next time it is offered.

5.4 SCHEDULING OF THE CANDIDACY EXAMINATION

Students who hold an M.S. degree (from a Penn State program other than EME or any other institution) must pass the Candidacy Examination before completing one calendar year in the

Ph.D. program. For students in the EME M.S. program who wish to pursue the Ph.D., the M.S. thesis defense may serve as the Candidacy Examination. Additional details on scheduling of the candidacy examination may be found in Sections 5.2 and 5.3.

The student must be registered full-time or part-time in the semester in which the candidacy examination is taken (see the Graduate Degree Programs Bulletin, [http://www.psu.edu/bulletins/whitebook/\\$gradreqs.htm](http://www.psu.edu/bulletins/whitebook/$gradreqs.htm)).

5.5 CRITERIA OF RESEARCH PERFORMANCE

Research performance may also be used as a criterion in making the pass/fail decision on the Candidacy Examination. Research advisors will be asked to provide the Candidacy Examination Committee with an evaluation of the research performance of the student. If the student completes an M.S. thesis with a Penn State advisor who is not on the candidacy committee, the advisor may be asked to present the committee with an evaluation of the student's M.S. thesis research performance.

5.6 ENGLISH COMPETENCY REQUIREMENT FOR Ph.D. STUDENTS

The EME Program has an English Proficiency requirement that integrates the goal of attaining English proficiency with a simultaneous enhancement of student's research capabilities. This requirement should be viewed not as a barrier to or a distraction from research, but as a beneficial component of doctoral studies. The program's policy requires demonstration of high level of competence in reading, writing and speaking English. The main elements of this policy are detailed in Section 5.7.

5.7 CONTENTS OF ENGLISH COMPETENCY EXAMINATION

All Ph.D. students, domestic and international, will undergo an assessment of English competency during their first year. The assessment will include the student's ability to read and comprehend technical literature, the ability to write well, the ability to make formal presentations and the ability to participate in scientific and technical discussions. The assessment will be conducted during the Ph.D. Candidacy Examination (see form in the Appendix). The English Competency Testing will consist of three parts.

(a) Writing

The student will prepare a detailed research proposal on the topic chosen for his/her candidacy in accordance with the format given in Section 5.2. This document will be judged for its organization, the logical arguments in support of the student's hypothesis, the inclusion of relevant details, style in the use of language, grammar, punctuation and spelling. The written document must be the individual work of the student and no editing of the written proposal by the student's thesis advisor should be included. Section (ii) of the written proposal containing analysis of pertinent literature will be used to evaluate the student's reading comprehension of the technical literature.

(b) Formal Presentation

The student will make a formal presentation of the research proposal, typically of about 30 minutes duration (see Section 5.2).

(c) Oral Discussion

The main purpose of the oral part of the English Competency Test is to evaluate the ability of the student to participate in scientific and technical discussions with other professionals, including those who may not be specialists. This will follow the formal presentation of the research proposal by the student. The examination committee will conduct a discussion with the student on all aspects of the research proposal and also on the scientific and technical issues surrounding the research area.

At the end of the Candidacy Examination, each member of the committee will provide an assessment of the student's English competency in three categories: writing, formal presentation and oral discussion. These assessments will be used to certify the attainment of English competency for students judged to be competent, or to recommend measures for improving English competency for students judged to be deficient.

5.8 IMPROVING ENGLISH COMPETENCY

If the expected level of competence is not demonstrated, the student will be required to enroll in course(s) offered at the University to improve English competency. The committee will recommend the suitable course(s) for each student from among the following:

(i) Oral Language Skills

SPCOM 114G Basic English as a Second Language

SPCOM 115G English as a Second Language: Speaking and Listening

(ii) Presentational Skills

SPCOM 100A Effective Speech, Public Speaking

SPCOM 312 Informative Technical and Presentational Speaking

(iii) Writing Skills

SPCOM 116G English as a Second Language: Reading and Writing

ENGL 202C Effective Writing: Technical Writing

ENGL 198G Writing in the Disciplines

5.9 ATTAINMENT OF ENGLISH COMPETENCY

If the student completes and passes the recommended course(s) with a B grade or better, then the student will be certified as having attained English competency. If the student fails to achieve a B or better, then the student will have to retake the course (or another comparable course); upon recommendation of the thesis advisor, a student may be asked to abandon the Ph.D. program if sufficient progress toward English competency is not achieved within a reasonable period of time.

5.10 OPPORTUNITIES FOR ENHANCEMENT OF ENGLISH COMPETENCY

The program has two other formal requirements designed to enhance the English competency of all doctoral students. These requirements relate to the EME colloquium and the Comprehensive Examination.

(a) Colloquium

All Ph.D. students are required to register for one (1) credit of EME 590. The students scheduling EME 590 may be required to give a formal oral presentation on a topic of their choice. The formal presentation should be comparable to that given in technical and professional society meetings. The students will also participate in the question and answer session following the presentation. In addition, students are strongly encouraged to participate in other department and program special seminars.

(b) Ph.D. Comprehensive Examination

This exam will be scheduled only after the program certifies that the student has attained competency in English. The format of the Comprehensive Exam gives students additional opportunities to enhance their reading, writing, formal presentation and oral discussion skills. The format of the exam is similar to that of the Ph.D. Candidacy Examination described earlier (see Section 5.2).

5.11 APPOINTMENT OF DOCTORAL COMMITTEE

- A. This committee will be constituted after the student passes his or her candidacy exam by the student and his advisor in consultation with the Program Officer. The program will recommend this committee as the official doctoral committee of the student to the Dean of the Graduate School for formal approval and appointment. The committee chair will ordinarily be the candidate's thesis advisor. If the thesis advisor is not a member of the EME faculty, the thesis project must be approved by the committee.
- B. The Doctoral Committee is to consist of at least 3 faculty members in the EME Program and at least one faculty member in a related field (outside the department).
- C. The student's doctoral committee has the responsibility to guide the course of study undertaken by the student.
- D. The responsibility of this committee includes periodic review of research progress when requested by the advisor or the student. When the student is ready to write the first draft of the thesis, he/she is encouraged to schedule a committee meeting to present his/her results for discussion and early feedback. After the student completes the draft of the thesis and the advisor approves it, it should be given to each of the committee members as early as possible, but no later than two weeks prior to the scheduled thesis defense.

5.12 COMPREHENSIVE EXAMINATION

A Comprehensive Examination is required of all doctoral candidates by the Graduate School. The program has adopted the following guidelines for this examination. The comprehensive examination in EME is primarily an oral examination, administered by the candidate's Ph.D. committee. The Chair of the candidate's committee will chair the examination. The examination will consist of two parts. In the first phase of the examination, which will be nominally two hours in duration, the candidate will give a formal oral presentation (not to exceed 30 minutes) typically on some aspects of his/her research topic, including objectives, methods and current progress. At the discretion of the student's advisor, a written summary of the presentation (e.g., a PowerPoint file, a conference paper, or a published paper) may be distributed to the committee in advance. The committee will thus be motivated to ask questions that will both clarify important research issues and better assess the competence of the student in his/her field. A discussion of the details of student's research is not, however, the main focus of the comprehensive examination. The second phase that may take about an hour will consist of questions by the committee to determine the candidate's ability to synthesize his or her knowledge, especially in his/her area of specialization, and apply the tools learned to the solution of relevant problems. Although the comprehensive examination will draw heavily upon formal course work, it is not intended that the examination simply be the oral version of the final examinations from various courses, nor to determine if the student still remembers many of the facts from the lectures.

In addition to questions that require synthesizing knowledge from course work and applying it to specific research issues, questions drawn from recent guest lectures sponsored by the EME Program can be asked. Questions on recent newsworthy events that have a direct bearing on a student's area of specialization might also be asked.

The Ph.D. Comprehensive Examination should be scheduled within 2 years of passing the Candidacy Exam and at least six months before the Final Ph.D. Thesis Defense. The Graduate School officially schedules both examinations. To allow sufficient time for the Graduate School to process the paperwork, the students should contact the Thesis advisor and Graduate Staff Assistant at least four weeks prior to the desired date of the examination.

5.13 Ph.D. THESIS DEFENSE

The student will schedule a thesis defense that is to be conducted under the following guidelines:

1. If a Committee member has reservations about the student's readiness to defend the thesis, he/she should voice these concerns to the thesis advisor at least one week before the scheduled defense.
2. All parts of the defense are to be public, except the final deliberations of the committee.
3. The student shall begin the defense with a 30-minute presentation of the highlights of the work that under no circumstances will exceed 45 minutes.
4. The general audience will then be invited to ask questions.

5. The committee will follow this with questions prepared on the basis of their study of the dissertation. This questioning will serve as the Final Oral Examination required by the Graduate School.
6. A time period of at least two hours must be provided for the defense.
7. The committee will then meet in closed session to determine pass/fail status. A student may pass after additional modifications in the final draft without another presentation, or fail. In the case of failure, the committee may decide to give a candidate another attempt.

Upon successful completion of the defense, the student will make necessary corrections to the draft, obtain the committee's approval and prepare the final version.

The student will submit the thesis to the Graduate School after obtaining the required signatures from the advisor, the thesis committee and the Program Officer.

The Ph.D. Thesis Defense must be held within six years of the date that the Comprehensive Examination was passed. If more than six years have passed, a second Comprehensive Examination must be taken (and passed) before scheduling the Ph.D. Thesis Defense.

5.14 CONTINUOUS REGISTRATION REQUIREMENT

EME 600/610 - If the student does not need to maintain full-time student status, he/she should register for the appropriate number of thesis credits which accurately reflects the amount of research being done on the thesis (number of credits to be determined in consultation with advisor).

EME 601/611 - This special registration may be used only by Ph.D. students starting with the semester after the Comprehensive Examination is passed. If a student must maintain full-time status for an assistantship, fellowship, bank loan deferment, etc., 601 would be an appropriate registration. EME 601 students must be devoting their efforts entirely to thesis research/writing (i.e., taking no courses) but they may take up to 3 additional credits of course work for audit to broaden their program.

If a student is in the continuous registration state of his/her program, registration must be maintained each semester, including summer sessions if student is using University facilities, faculty time, etc. If the student is not on campus during the summer and is not using University facilities or faculty time, registration in the summer is not required (except as noted below).

Note: Registration is required for the semester in which the Final Oral Examination is held, even if it is held during a summer session. This requirement also applies to the Comprehensive Examination.

5.15 REGULAR REVIEW OF STUDENT PROGRESS

Regular written reviews accompanied by face-to-face meetings will be conducted between all Ph.D. students and their advisors or Program Officer (if no advisor has been selected) at least

once a year. An annual progress review (see page 50) is required of all Ph.D. students. The reviews are to provide students needed feedback and allow students and advisors to share perspectives on the student's progress and goals. The reviews will allow the program to counsel students, set goals, and in the worst case prepare a student for a decision that could end in termination.

5.16 CHECK LIST OF GRADUATE SCHOOL REQUIREMENTS

The following is a summary of Graduate School requirements that Ph.D. students must meet before the Office of Graduate Programs may approve their graduation. For more detailed information on these and other requirements, please refer to the Graduate Degree Programs Bulletin: [http://www.psu.edu/bulletins/whitebook/\\$gradreqs.htm](http://www.psu.edu/bulletins/whitebook/$gradreqs.htm).

Residency requirement. After passing the doctoral candidacy examination, students must be registered full time for two semesters within a twelve-month period. This may include the semester of candidacy examination if it is taken during Spring or Fall.

A Ph.D. candidate must have satisfied the departmental English Competency Test before taking the Comprehensive Examination.

Three or more months must have elapsed between the passing of the Comprehensive Examination and scheduling of the Ph.D. Thesis Defense.

The Ph.D. Thesis Defense must be held within six years of the date the Comprehensive Examination was passed. If more than six years have elapsed, a second Comprehensive Examination must be passed before scheduling the Ph.D. Thesis Defense.

Continuous registration requirement. Students must be registered continuously each semester beginning with the semester following the passing of the Comprehensive Examination and continuing each semester until the Final Oral Examination is passed.

Time limitation. All requirements including submission of the thesis must be completed within eight years of the Candidacy Examination date.

Students MUST be registered for the semester of the Candidacy Examination and the Oral Comprehensive Examination, even if these are taken during a summer session.

No missing or deferred grades can appear on a student's transcript when the Oral Comprehensive Examination or the Final Oral Examination is scheduled.

Students must have at least a 3.0 grade point average to schedule an Oral Comprehensive Examination or Final Oral Examination and to graduate.

No more than 12 credits of thesis research (600/610) may be assigned a quality letter grade. Any credits over this maximum must be changed to "R" before a student will be permitted to graduate.

THESE ARE GRADUATE SCHOOL REQUIREMENTS ONLY AND DO NOT INCLUDE SPECIFIC PROGRAM REQUIREMENTS.

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6. OTHER INFORMATION SOURCES

The following is a list of booklets or resources available to graduate students:

Thesis Guidelines:

“REQUIREMENTS FOR THE PREPARATION OF MASTERS
AND DOCTORAL THESIS”

Thesis Office

115 Kern Building

865-5448

<http://www.gradsch.psu.edu/enroll/thesisguide.html>

Health Insurance:

MEGA Life and Health Insurance

320 Grange Building

865-7467

<http://www1.sa.psu.edu/uhs/basics/insurance.cfm>

Tax Information:

“A TAX GUIDE” by Graduate Student Association

111B Kern Building

865-4211

<http://felix.metsce.psu.edu/GSA/-Services/tax-guide.html>

General information on campus, student organizations, etc.:

“A GUIDE TO GRADUATE LIFE”, by Graduate Student Association

111B Kern Building

865-4211

<http://www.clubs.psu.edu/up/gsa/guide.pdf>

Financial Aid Information:

Student Aid Office

314 Shields Building

865-6301

<http://www.psu.edu/studentaid/>

Graduate Student Resource Guide:

Various resources available to graduate students may be found at the website:

<http://www.gradsch.psu.edu/current/documents/GraduateStudentResources.pdf>

These include information on:

International Student Services (<http://www.international.psu.edu>)
Graduate Student Association (<http://www.clubs.psu.edu/up/gsa/>)
The Office of Student Aid (<http://www.psu.edu/studentaid/>)
The Office of Disability Services (<http://www.equity.psu.edu/ods/>)
The Writing Center (<http://www.psu.edu/dept/cew/GWC.shtml>)
Penn State Escort Service (<http://www.psu.edu/dept/police/escortservice.html>)
Off-campus Housing (<http://www.sa.psu.edu/ocl/>)
Office of Judicial Affairs (<http://www.sa.psu.edu/ja/>)
The Code of Conduct (<http://www.sa.psu.edu/ja/conduct.shtml>)
The Affirmative Action Office (<http://www.psu.edu/dept/aaoffice/>)
HUB-Robeson Center (<http://www.sa.psu.edu/usa/hub/>)
Counseling and Psychological Services (<http://www.sa.psu.edu/caps/>)
Career Services (<http://www.sa.psu.edu/career/>)
Research Protections (<http://www.research.psu.edu/orp/>)
Pasquerilla Spiritual Center (<http://www.sa.psu.edu/insights/jan04/spiritual.shtml>)
Problem Resolution
Academic Integrity (PSU, <http://www.psu.edu/dept/ufs/policies/47-00.html#49-20>;
EMS, <http://www.ems.psu.edu/students/integrity>)
Plagiarism
University Policies (<http://www.guru.psu.edu/policies/>)
Graduate Student Policies (<http://www.gradsch.psu.edu/policies/student.html>)

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7. STUDENT ACTION CHECKLISTS

7.1 STUDENT ACTION CHECKLIST FOR M.S. DEGREE

- Select Thesis Topic and Advisor
 - No later than the first year after admission to the program
- Schedule M.S. Thesis Defense
 - Notify Graduate Staff Assistant at least 3 weeks prior to proposed date.
 - No more than 6 credits of thesis research (600 level) may be assigned a quality letter grade. Any credits over this maximum must be changed to “R” before a student will be permitted to graduate.
- Regular Reviews of M.S. Student Progress Maintained

7.2 STUDENT ACTION CHECK LIST FOR Ph.D. DEGREE

- Schedule Test of Spoken English (International Students)
 - Must be taken in the first semester at Penn State.

| | | |
|------|------|-------|
| | | |
| time | date | place |
- Schedule Candidacy Examination and English Competency Test
 - Before completing 12 months in the program
 - Student must meet the Ph.D. eligibility requirement with a minimum GPA of 3.0 in designated courses.
 - English Competency test is taken during the Candidacy Examination.

- Student must be registered for the semester the Candidacy Examination is taken.
 - Notify Graduate Staff Assistant at least 3 weeks prior to proposed date.
 - Notify Candidacy Examination Chair and committee members at least 3 weeks prior to proposed date.
 - Submit research proposal to Candidacy Committee Chair and committee members and give a copy to the Graduate Staff Assistant two weeks prior to the examination date.
- Select Ph.D. Committee
- Complete form and submit to Graduate Staff Assistant.
- Schedule Comprehensive Examination
- Candidacy Examination and English Competency Test must be taken before scheduling Comprehensive Examination.
 - Must have a GPA of at least 3.0 average in course work.
 - No missing or deferred grades can appear on a student's transcript when the Comprehensive Examination is scheduled.
 - Student must be registered for the semester the Comprehensive Examination is taken.
 - Notify Graduate Staff Assistant at least 3 weeks prior to proposed date.
 - Notify Committee at least 3 weeks prior to proposed date.
 - Submit Comprehensive Exam Research Paper to Doctoral Committee and a copy to the Program Staff Assistant.
 - Notify Graduate Staff Assistant upon successful completion of Comprehensive Examination.

Schedule Ph.D. Thesis Defense

- Student must be registered for the semester in which Ph.D. Thesis Defense is scheduled.
- Notify Graduate Staff Assistant at least 4 weeks prior to proposed date.
- Must have a GPA of at least 3.0 in course work to schedule exam.
- No missing or deferred grades can appear on a student's transcript when the Ph.D. Thesis Defense is scheduled.
- No more than 12 credits of thesis research (600) may be assigned a quality letter grade. Any credits over this maximum must be changed to "R" before a student will be permitted to graduate.
- Notify Doctoral Committee at least 4 weeks prior to proposed date.
- Residency requirement: After passing Candidacy Examination, student must have been registered full-time for two semesters in a one-year period.
- At least 3 months must have elapsed between the Comprehensive Examination and the Ph.D. Thesis Defense.
- Continuous Registration Requirement: Student must have been registered continuously each semester beginning with the semester following the passing of the Comprehensive Examination.
- Defense must be held within six years of the date the Comprehensive Examination was passed.
- All requirements including submission of the thesis must be completed within eight years of the Candidacy Examination date.
- Regular Reviews of Ph.D. Student Progress Maintained

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8. INFORMATION ON REGISTRATION AND TUITION

8.1 REGISTRATION

At least 2-3 months before the beginning of a semester, the University publishes the Semester Schedule of Classes (<http://soc.our.psu.edu/soc/>). It provides all registration instructions and a worksheet to help with the registration process. Students are encouraged to register in advance to avoid any late fees. This process will generate a semester tuition bill (see below).

8.2 TUITION BILL: “Who must file?”

Graduate Assistants or Fellowship/Scholarship students must reconcile the bill EVEN IF NO MONEY IS OWED. Line 6(A) on the bill shows the deduction for a Graduate Assistantship. This bill must be reconciled on eLion (<https://elion.oas.psu.edu/>) so it can be processed by the Bursar’s Office to complete the registration. If the bill is not processed by the Bursar’s Office, the student’s name is removed from the class roster, and the class space is then made available to other students.

8.3 COMMITMENT TO THE PROGRAM

As a Graduate Assistant, your first commitment is to the EME Program and the EME department. If you are going to be employed by any other department, project or program, you must inform your advisor before you are appointed. Failure to comply with this procedure could result in the termination of a Graduate Assistantship.

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9. THESIS INFORMATION

9.1 SELECTION OF A THESIS RESEARCH TOPIC

The program wishes its graduate students to have as much freedom of choice as possible in selecting a thesis topic, within the confines of the program's financial resources and faculty interests. This is done either before the student arrives on campus or during the first year, in consultation with the thesis advisor or, if necessary, the Program Officer.

9.2 THESIS REGISTRATION AND GRADING POLICY

Graduate students normally register for thesis research using the course number EME 600. Those who have passed the Ph.D. Comprehensive Examination register for EME 601. The thesis work is graded according to the policy adopted by the Graduate Council. The normal passing grade assigned is R. Letter grades are not to be given for EME 600, except for a failing performance. At the completion of a degree program, a specified maximum number of research credits may be changed from R to a letter grade. (The maximum number of credits for which a grade change is allowed is 6 for M.S. students and 12 for Ph.D. students. Since grade changes are usually permitted for only the prior semester, the students are advised to register for 6 or less credits of research in their last semester for which the letter grade can be assigned.)

9.3 TIMETABLE FOR THESIS WRITING

The mechanism of producing a finished thesis, from the first written rough draft to the definitive version, is often more time-consuming than the student realizes. In estimating the time of completion, allowances should be made for each step in the process. Typical times required for producing a Ph.D. thesis by a student in residence are:

| | |
|---|-----------------|
| rough draft writing | 2-3 months |
| advisor reading | 2-3 weeks |
| correcting and preparing for committee | 2-4 weeks |
| <u>final editing and typing after defense</u> | <u>1 month+</u> |
| TOTAL TIME | 4-5 months |

The time to complete an M.S. thesis can be expected to be shorter. One should be cautious about accepting a job before the thesis is completed and successfully defended. Many students underestimate the conflicting demands of a new job and an uncompleted thesis.

9.4 LEAVING CAMPUS BEFORE THESIS COMPLETION

Some students leave the program and accept employment before their theses are accepted by their committee and the Graduate School. If such is the case, the following regulation should be noted: A graduate student who has completed all program requirements, except thesis submission and defense, must register for one credit each succeeding semester following departure from campus and is responsible for payment of the corresponding tuition.

9.5 THESIS PREPARATION

It is the student's responsibility to deliver the thesis to the Graduate School by the specified deadlines. Specific arrangements for preparing and reproducing the thesis should be made with the help of the student's advisor. In the production of the thesis, the student should follow the instructions provided in the following website:

<http://www.gradsch.psu.edu/enroll/thesisguide.html>.

Students are responsible for proofreading and any drafting work required in connection with the thesis. They are also responsible for the payment of binding and other Graduate School fees related to the thesis and graduation.

9.6 GRADUATION TIMETABLE

The graduating student should be aware of specific deadlines relating to certain obligations that must be met during their last semester or summer session before graduation (for details, see <http://www.gradsch.psu.edu/enroll/gradcal.html>). These include:

- Last date to deliver thesis/research paper to Ph.D. Committee or M.S. Committee
- Last date for Final oral Ph.D. Examination
- Last date to pay thesis fee
- Last date to activate intent to graduate
- Last date to deliver thesis/research paper to Graduate School
- Last date to resubmit corrected final copy of a thesis/research paper
- Last date to submit a request to graduate in absentia

Specific dates for these deadlines in any particular semester or summer session can be found at the website listed above.

Graduate Program in
Energy and Mineral Engineering (EME)

10. FACULTY

R. Larry Grayson, Graduate Program Officer

Degrees Conferred: Ph.D., M.S. (with or without options in Petroleum and Natural Gas Engineering; Mining and Mineral Process Engineering; Environmental Health and Safety Engineering; Fuel Science; and Energy Management and Policy)

The Graduate Faculty

Michael A. Adewumi, Ph.D. (IIT) *Professor of Petroleum and Natural Gas Engineering*

Luis Ayala, Ph.D. (Penn State), *Assistant Professor of Petroleum and Natural Gas Engineering*

Andre Boehman, Ph.D. (Stanford), *Professor of Fuel Science*

Seth Blumsack, Ph.D. (Carnegie Mellon), *Assistant Professor of Energy and Mineral Engineering*

Jeffrey Brownson, Ph.D. (Wisconsin), *Assistant Professor of Energy and Mineral Engineering*

Yongsheng Chen, Ph.D. (Lehigh), *Assistant Professor of Energy and Mineral Engineering*

Caroline B. Clifford, Ph.D. (Penn State), *Senior Research Associate, Energy Institute*

Timothy J. Considine, Ph.D. (Cornell) *Professor of Natural Resource Economics*

Derek Elsworth, Ph.D. (California, Berkeley), *Professor of Energy & Geo-Environmental Engineering*

Turgay Ertekin, Ph.D. (Penn State) *Professor of Petroleum and Natural Gas Engineering*

Semih Eser, Ph.D. (Penn State), *Professor of Energy and Geo-Environmental Engineering.*

Maochen Ge, Ph.D. (Penn State) *Associate Professor of Mining Engineering*

R. Larry Grayson, Ph.D. (West Virginia), *Professor of Energy and Mineral Engineering*

William A. Groves, Ph.D. (Michigan) *Associate Professor of Industrial Health and Safety*

Joel M. Haight, Ph.D. (Auburn) *Associate Professor of Energy and Mineral Engineering*

Phillip M. Halleck, Ph.D. (Chicago) *Associate Professor of Energy and Mineral Engineering*

Richard Hogg, Ph.D. (California, Berkeley) *Professor Emeritus of Mineral Processing and Geo-Environmental Engineering*

M. Thaddeus Ityokumbul, Ph.D. (Western Ontario) *Associate Professor of*

Mineral Processing and Geo-Environmental Engineering

Zuleima Karpyn, Ph.D. (Penn State), *Assistant Professor of Petroleum and Natural Gas Engineering*

Vladislav Kecojevic, Ph.D. (Belgrade) *Associate Professor of Mining Engineering*

Andrew Kleit, Ph.D. (Yale) *Professor of Energy and Environmental Economics*

Mark S. Klima, Ph.D. (Penn State) *Associate Professor of Mineral Processing and Geo-Environmental Engineering*

Angela Lueking, Ph.D. (Michigan), *Assistant Professor of Energy and Geo-Environmental Engineering*

Peter T. Luckie, Ph.D. (Penn State) *Professor Emeritus of Mineral Processing*

Serguei Lvov, Ph.D. (St. Petersburg), *Professor of Energy and Mineral Engineering*

Xiaoliang Ma Ph.D. (Kyushu, Japan), *Senior Research Associate, Energy Institute.*

Chris Marone, Ph.D. (Columbia), *Professor of Geosciences*
Jonathan Mathews, Ph.D. (Penn State), *Assistant Professor of Energy and Mineral Engineering*
K. Osseo-Asare, Ph.D. (California, Berkeley) *Professor of Metallurgy and Energy and Mineral Engineering*
Sarma Pisupati, Ph.D. (Penn State), *Associate Professor of Energy and Mineral Engineering*
Mark Radomsky, Ph.D. (Penn State), *Senior Lecturer*
Ljubisa Radovic, Ph.D. (Penn State), *Professor of Energy and Mineral Engineering*
Raja V. Ramani, Ph.D. (Penn State) *Professor Emeritus of Mining and Geo-Environmental Engineering*
Jamal Rostami, Ph.D. (Colorado School of Mines), *Assistant Professor of Energy and Mineral Engineering*
Alan Scaroni, Ph.D. (Penn State), *Professor of Energy and Mineral Engineering and Associate Dean for Graduate Education and Research*
Harold Schobert, Ph.D. (Iowa State), *Professor of Fuel Science*
Chunshan Song, Ph.D. (Osaka, Japan), *Professor of Fuel Science*
Robert W. Watson, Ph.D. (Penn State) *Associate Professor Emeritus of Petroleum and Natural Gas Engineering and Geo-Environmental Engineering*
Yaw D. Yeboah, ScD (MIT), *Professor and Head of Energy and Mineral Engineering*
Fan Zhang, Ph.D. (Harvard), *Assistant Professor of Energy and Mineral Engineering*

Graduate Program in
Energy and Mineral Engineering (EME)

11. CORE COURSE OUTLINES

EME 500
Energy and Mineral Project Investment Evaluation

EME 580
Integrative Design in Energy and Mineral Engineering Systems

EME 590
Colloquium

Energy and Mineral Project Investment Evaluation (EME 500)

Semester: Spring

Objectives: To reinforce the principles and application of industrial cost engineering and investment analysis in the petroleum and mineral industries. The emphasis is on cost review, cost estimation and cost prediction methodology as a means for management decision making for projects and ongoing enterprise. The course will include full-cycle economics and time-value-of-money of greenfield and existing projects. Cost and financial procedures will be presented with regard to managerial and engineering control versus accounting reporting. The course will have a significant engineering cost analysis component.

Content:

1. The engineering cash flow calculation as applied to petroleum and mineral industries.
2. Cost engineering methodology to analyze historical performance, current operations, and forecast future costs.
3. Managerial analysis versus accounting reporting.
4. Case studies in project evaluation and investment decision making.
5. Sensitivity and risk analysis.

Prerequisite: None

Credits: 3

Integrative Design of Energy & Mineral Engineering Systems (EME 580)

Semester: Spring

Objectives: Students will work on interdisciplinary problems of societal significance that fall at the interfaces of the disciplinary options in the Energy and Mineral Engineering

graduate program. They will work collaboratively in teams to find an engineering solution to the problem and evaluate the economic feasibility of the solution. Results and conclusions will be communicated through oral and written presentations. The design methods will cover both physical and chemical processes. The importance of the exposure of energy and mineral engineering students to real world interdisciplinary problems will enhance their understanding of the class room concepts learned. Thus, a team-focused learning experience is promoted to ensure broadly educated graduates capable of taking advantage of the synergies among disciplines to address a common societal problem or concern.

- Content:
1. Methane hydrates and Coal bed methane
 2. Carbon sequestration
 3. Safety and transportation
 4. Sustainable energy
 5. Conventional fossil energy
 6. Production, processing and utilization of fossil and renewable energy
 7. Environmental, health and safety issues
 8. Economics. Management and Policy issues

Prerequisites: Students must have completed the required option courses in the Energy and Mineral Engineering graduate program or be in the second semester.

Credits: 5

Colloquium (EME 590)

Semester: Fall and Spring

Objectives: To facilitate, stimulate and guide active and collaborative learning in the formulation, solution and presentation of practical problems in energy and mineral engineering. The emphasis is on the methodology of problem solving and on the integrated use of scientific and engineering tools (mathematics, thermodynamics, kinetics, and transport phenomena). The course will focus on “how to engineer technical presentations”.

Content:

1. Development of concept map
2. Assessment of the relevant literature
3. Development of research road map
4. Preparation, presentation and analysis of progress reports
5. Development of technical presentation skills (i.e., how to engineer your presentation)
6. Preparation and presentation of final report.

Prerequisites: None

Credits: 1

Graduate Program in
Energy and Mineral Engineering (EME)

12. APPENDIX

The attached forms are to be filled out by the student, in consultation with the thesis advisor, and are to be submitted to the Graduate Program Staff Assistant.

- EME M.S. CHECKSHEET
- APPOINTMENT OF M.S. COMMITTEE
- SCHEDULING OF M.S. THESIS DEFENSE
- REPORT ON M.S. THESIS DEFENSE
- EME PH.D. CHECKSHEET
- SCHEDULING OF PH.D. CANDIDACY EXAMINATION
- ASSESSMENT OF ENGLISH COMPETENCY
- RECOMMENDATION OF PH.D. THESIS COMMITTEE
- SCHEDULING OF ORAL COMPREHENSIVE EXAMINATION
- SCHEDULING OF PH.D. FINAL THESIS DEFENSE
- REGULAR REVIEWS OF STUDENT PROGRESS

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY

EME M.S. CHECKSHEET

400/500-Level Courses (At least 18 course credits must be at level 500)

Core Program Courses (6 Credits Required)

| | |
|---------|-----------|
| EME 590 | 1 Credit |
| EME 580 | 5 Credits |

Required Option Course Credits (minimum) 8 Credits

| | |
|---|-----------|
| EHSE (EME 510 and STAT 512 and BBH 503 or IE 553) | 9 Credits |
| EMP (EME 525 and AEREC 597 and ECON 490 or ENNEC 473) | 9 Credits |
| FSc (FSc 504 and FSc 506 and EME 570) | 9 Credits |
| MMPE (MNG 515 or 541 or 554; and MNPR 501 or 505 or 506; and one from either group not selected) | 9 Credits |
| PNGE (PNG 501 or 502; and PNG 511 or 512; and PNG 520 or 530) | 9 Credits |

500-Level course credit requirement 18 credits

English Competency Test

Thesis Research (600 level) 6 Credits

Regular Reviews of Student Progress

M.S Thesis Defense

M.S. Thesis

Title: _____

M.S. Committee Members:

1. _____ (Committee Chair)
2. _____
3. _____
4. _____ (optional)

Note: This form should be filled out, approved by the Thesis Committee, and placed in the student's file during the student's first year in residence.

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY
APPOINTMENT OF M.S. THESIS COMMITTEE

To: EME Program Officer

The thesis topic of _____ is
(name of student)

The following faculty members have agreed to serve on the M.S. Committee. This committee, in accordance with Program rules, includes at least three members of the graduate faculty, and a majority of EME faculty.

1. _____ (Committee Chair)
2. _____
3. _____
4. _____ (optional)

Approved:

Committee Chair

Date

Note: This form should be filled out, approved by the Program Officer, and placed in the student's file during the student's first semester in residence.

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY
SCHEDULING OF M.S. THESIS DEFENSE

Name: _____

Thesis Title:

Time: _____

Date: _____

Place: _____

Committee Members

1. _____ (Committee Chair)
2. _____
3. _____
4. _____ (optional)

Note: This form should be completed by the student and returned to the Graduate Program Office no later than three weeks prior to the thesis defense.

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY

REPORT ON M.S. THESIS DEFENSE

Name:

Thesis Title:

Degree Sought:

| Committee Members (Sign Below) | Thesis Defense (Pass or Fail) | Date |
|-----------------------------------|----------------------------------|-------|
| 1. _____ (Advisor) | _____ | _____ |
| 2. _____ | _____ | _____ |
| 3. _____ | _____ | _____ |
| 4. _____ | _____ | _____ |

Note: This form should be completed and returned to the Graduate Program Office by the advisor after the thesis defense.

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY

EME Ph.D. CHECKSHEET

400/500-Level Courses (At least 12 course credits must be at level 500)

Core Program Courses (4 Credit Required)

EME 500 3.0 credits

Required option courses 4 credits

[FSc 503 and 590; or MNPR 506 and MNG 590;
or STAT 512 and IHS 590; or PNG 530 and 590;
or ENNEC 540 and 590]

Additional course credits (Minimum Beyond M.S) 12 Credits

500-Level course credit requirement 18 credits

English Competency Test

Candidacy Examination

Thesis Research (600 Level) 3 Credits

Thesis Committee

Oral Comprehensive Examination

Thesis Research (600 Level) 9 Credits

Regular Reviews of Student Progress

Ph.D. Final Thesis Defense

Ph.D. Thesis Title:

Ph.D. Thesis Committee Members:

1. _____ (Committee Chair)
2. _____
3. _____
4. _____
5. _____ (Outside Member/Department)

Note: This form should be filled out, approved by the Thesis Committee, and placed in the student's file during the student's first year in the Ph.D. program.

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY
SCHEDULING OF Ph. D. CANDIDACY EXAMINATION

Name:

Penn State ID Number:

Advisor:

Date of Candidacy Examination:

Time:

Place:

Committee Members: 1. _____ (Committee Chair)
2. _____
3. _____
4. _____
5. _____ (Outside Member/Dept.)

Committee Members - Should consist of at least three (3) specialty option Faculty members (not including your Advisor) plus an additional faculty member from a related or another option area. The Program Officer may participate as a quality monitor.

Room Scheduling – Make arrangements with the Staff Assistants in Room 110 Hosler to reserve a room for the exam. Room 104 Hosler is commonly-used, but if it is not available, another room can be scheduled.

Note: This form should be filled out by the student in consultation with the thesis advisor and submitted to the Graduate Staff Assistant at least three weeks prior to the date of the examination.

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY
ASSESSMENT OF ENGLISH COMPETENCY

This is to certify that _____ appeared before the undersigned committee on _____ and was given the English Competency Test required of all doctoral students. The results are indicated below.

Evaluation of the candidate's English Competency attainment by each committee member

Signature of
committee
member

| | | | |
|--------------------------|---------|------------------------|--------------------|
| READING COMPREHENSION | WRITING | FORMAL PRESENTATION | ORAL DISCUSSION |
|--------------------------|---------|------------------------|--------------------|

[Indicate either (S) or unsatisfactory (U) in each of the four categories.]

Two or more dissenting votes by the committee members will constitute a failure in each category of the English Competency Test. In case of failure in one or more categories, the student should follow the remedial steps outlined in the policy statement by the EME Program.

Signature of Committee Chair

Date

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY
RECOMMENDATION OF Ph.D. THESIS COMMITTEE

To: EME Program Officer

The following faculty members have agreed to serve on the Ph.D. Thesis Committee for

_____. This committee, in accordance with Program rules, includes at least three members of the graduate faculty, and one faculty member in a related field, outside the major.

1. _____ (Committee Chair)
2. _____
3. _____
4. _____
5. _____ (Outside Member/Department)

Approved: _____
Committee Chair

Date

Note: This form should be completed by the student in consultation with the advisor and submitted to the Program Officer by the end of the student's first year in the Ph.D. program. (The selection of the outside committee member(s) should be made as early as possible, but no later than three weeks prior to the date of the Candidacy Examination.)

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY

SCHEDULING OF ORAL COMPREHENSIVE EXAMINATION

Name:

Penn State ID No.:

Thesis Title:

Time:

Date:

Place:

Committee Members

1. _____ (Committee Chair)

2. _____

3. _____

4. _____

5. _____ (Outside Member/Department)

Note: This form is to be completed by the student and returned to the Program Office, 110 Hosler, no less than three weeks prior to date of examination.

EME PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY
SCHEDULING OF Ph.D. FINAL THESIS DEFENSE

Name: _____

Penn State ID No.:

Thesis Title:

Time:

Date: _____

Place:

Committee Members:

1. _____ (Committee Chair)

2. _____

3. _____

4. _____

5. _____ (Outside Member/Department)

Note: This form is to be completed by the student and returned to the Program Office no less than four weeks prior to date of defense.

**EME GRADUATE PROGRAM
THE PENNSYLVANIA STATE UNIVERSITY**

ANNUAL PROGRESS REVIEW REPORT

1. All students who have not formally scheduled a thesis defense must submit a report to the Program Office (Program Staff Assistant) by **April 30**.
2. The student should schedule a meeting with her/his committee.
3. At this meeting the student should present a 1-2 page summary of progress since the last meeting. This may include classes taken, meetings attended, awards received, papers written, and research progress made.
4. The committee will discuss these above items, provide constructive feedback on progress, and complete the form below.
5. The advisor will **attach the 1-2 page "summary of progress"** to this form and file with the Program Office.

Name _____ Program (M.S./Ph.D.) _____ Date Entered Program

Date M.S. Granted _____ Date of Last Comm. Mtg. _____ Date of This Comm. Mtg. _____ Anticipated Graduation

Notable Achievements this Year

SUMMARY EVALUATION

| | | Achievement and Progress | | | | |
|------------------|-------|--------------------------|-----------|------|------|------|
| Signature: | Date: | Excellent | Very Good | Good | Fair | Poor |
| Advisor | | | | | | |
| Committee Member | | | | | | |
| Committee Member | | | | | | |
| Committee Member | | | | | | |
| Committee Member | | | | | | |
| Committee Member | | | | | | |

Concerns or Recommendations from the Committee:

Graduate Bulletin Copy

ENERGY AND MINERAL ENGINEERING (EME)

YAW D. YEBOAH, *Head of the Department of Energy and Mineral Engineering*
118 Hosler Building
814-865-0269
Email: ydy1@psu.edu

R. Larry Grayson, *Graduate Program Officer*
103A Hosler Building
814-863-1644;
Email: rlg19@psu.edu
www.eme.psu.edu

Degrees Conferred: Ph.D., M.S. (with or without options in Petroleum and Natural Gas Engineering; Mining and Mineral Process Engineering; Environmental Health and Safety Engineering; Fuel Science; and Energy Management and Policy)

The Graduate Faculty

Michael A. Adewumi, Ph.D. (IIT) *Professor of Petroleum and Natural Gas Engineering*
Luis Ayala, Ph.D. (Penn State), *Assistant Professor of Petroleum and Natural Gas Engineering*
Andre Boehman, Ph.D. (Stanford), *Professor of Fuel Science*
Seth Blumsack, Ph.D. (Carnegie Mellon), *Assistant Professor of Energy and Mineral Engineering*
Jeffrey Brownson, Ph.D. (Wisconsin), *Assistant Professor of Energy and Mineral Engineering*
Yongsheng Chen, Ph.D. (Lehigh), *Assistant Professor of Energy and Mineral Engineering*
Caroline B. Clifford, Ph.D. (Penn State), *Senior Research Associate, Energy Institute*
Timothy J. Considine, Ph.D. (Cornell) *Professor of Natural Resource Economics*
Derek Elsworth, Ph.D. (California, Berkeley), *Professor of Energy & Geo-Environmental Engineering*
Turgay Ertekin, Ph.D. (Penn State) *Professor of Petroleum and Natural Gas Engineering*
Semih Eser, Ph.D. (Penn State), *Professor of Energy and Geo-Environmental Engineering*
Maochen Ge, Ph.D. (Penn State) *Associate Professor of Mining Engineering*
R. Larry Grayson, Ph.D. (West Virginia), *Professor of Energy and Mineral Engineering*
William A. Groves, Ph.D. (Michigan) *Associate Professor of Industrial Health and Safety*
Joel M. Haight, Ph.D. (Auburn) *Associate Professor of Energy and Mineral Engineering*
Phillip M. Halleck, Ph.D. (Chicago) *Associate Professor of Energy and Mineral Engineering*
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Serguei Lvov, Ph.D. (St. Petersburg), *Professor of Energy and Mineral Engineering*
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Mark Radomsky, Ph.D. (Penn State), *Senior Lecturer*
Ljubisa Radovic, Ph.D. (Penn State), *Professor of Energy and Mineral Engineering*
Raja V. Ramani, Ph.D. (Penn State) *Professor Emeritus of Mining and Geo-Environmental Engineering*
Jamal Rostami, Ph.D. (Colorado School of Mines), *Assistant Professor of Energy and Mineral Engineering*
Alan Scaroni, Ph.D. (Penn State), *Professor of Energy and Mineral Engineering and Associate Dean for Graduate Education and Research*
Harold Schobert, Ph.D. (Iowa State), *Professor of Fuel Science*
Chunshan Song, Ph.D. (Osaka), *Professor of Fuel Science*
Robert W. Watson, Ph.D. (Penn State) *Associate Professor Emeritus of Petroleum and Natural Gas Engineering and Geo-Environmental Engineering*
Yaw D. Yeboah, ScD (MIT), *Professor and Head of Energy and Mineral Engineering*
Fan Zhang, Ph.D. (Harvard), *Assistant Professor of Energy and Mineral Engineering*

The Department of Energy and Mineral Engineering provides a vertically integrated approach to research and education in all aspects of the energy and mineral industries, including scientific and engineering issues, health and safety and maintenance of high environmental standards. The department's mission is to forge an intellectual and scientific cohesiveness in energy and mineral resource technology. This objective is achieved by exploiting the natural synergy between the exploration, extraction, processing and utilization of energy and mineral resources so as to cater to the emerging needs of society. The Department offers advanced degrees in Energy and Mineral Engineering (M.S. and Ph.D.) and an online professional Master of Engineering (M. Eng.) degree in Oil and Gas Engineering Management. The Department has overall requirements for the M.S., M. Eng., and Ph.D. degrees with specific requirements associated with each program.

Energy and Mineral Engineering

The Energy and Mineral Engineering (EME) program is a single graduate program with a focus on the production of energy and minerals in an economic, safe and efficient manner. The program provides flexible education of students in energy and mineral sciences and engineering, with focus on both non-renewable and renewable resource and energy industries. The program is designed to resolve the sometimes-competing goals of flexible education of requisite breadth while still providing in-depth study; students are required to follow a focused curriculum that combines the requisite rigor with flexibility in a rapidly changing field of endeavor. Participating students take core program and required option courses and additional courses from a broad array of courses to meet the total credit requirements. Students are not required to choose an option. However, a student who desires disciplinary identity may choose from among the five available options: petroleum and natural gas engineering, mining and mineral process engineering, environmental health and safety engineering, fuel science, and energy management and policy.

Admission Requirements

Scores from the Graduate Record Examination (GRE) are required for admission, though this may be waived at the discretion of the Energy and Mineral Engineering graduate program. The best-qualified applicants will be accepted by the Energy and Mineral Engineering graduate program up to the number of spaces available for new students. At the discretion of the Energy and Mineral Engineering graduate program, a student may be granted provisional admission. Requirements listed here are in addition to general Graduate School requirements stated in the GENERAL INFORMATION section of the *Graduate Bulletin*. Admission to the Energy and Mineral Engineering graduate program in the Department of Energy and Mineral Engineering is competitive. Entering students must hold a bachelor's degree in a science or engineering discipline. Students with 3.00 or better (out of 4.0) junior/senior cumulative grade-point average and appropriate course backgrounds will be considered for admission. Exceptions to the minimum 3.00 grade-point average may be made for students with special backgrounds, abilities and interests. Undergraduate students from the Department of Energy and Mineral Engineering with sixth semester standing, minimum grade-point average of 3.3, and excellent faculty recommendations may be admitted for a five-year B.S./M.S. dual degree.

The language of instruction at Penn State is English. International applicants must take and submit scores for the TOEFL (Test of English as a Foreign Language) or the IELTS (International English Language Testing System), with the exceptions noted below. The minimum acceptable score for the TOEFL is 550 for the paper-based test, 213 for the computer-based test, or a total score of 80 with a 20 on the speaking section for the Internet-based test (iBT). Applicants with iBT speaking scores between 15 and 19 may be considered for provisional admission, which requires an institutional test of English proficiency upon first enrollment and, if necessary, remedial course work. The minimum composite score for the IELTS is 6.5. Specific graduate programs may have more stringent requirements. International applicants are exempt from the TOEFL/IELTS requirement who have received a baccalaureate or a master's degree from a college/university/institution in any of the following: Australia, Belize, British Caribbean and British West Indies, Canada (except Quebec), England, Guyana, Republic of Ireland, Liberia, New Zealand, Northern Ireland, Scotland, the United States, and Wales.

Letters of recommendation and an applicant's statement of purpose are also required.

Masters Degree requirements

The M.S. degree program in Energy and Mineral Engineering is designed for students to gain advanced knowledge for research, analysis and design in Energy and Mineral Engineering. Students pursuing an M.S. degree will be required to complete 24 course credits and submit a thesis (6 credits) to the Graduate School. Graduate committees in the graduate program in the Department of Energy and Mineral Engineering play an important role in formulating individual course and research schedules. At least 18 of the total course credits must be at the 500 level.

Doctoral Degree Requirements

The Ph.D. program in Energy and Mineral Engineering emphasizes scholarly research and helps students prepare for research and related careers in industry, government, and academe. Acceptance into the Ph.D. degree program in Energy and Mineral Engineering is based on the student's performance on the Ph.D. candidacy examination administered by the faculty of the EME graduate program. A comprehensive examination is required of all Ph.D. candidates and should be taken after substantial completion of course work. The comprehensive examination is the responsibility of the candidate's doctoral committee and administered according to rules specified by the Graduate School. The Ph.D. program in Energy and Mineral Engineering is quite flexible, with minimum formal requirements. A minimum of 12 post M.S. course credits is required. At least 18 course credits for the graduate program must be at the 500 level. For students entering the program with an M.S. degree, 500-level courses already taken either at Penn State or other institutions may be accepted in partial fulfillment of the Ph.D. 18 credits of 500-level course requirements if they are found to be appropriate. The communication and foreign language requirements for the Ph.D. degree may be satisfied by intermediate knowledge of one foreign language. The general requirements for graduation are outlined in the GENERAL INFORMATION section of the *Graduate Bulletin*. The specific credit requirements of the Ph.D. programs in the Department of Energy and Mineral Engineering are available upon request.

Other Relevant Information

All graduate students are expected to attend general department seminars. Graduate students may be asked to contribute to the instructional programs of the department by assisting with laboratory and lecture courses. Students in Energy and Mineral Engineering may elect the dual title degree program option in Operations Research for the Ph.D. and M.S. degrees.(see also Operations Research; online at www.psu.edu/bulletins/whitebook/courses/o_r.htm)

Student Aid

Graduate students are supported by a variety of government and industry fellowships, and research and teaching assistantships. Stipends vary depending on the source. Please see the STUDENT AID section of the *Graduate Bulletin* to learn other forms of the student aid.

For course descriptions for the Energy and Mineral Engineering graduate program, see the corresponding URL.

Energy and Mineral Engineering (EME):

www.psu.edu/bulletins/whitebook/courses/EME.htm

Graduate courses carry numbers from 500-599. Advanced undergraduate courses numbered between 400 and 499 may be used to meet graduate degree requirements when taken by graduate students. Courses below the 400 level may not. A graduate student may register for or audit these courses in order to make up deficiencies or to fill gaps in previous education but not meet requirements for an advanced degree.