Insider’s Guide to Energy Business and Finance (EBF) at Penn State University, AY 2015-16

For students in the General Option with a Program Year of 2014 or Earlier

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This version of the EBF Insider’s Guide is for students in the General Option with a program year of 2014 or earlier. If you are in the Energy Land Management Option or have a program year after 2014, a different set of requirements applies to you. Please refer to the appropriate course requirements at www.eme.psu.edu/ebf.
# Table of Contents

1 ABOUT EBF AND THE INSIDER’S GUIDE ................................................................. 4  
1.1 Get to Know Your Advisor! ............................................................................ 4  
1.2 Schedule Classes Early! .............................................................................. 5  

2 REQUIREMENTS FOR THE EBF GENERAL OPTION ........................................... 5  
2.1 Entry to the Major ....................................................................................... 5  
2.2 Overview of EBF General Option Requirements ........................................... 5  
   2.2.1 Coursework Requirements .................................................................... 5  
2.3 An Important Note on Math Requirements .................................................. 6  
2.4 Common Course Substitutions ..................................................................... 7  
2.5 Credit for Summer Internships ..................................................................... 8  
2.6 Summer Coursework ................................................................................... 9  
2.7 Honors Coursework ................................................................................... 9  
2.8 Taking Minors ............................................................................................ 9  

3 CONSIDERING GRADUATE SCHOOL? ............................................................... 10  
3.1 The IUG Program in Energy and Mineral Engineering ................................ 10  

4 DETAILED COURSE DESCRIPTIONS .................................................................. 10  
4.1 EBF General Option Core and Required Courses ....................................... 11  
4.2 Introductory Electives ................................................................................. 19  
4.3 Advanced Electives ..................................................................................... 19  
   4.3.1 Advanced Electives from the Energy Land Management Option ........... 19  
   4.3.2 Advanced Electives from Other Programs .......................................... 20
1 About EBF and the Insider’s Guide

The Energy Business and Finance degree program, offered through the John and Willie Leone Family Department of Energy and Mineral Engineering at Penn State, is a unique and focused degree program designed to train students for careers in energy or related industries. The General Option provides students with broad training in business and economics as relevant to energy production, consumption and delivery.

The General Option is designed for breadth of training. Students interested in a highly focused energy-related degree program should consider the Energy Land Management Option rather than the General Option. More information on the Energy Land Management Option is available at http://www.eme.psu.edu/ebf/landmanagement-option.

While the EBF General Option covers many of the essentials that students will find in conventional economics or business programs, our requirements are much more difficult than either. In particular, the EBF program expects a level of comfort with mathematical, statistical and quantitative thinking that is higher than expectations in economics or business.

The EBF Insider’s Guide is designed to provide students in the General Option of the Energy Business and Finance program at Penn State with detailed information on program requirements, courses available to students in the major, and pathways to graduation. It expands upon information available through two online resources:

- The EBF General Option program description available through the University Bulletin (http://bulletins.psu.edu/undergrad/programs/baccalaureate/E/EBF, also known as the ‘Blue Book’);
- The Recommended Academic Plans for the EBF General Option (located at https://rap.psu.edu/node/689).

The EBF major has a number of aspects that some students find complicated. The Insider’s Guide is designed to provide a clear explanation of program requirements and the courses that make up the EBF major. To minimize pain and confusion, all EBF General Option are urged to read this document carefully and to take two additional steps.

1.1 Get to Know Your Advisor!

We encourage students to know their advisors. Meeting with you advisor regularly can save you lots of trouble. If you do not know who your assigned advisor is, look on your degree audit or email Alisha Simon at anw114@psu.edu. If there is a question your advisor cannot answer, please contact the program chair, Dr.
Blumsack. But do not contact the program chair first with an issue your advisor can handle. You will simply be directed to talk to your advisor.

Ms. Simon is the dedicated academic advisor for the EME Department and is available to answer questions. Please see http://www.eme.psu.edu/academics/undergraduate/advising for information about which advising topics to discuss with your faculty advisor or Ms. Simon.

1.2 Schedule Classes Early!
Demand for every EBF course exceeds capacity. It is therefore imperative that students schedule courses as early as possible. If you don’t know when your scheduling date is, you can find out through the Registrar’s Office: http://www.registrar.psu.edu/Reg_Timetable/RegTimetable_Main.cfm.

We suggest scheduling courses literally as soon as you can – at 12:01 am on the earliest day that you are allowed to schedule. There is very little that the faculty or advisors can do to help you if you delay scheduling, even by one day!

2 Requirements for the EBF General Option
This section details the requirements for the EBF General Option. It largely repeats material available from the University Bulletin, but with some additional information.

2.1 Entry to the Major
Students must complete all of the following requirements to enter the EBF General Option:

- Completion of at least third semester standing, in terms of credits of coursework;
- Cumulative GPA of 2.0 or higher;
- Completion of ECON 102 and MATH 140, with a grade of C or higher in each.

2.2 Overview of EBF General Option Requirements

2.2.1 Coursework Requirements
We divide coursework for the EBF General Option into core EBF courses, required supporting courses, and electives.

Core EBF Courses: EBF 200, EBF 301, EBF 304W, EBF 401, EME 460, EBF 483 or 484, and EBF 473. These courses provide the business and economics foundation for careers in the energy industries. A grade of C or higher is required for all core EBF courses with the exception of EBF 473.
Required Supporting Courses:

*Mathematics:* MATH 140 and 141. A grade of C or higher is required for each of MATH 140 and 141. The EBF program takes this requirement very seriously.

*Statistics:* STAT 301, 401 or EBF 472. A grade of C or higher is required.

*Computer Programming:* CMPSC 101, CMPSC 200, CMPSC 201, or CMPSC 202.

*Economics:* ECON 102, ECON 104, ECON 302. A grade of C or higher is required for ECON 102 and ECON 302.

*Business:* ACCTG 211, B LAW 243 (or B A 241 and B A 242), IB 303, R M 302. A grade of C or higher is required for R M 302.

*English:* ENGL 15 or ENGL 30, ENGL 202C or ENGL 202D.

**Electives**
- 9 credits of introductory electives (200-level or lower) from an approved list.
- 9 credits of advanced electives (400-level) from an approved list.

The approved electives lists can be found in the PSU Bulletin under “Additional Courses” for the General Option: [http://bulletins.psu.edu/undergrad/programs/baccalaureate/E/EBF](http://bulletins.psu.edu/undergrad/programs/baccalaureate/E/EBF).

Note that the number of elective credits required for students with a program year of 2014 or earlier differ from what is described in the Bulletin. *Your degree audit will list the correct elective requirements.*

Some course substitutions are possible, and the EBF program will accept a wider range of electives than what is on the approved list. Common substitutions are discussed in Section 2.4 of this document. Electives that the EBF program will accept are found in Section 4, which also provides detailed course descriptions.

### 2.3 An Important Note on Math Requirements

The EBF General Option requires completion of both MATH 140 and MATH 141, with a grade of C or higher in each. In the past, the EBF General Option has permitted two exceptions to this requirement:

- MATH 110 was permitted in place of MATH 140 as a requirement for entry to the major;
- Students entering the EBF General Option with MATH 110 would be allowed to skip MATH 140 if they had previously taken MATH 110 with a grade of B or higher, scored at least a 76% on the ALEKS exam and passed MATH 141 with a grade of C or higher.
These exceptions will be maintained for students entering the major in the 2015/16 academic year, but students should be aware that the Math Department plans to start enforcing prerequisites more stringently than in the past. This means that even if a student enters the EBF General Option with MATH 110, the Math Department may still require MATH 140 before a student may move on to MATH 141.

The EBF program takes the math requirement very seriously. Our experience has been that a student’s grade in calculus is one of the best predictors of success in the EBF major. We urge students to fulfill the mathematics requirement as early in their careers as possible. **The mathematics requirements for the major will not be waived!** This means that students in the EBF General Option need to take MATH 140 and 141 (or an equivalent from another institution) and to earn a grade of C or higher in both courses. No exceptions to this requirement or petitions to have math courses waived will be accepted.

### 2.4 Common Course Substitutions

Many EBF students fill some of their program requirements with courses taken at other institutions, or in some cases with other Penn State courses besides those listed in the curriculum. There is a three-step process for approving course substitutions:

1. Have the substitution approved in writing by an advisor or the program chair.
2. Once the substitute course appears on the degree audit, fill out a course exemption form (available in 110 Hosler or in the Ryan Family Student Center) and bring it to your advisor to sign.
3. Place the completed course exemption form with supporting documentation (written approvals for the substitution and transcripts from other institutions where appropriate) in Dr. Blumsack’s mailbox in 110 Hosler.

If you take a course at another university that Penn State recognizes as equivalent to one of its own courses (through the Transferring Credits Tool at https://www.admissions.psu.edu/my_admissions/tas/), then you don’t need to go through the course substitution approval process (but you do need to make sure that Penn State gets the transcript).

Here are some of the more common course substitutions used by EBF students:

- Either EBF 483 or EBF 484 may count to meet core EBF requirements. If a student takes (and passes) both, one may be used to fill the advanced elective requirement. **Students are encouraged to take both EBF 483 and 484 but are not required to.**
- Virtually any introductory accounting course from a community college or other university may be used to meet the ACCTG 211 requirement. Many
introductory accounting courses at other universities are 3-credit courses, whereas ACCTG 211 is a 4-credit course. We will waive the extra credit for students taking introductory accounting at other universities.

- B A 241 and B A 242 may be taken in place of B LAW 243 or B A 243.
- Students may meet the mathematics requirements using calculus courses taken at community colleges or other universities. You will need to be sure that the substitute course is a close match for MATH 140 or 141. In particular, substitute courses should demonstrate the use of trigonometric derivatives (which are used in MATH 140 and 141 but not in MATH 110). **Students should be aware that the program chair will be very stringent in enforcing this requirement.** We do not, however, require that a substitute calculus course taken at another university be a 4-credit course. Three-credit calculus courses are acceptable, as long as they are taught at the right level.
- Students may meet the statistics requirement using a course taken at a community college or another university. EBF requires a calculus-based statistics course, and this requirement extends to any substitute statistics course. **The program chair will not approve any substitute statistics course that does not have calculus as a pre-requisite.**
- Equivalent courses for ECON 102, ECON 104 and ECON 302 can be found at many other universities.
- Students may elect to take a computer science course from another university or one at Penn State other than those listed in the degree requirements. EBF requires a course in a programming language (e.g., C++, Python, Matlab). Courses in word processing or spreadsheet management (e.g., Excel) or courses in web design (HTML), for example, do not meet this requirement.

## 2.5 Credit for Summer Internships

Some students wish to get credit for summer internships. Advanced students in the general option (rising juniors or higher) can get 3 credits towards their advanced elective requirement using a qualified internship. Students wishing to take this option must meet the following requirements:

1. Entrance to the major prior to the start of the internship;
2. Completion of at least four semesters of University coursework prior to the start of the internship;
3. Completion of EBF 200 and EBF 301, with grades of C or higher in each.

There is a four-step process for getting internship credit:

1. An internship that clearly builds upon and complements the EBF curriculum (just working for an energy company is not sufficient – qualifying internships will utilize industry or analytic skills developed through coursework or will build upon a student’s analytic tools in a meaningful way);
2. You must get permission of your faculty advisor by June 1 of the relevant year (much earlier if possible, since many faculty travel a lot over the summer);
3. You need to sign up for a section of ENNEC 496 in the fall term (your advisor can help with this);
4. You need to write a 20-page paper describing your internship, to be evaluated by your advisor.

2.6 Summer Coursework
A number of EBF General Option requirements can be met by taking summer courses, either at University Park, online or through other institutions. Some EBF core courses, such as EBF 200 and EBF 301, can be taken over the summer through World Campus. More information on summertime course availability is available at http://www.eme.psu.edu/sites/default/files/ebf-summertime.pdf.

2.7 Honors Coursework
We strongly encourage students with GPAs greater than 3.7 and at least an A- in EBF 200 who have not yet entered their junior year to apply to the Schreyer Honors College. More information on the “sophomore gateway” is available from the Honors College at https://www.shc.psu.edu/admissions/apply/gateway.cfm. Students wishing to write an EBF honors thesis are expected to take additional coursework in statistics beyond what is required for the EBF General Option – specifically, either ECON 490/306 or STAT 462. The EBF program will allow this additional statistics work to count as three of the required advanced elective credits. If you wish to apply to the Honors College at the end of your freshman year, please contact Dr. Blumsack about getting into EBF 200.

For students with strong quantitative and analytical skills, the Honors College provides an excellent pathway to get involved in EBF faculty research. If you have any interest in research-based graduate study someday (see Section 3), getting research experience as an undergraduate is extremely beneficial. Many EBF honors theses wind up getting published!

2.8 Taking Minors
We encourage students to take minors that complement the EBF curriculum in some way, or demonstrate well-roundedness and an interest in something other than EBF. While getting a minor in economics is relatively simple and straightforward, it doesn’t add much value to your transcript because there is so much overlap between the EBF curriculum and the economics minor. Some types of minors that we encourage students to consider include:

- Technical minors in science or engineering;
- Foreign language minors
Any minor that requires a lot of writing, like history.
A minor in a subject you've always been interested in – you don’t get to go to college again, so this is your chance!

3 Considering Graduate School?
The EBF General Option positions students very well for graduate study in a number of areas, including economics, finance, law and public policy. A number of our alumni have gone on to graduate study, either directly from Penn State or after a stint in the workplace.

Students with an interest in graduate study should consider taking additional coursework that complements the EBF General Option and will strengthen their applications. How best to do this depends on the type of graduate study – professional degrees (e.g. a law degree or MBA) or research-based graduate study (e.g. the M.S. or Ph.D.). Students with an interest in graduate study are encouraged to discuss the type of program of interest with advisors or with Dr. Blumsack.

Students interested in M.S. or Ph.D. programs in economics, finance or in some cases public policy should plan to take as much mathematics and statistics as possible. Minoring in math, physics or statistics (or double-majoring) is very strongly encouraged as preparation before pursuing admission to a M.S. or Ph.D. program in one of these fields. Students interested in most areas of professional graduate study are advised to take coursework that develops written communication skills (such as history). An exception might be quantitative MBA programs, where mathematical skills are more highly valued.

3.1 The IUG Program in Energy and Mineral Engineering
The EME Department has now adopted an IUG program which allows successful students to graduate in five years with both the B.S. in EBF and the M.S. in Energy and Mineral Engineering (Energy Management and Policy Option). EBF General Option students who wish to be considered for this program need to have a GPA of 3.5 or better and should be pursuing a minor in a relevant engineering field (math does not count). Students interested in the IUG option should discuss this interest with an advisor as soon as possible.

4 Detailed Course Descriptions
This section contains detailed descriptions of courses that can be used to meet EBF requirements. Course descriptions are largely from the Blue Book, with some commentary. Students should be aware that in some cases the prerequisites are strictly enforced and in some cases not. Prerequisite checking across the University will become more stringent in the near future, so it is always best to check with the instructor or department offering the course if you have questions about prerequisites!
4.1 EBF General Option Core and Required Courses

**ECON 102** (GS) **INTRODUCTORY MICROECONOMIC ANALYSIS AND POLICY** (3) Methods of economic analysis and their use; price determination; theory of the firm; distribution. *A grade of C or better is required.*

Students should take this as early as possible (it is required for entry into the major). It is offered in the summer at most PSU campuses, and equivalents are offered in the summer at most universities.

**ECON 302** (GS) **INTERMEDIATE MICROECONOMIC ANALYSIS** (3) Allocation of resources and distribution of income within various market structures, with emphasis on analytical tools. Prerequisite: ECON 102. *A grade of C or better is required.*

This should be taken immediately after students take ECON 102, or during sophomore year as stated on the Recommended Academic Plan. It can be taken in the summer at several campuses, and equivalents can be taken at many universities.

**EBF 200** (GS) **INTRODUCTION TO ENERGY AND EARTH SCIENCES ECONOMICS** (3) Resource use decisions and their effect on local, national, and global development. *A grade of C or better is required.*

This is the introductory course to the major. ECON 102 is a prerequisite, along with MATH 022 (or a more advanced math course). It is offered both fall and spring semesters, in person and on the web. It is offered online in the summer, and some other Penn State campuses are beginning to offer it periodically.

**EBF 301** **GLOBAL FINANCE FOR THE EARTH, ENERGY, AND MATERIALS INDUSTRIES** (3) The aim of this course is to introduce fundamental concepts of financial management and illustrate their global applications. *A grade of C or better is required.*

EBF 301 focuses on commodity markets. Students should take this by their fifth semester, after they have taken ECON 102. This course is online, and offered fall, spring, and summer.

**EBF 304W** **GLOBAL MANAGEMENT FOR THE EARTH, ENERGY, AND MATERIALS INDUSTRIES** (3) This class is designed to introduce students to modern management and organization strategies for resource businesses. Prerequisite: EBF
200. A grade of C or better is required.

We offer this class, which focuses on risk analysis and making decisions in the face of uncertainty, during both semesters. The “W” limits the seats, making this class very hard to get into. Students taking a concurrent major can have the “W” class in their other major count in place of EBF 304W.

**EBF 401 STRATEGIC CORPORATE FINANCE FOR THE EARTH, ENERGY, AND MATERIALS INDUSTRIES (3)** Financial decisions corporations in the earth science area make and the tools and analyses used to make these decisions. Prerequisite: EBF 200, EME 460, and junior or senior standing. A grade of C or better is required.

This course is offered both semesters, and the prerequisites will be enforced.

**EBF 473 RISK MANAGEMENT IN ENERGY INDUSTRIES (3)** Analysis of strategies for mitigating business risk from market, atmospheric, geophysical uncertainties including the use of energy/mineral commodity futures/options, weather derivatives, and insurance. Prerequisite: EBF 472, STAT 301 or STAT 401

Any of the statistics classes above serve as the prerequisite. This is the most challenging course in the major, and is one of the most relevant to employment opportunities. Less than fully motivated students taking this course senior year should beware – you can fail this class, if you work at it!

Alternatives for this class are difficult to find. It may be helpful to take EBF 301 and EBF 401 previously or concurrently.

**EBF 483 Introduction to Electricity Markets (3)** This course will introduce students to the structure of regulated and deregulated electricity markets; emerging environmental regulations shaping the electricity industry; and the potential impacts of the "smart grid" on electricity generation, transmission and utilization.

Prerequisites: ECON 302, MATH 110 or 140.

Students are required to take either EBF 483 or EBF 484. If you take both, one of the classes can count for the 400-level elective course. EBF 483 is offered only in the spring term. EBF 483 provides excellent preparation for a career in the electric power sector.

**EBF 484 ENERGY ECONOMICS (3)** Economics of energy demand, production, storage, and pricing; advanced energy policy issues including regulation, climate change, new energy technology. Prerequisite: ECON 102 or EBF 200, 3 credits of calculus. A grade of C or better is required.
The economics department offers its own version of this class, ECON 427, which can substitute for EBF 484. Of course, we won’t give you credit for both EBF 484 and ECON 427.

**ENGL 202C (GWS) Effective Writing: Technical Writing (3)** Writing for students in scientific and technical disciplines. (A student may take only one course for credit from ENGL 202A, 202B, 202C, and 202D.)
Prerequisite: [ENGL 015](https://example.com) or [ENGL 030](https://example.com); fourth-semester standing

Or

**ENGL 202D (GWS) Effective Writing: Business Writing (3)** Writing reports and other common forms of business communication. (A student may take only one course for credit from ENGL 202A, 202B, 202C, and 202D.)
Prerequisite: [ENGL 015](https://example.com) or [ENGL 030](https://example.com); fourth-semester standing

Any English 202 course (A, B, C, or D) will do.

**IB 303 (IL) INTERNATIONAL BUSINESS OPERATIONS (3)** A survey of the major aspects of international business environment and operations with an emphasis on the cultural dimension. Prerequisite: fifth-semester standing

This class does not appear to be taught at other PSU campuses but may be offered during the summer at University Park.

**RM 302 RISK AND INSURANCE (3)** Introduction to the principles and methods of handling business and personal risks; emphasis on insurance techniques. Prerequisite: fourth-semester standing. *A grade of C or better is required.*

This class does not appear to be taught at other PSU campuses or during the summer.
**EM SC 100S** (GWS) **Earth and Mineral Sciences First-Year Seminar** (3) Writing, speaking, and critical thinking skills applied to topics of general interest in Environmental and Materials Science. This is only for first-year students in the EMS College.

Or

**CAS 100** (GWS) **Effective Speech** (3) Introduction to speech communication: formal speaking, group discussion, analysis and evaluation of messages.

If you entered the EMS College as a freshman, you should have taken EM SC 100S. If you entered EMS after your freshman year, you need to take CAS 100 and a freshman seminar. You probably already took the freshman seminar from another college. If you are a transfer student, you do not have to take the freshman seminar, and you will need CAS 100 in place of EM SC 100S

**ACCTG 211** **FINANCIAL AND MANAGERIAL ACCOUNTING FOR DECISION MAKING** (4) Introduction to the role of accounting numbers in the process of managing a business and in investor decision making.

This is the standard accounting course, taught at almost every university in the country. Most UP sections are now offered as hybrid resident-online courses. Unfortunately, the Smeal College has made it difficult for EBF students to take this course in the fall term, so it is usually taken in the spring semester by EBF students. In the summer, you may wish to take the World Campus version. This means you have to find out about it by looking at the World Campus website, http://www.worldcampus.psu.edu/index.shtml

Substitutes can be taken for this class at almost all universities. If you take an accounting course at another university that is only worth 3 credits, Penn State will not recognize it as “ACCTG 211”, but merely “Accounting.” So you’ll need an exemption sheet signed, which is no problem.

**CMPSC 101** (GQ) **INTRODUCTION TO ALGORITHMIC PROCESSES** (3) Properties of algorithms, languages, and notations for describing algorithms, applications of a procedure-oriented language to problem solving. A student may receive credit for only one of the following courses: CMPSC 101, 201C, 201F, CSE 103. Prerequisite: 2 entrance units in mathematics.

Or

**CMPSC 121** (GQ) **Introduction to Programming Techniques** (3) Design and implementation of algorithms. Structured programming. Problem solving techniques. Introduction to a high-level language, including arrays, procedures, and recursion.

Prerequisite: MATH 110 or MATH 140
Or

**CMPSC 200** (GQ) **PROGRAMMING FOR ENGINEERS WITH MATLAB** (3)
Development and implementation of algorithms in a MATLAB environment, with emphasis on numerical methods for engineering problems. Students can receive credit for only one of the following: CMPSC 101, 201A, 201C, 201F or CSE 103. Prerequisite: **MATH 140** Concurrent: **MATH 141**

Or

**CMPSC 201** (GQ) **PROGRAMMING FOR ENGINEERS WITH C++** (3) Development and implementation of algorithms in a procedure-oriented language, with emphasis on numerical methods for engineering problems. Students who have passed CMPSC 101, 201F, or CSE 103 may not schedule this course. Prerequisite: **MATH 140** Concurrent: **MATH 141**

Or

**CMPSC 202** (GQ) **Programming for Engineers with FORTRAN** (3) Development and implementation of algorithms in a procedure-oriented language, with emphasis on numerical methods for engineering problems. A student may receive credit for only one of the following courses: CMPSC 101, 102, 200, 201, or 202. Prerequisite: **MATH 140** Concurrent: **MATH 141**

The idea here is that we want you to take a programming class. Lots of alternatives are available at other universities.

**MATH 140** (GQ) **CALCULUS WITH ANALYTIC GEOMETRY I** (4) Functions, limits; analytic geometry; derivatives, differentials, applications; integrals, applications. Students may only take one course for credit from MATH 110, 140, 140A, 140B, and 140H. Prerequisite: **MATH 022, MATH 026**; or **MATH 040** or **MATH 041** or satisfactory performance on the mathematics proficiency examination. A grade of C or better is required.

These classes, or their equivalents, are offered in a large number of places and times. We emphasize again that students need to earn a C or higher in this course and in MATH 141. Frankly, if you got a D in calculus, you are probably in the wrong major.

Many students take pre-calculus courses in the math department (i.e., MATH 26, MATH 40, etc.) These classes do not count toward your 120 credit hours required for University graduation if you are in a major that requires calculus (such as EBF). No exemptions are allowed.

**MATH 141** (GQ) **Calculus with Analytic Geometry II** (4) Derivatives, integrals, applications; sequences and series; analytic geometry; polar coordinates. Students
may take only one course for credit from MATH 141, 141B, and 141H. *A grade of C or better is required.*

Prerequisite: **MATH 140, MATH 140A, MATH 140B or MATH 140H**

**B LAW 243 LEGAL ENVIRONMENT OF BUSINESS** (3) Social control through law: courts, basic policies underlying individual and contractual rights in everyday society. May not be used to satisfy Smeal College baccalaureate degree requirements.

Or

**E R M 411 LEGAL ASPECTS OF RESOURCE MANAGEMENT** (3) Legal systems and lawmaking processes; property rights in land, water, and wildlife resources; jurisdictional problems in planning resource use. Prerequisite: **E R M 151**

B LAW 243 is offered in the summer at various PSU campuses. There may be alternatives available in the summer at other universities. ERM 411 is offered fall term. You can take E R M 411 in place of B LAW 243 or as a 400-level elective, but not both. You can also take B A 241 and B A 242 (together 4 credits) for this requirement, though you have to be in DUS or the Smeal College to do so. These classes are described below.

or

**B A 241 Legal Environment of Business** (2) Examines the legal system’s role and impact regarding business transactions, liability issues, and ownership of intellectual property. Students earning credit for B A 241 may not earn credit toward Smeal College baccalaureate degree for B LAW 243 and/or B A 243.

And (if you take this route)

**B A 242 Social and Ethical Environment of Business** (2) Explores the social and ethical environment of business and ethical decision making in a business context.

**ECON 104** (GS) **INTRODUCTORY MACROECONOMIC ANALYSIS AND POLICY** (3) National income measurement; aggregate economic models; money and income; policy problems.

Or
**GEOG 126** (GS; US; IL) **ECONOMIC GEOGRAPHY** (3) The location of economic activity at both macro- and micro-regional levels on the earth's surface.

ECON 104 is more relevant to the curriculum than GEOG 126. Some students prefer the smaller class size of GEOG 126. ECON 104 not a prerequisite to anything in the EBF curriculum, and so there is no need to take it at a particular time. ECON 104 is offered in the summer at most PSU campuses, and equivalents are offered in the summer at most universities.

**EBF 472** **QUANTITATIVE ANALYSIS IN EARTH SCIENCES** (3) Quantitative analysis of decision making in atmospheric/geophysical sciences: exploratory data analysis, quantification of uncertainty, parametric/non-parametric testing, forecasting, time series analysis. Prerequisite: **MATH 110** or **MATH 140**

Or

**STAT 301** (GQ) **STATISTICAL ANALYSIS I** (3) Probability concepts; nature of statistical methods; elementary distribution and sampling theory; fundamental ideas relative to estimation and testing hypotheses. Prerequisite: 3 credits of calculus

Or

**STAT 401** **EXPERIMENTAL METHODS** (3) Random variables; probability density functions; estimation; statistical tests, t-tests; correlation; simple linear regression; one-way analysis of variance; randomized blocks. Prerequisite: **MATH 111** or **MATH 141**

*A grade of C or better is required for any statistics class used to fill this requirement.*

Some students come into the EBF program already having taken STAT 200. You still have to take one of the above classes. If you did well in STAT 200 and have taken MATH 141, try STAT 401. The statistics department generally offers more STAT 401 than STAT 301 sections. EBF 472 (which we encourage students to take), is typically taught one semester each year.

Options at other universities are limited because we require a higher level of statistics than other programs. The EBF program requires a statistics class with a calculus requirement.

Some students may have AP Statistics credit from high school, but that is not an acceptable substitute for the EBF statistics requirement.
EME 460 ENGINEERING EVALUATION OF OIL AND GAS PROPERTIES (3)
Application of present worth and rate-of-return analysis; reserve calculations; decline curve analysis; uncertainty and risk analysis to engineering project design and evaluation.

This class is offered in person fall term and online with varying frequency (in the past it has been offered online spring and summer but whether it will be offered online during both semesters in the future is uncertain). IE 302 is a potential substitute for this class, but talk to the instructor first. IE 302 technically requires MATH 141, and the IE department appears to be enforcing this requirement.
4.2 Introductory Electives
There are a large number of potential classes here, not all of which are listed on the degree audit or in the Blue Book. Basically, the program will accept any GN Class offered by the College of Earth and Mineral Sciences. Below is a discussion of a few classes that we particularly encourage students to take.

EGEE 101 (GN) (MATSC) ENERGY AND THE ENVIRONMENT (3) Energy utilization and technological development, energy resources, conversion and consequences on the local and global environment, and future energy alternatives.

This is an excellent introduction to energy engineering issues and is taught by popular instructors. It is also offered online.

EGEE 102 (GN) ENERGY CONSERVATION FOR ENVIRONMENTAL PROTECTION (3) Exposure to energy efficiency in day-to-day life to save money and energy, and thereby protect the environment.

This is an excellent introduction to energy conservation issues and is again taught by popular instructors and offered online.

EGEE 120 (GS;US;IL) OIL: INTERNATIONAL EVOLUTION (3) Survey of the commercial development of the world petroleum industry from various international, historical, business, and cultural perspectives.

This course investigates historical issues relevant to the major and is therefore a good choice for GS, US, and IL requirements (but not the GN requirement). It is only offered online.

METEO 004 (GN) Weather and Risk (3) Non-technical introduction to the science and historical development of meteorology, and the role of weather forecasting as a tool for risk management by individuals, businesses, and societies.

This is a very nice non-technical elective that discusses many risk management issues.

4.3 Advanced Electives
There are a number of choices here, and not all will be discussed. If students desire to concentrate in areas relevant to the major with courses not listed here, they should contact Dr. Blumsack.

4.3.1 Advanced Electives from the Energy Land Management Option
The recently-opened Energy Land Management Option within the EBF program offers some specialized courses focused on contractual and land-use issues related to energy development. EBF General Option students are welcome to take these
courses if space is available, which can count toward the advanced electives requirement.

**E B F 402 Energy Law and Contracts** (3) An examination of the law that applies to acquiring the property rights for exploration and drilling of energy sources. Effective: Spring 2014
Prerequisite: **B LAW 243**

**E B F 410 Petroleum and Natural Gas Operations** (3) The course is designed to instruct energy land management option students of the EBF major in the drilling of petroleum and natural gas wells and the challenges in that process. Effective: Summer 2015
Prerequisite: **PHYS 211** or **PHYS 250, GEOSC 001**

**E B F 411 Petroleum and Natural Gas Geology for Land Professionals** (3) This course provides energy land students with a knowledge base, as well as a set of notes and references, that they can draw on during a career in the petroleum industry. Effective: Summer 2015
Prerequisite: **GEOSC 001**

### 4.3.2 Advanced Electives from Other Programs

Prerequisite: **ECON 302, SCM 200** or **STAT 200**

**ECON 444 Economics of the Corporation** (3) Coordination and incentive issues within a corporation. Topics include employment contracts, performance incentives and pricing of financial assets. Effective: Summer 1997
Prerequisite: **ECON 302**

**EME 432 (GEOG 432) Energy Policy** (3) Analysis, formulation, implementation, and impacts of energy-related policies, regulations, and initiatives.
Prerequisite: **E B F 200, EGEE 120, PL SC 490**

This course is offered online periodically (check the Penn State scheduling web site or contact the Dutton e-Education Institute). The prerequisites have not been strictly enforced in the past.
**FIN 406 Security Analysis and Portfolio Management** (3) Advanced valuation theory; fundamentals of security analysis; portfolio construction and management. Prerequisite: B A 301 or FIN 301

This class is only available to EBF students during the summer. EBF students cannot take the listed prerequisites.

**FIN 408 Financial Markets and Institutions** (3) Functional analysis of major credit institutions; sources and uses of funds; impact of government regulation. Prerequisite: B A 301 or FIN 301

This class is only available to EBF students during the summer. EBF students cannot take the listed prerequisites.

**GEOSC 450 RISK ANALYSIS IN THE EARTH SCIENCES** (3) An introduction to concepts and methods of quantitative risk analysis with focus on water, climate, and energy related risks.

Prerequisite: MATH 140 or MATH 110, introductory Earth Science or Geoscience class, introductory Statistics class (e.g. STAT 200 or STAT 301 or EBF 472) Make sure you have the prerequisites. There will be a lot of math in this class.

**GEOSC 454 GEOLOGY OF OIL AND GAS** (3) Properties, origin, migration, and occurrence of oil and gas. This course has one or more required field trips for which a fee is charged to the student. Prerequisite: GEOSC 001

This is a challenging yet highly relevant class. Speak to the instructor before you sign up for it.

**METEO 473 APPLICATION OF COMPUTERS TO METEOROLOGY** (3) Application of statistical and numerical methods to practical problems in meteorology. Prerequisite: CMPSC 101, CMPSC 201, or CMPSC 202

This is a challenging class. If you are not also a meteorology major or minor, speak with the instructor before signing up.

**GEOG 430 HUMAN USE OF ENVIRONMENT** (3) The human use of resources and ecosystems and social causes and consequences of environmental degradation in different parts of the world; development of environmental policy and management strategies. Prerequisite: GEOG 030

**GEOG 424 (US;IL) GEOGRAPHY OF THE GLOBAL ECONOMY** (3) Focus on industrial location theory, factors in industrial location, studies of selected industries and problems of industrial development. Prerequisite: ECON 102, ECON 104, GEOG 126.
In the past, students have needed only 2 of the 3 listed prerequisites.

**GEOG 431 ** GEOGRAPHY OF WATER RESOURCES (3) Perspectives on water as a resource and hazard for human society; water resource issues in environmental and regional planning. Prerequisite: 6 credits in geography or natural sciences.

**GEOG 444 ** AFRICAN RESOURCES AND DEVELOPMENT (3) Ecological and cultural factors in the geography of Africa; natural resources and development. Prerequisite: **GEOG 010, GEOG 020, GEOG 030, or GEOG 124**

**CED 404 ** (AG EC) METHODS IN NATURAL RESOURCE AND ENVIRONMENTAL ECONOMICS (3) Students will learn empirical research methodology in the areas of environmental and natural resource economics. Prerequisite: **AG EC 201 or ECON 302, ECON 428**

**CED 409 ** LAND USE PLANNING AND PROCEDURE (3) General land use planning laws and procedures.

Prerequisite: 6 credits of B LAW, CED, ECON, E R M, E RRE, PL SC, R EST, SOC, or S T S (any combination)

**CED 429 ** (AG EC) NATURAL RESOURCE ECONOMICS (3) Optimal management of resources; roles of markets and other institutions; resources and economic development; public policy. Prerequisite: **ECON 302**

**CED 431W ** (AG EC) ECONOMIC ANALYSIS OF ENVIRONMENTAL AND RESOURCE POLICIES (3) Economic analysis of environmental and natural resource policies, benefit-cost analysis, non-market valuation techniques; resource damage assessment. Prerequisite: **ECON 302**

**CED 450 ** (IL) INTERNATIONAL DEVELOPMENT, RENEWABLE RESOURCES, AND THE ENVIRONMENT (3) Theories of agricultural and economic development, with particular attention to interactions between development, renewable resources, and the environment.

Prerequisite: 6 credits in agricultural economics or economics

**FOR 350 ** Forest Resources Biometrics (3) Quantitative approaches for characterization and comparison of natural resources in forested landscapes. Prerequisite: one course each in calculus, statistics, and computers

**FOR 401 ** Urban Forest Management (3) Uses and values of urban vegetation, open space, and wildlife; planning, financing, support, management, and administration of urban forestry programs.
Prerequisite: three credits in business management or economics and six credits in biology forestry or plant materials

The prerequisites in biology are not enforced, but you should be prepared to study some biology.

**FOR 440 Forest Economics and Finance** (3) The application of economic theory to forest resources systems, with emphasis on production and investment analyses. Prerequisite: ECON 102 or ECON 104

**PL SC 490 POLICY MAKING AND EVALUATION** (3) Advanced analysis of public policy, emphasizing policy evaluation and the factors that determine policy success and failure. Prerequisite: PL SC 001 or PL SC 002