Insider’s Guide to EBF major  
Courses in the EBF Curriculum

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The EBF major is rather complicated. This document is designed to give students direction on what courses they can take, and how to minimize the pain involved in the degree.

Perhaps the most important thing to note is that we have continued increased excess demand for seats in our classes. This means that you should sign up for classes as soon as you can! If you do not do this, there is likely very little we can do to help you.

Please note that the quantitative requirements for the EBF major are substantially greater than those of business majors or the major in economics. In particular, we require MATH 141 for the major. We expect that we will have a number of students entering the major who have taken Math 110. This will pose some difficulties. The problem appears to be that Math 140 uses derivatives of trigonometric functions, while Math 110 does not. Such derivatives are used in Math 141.

Therefore, if you had in high school a good pre-calculus class which incorporated trigonometric functions and you got at least a B in Math 110, we recommend that you skip from Math 110 to Math 141. If you can get through 141 with at least a C the Math 140 requirement will be waived. Be aware that you will have some deficiencies that you will have to make up. ALEKS (www.aleks.com) provides a great platform for self help. If you do not meet these criteria, we suggest you take Math 140.

Please do not wait until the end of your college career to meet this requirement. The sooner you do this, the less painful it will be. Also if you plan complete your coursework without Math 141, and then petition to have 141 waived, such waivers will not be granted. If you really cannot get through Math 141, you might want to think about the on-line major in Energy and Sustainability Policy (http://www.worldcampus.psu.edu/degrees-and-certificates/energy-and-sustainability-policy-bachelors/overview).

New this year is the option in energy land management. Land management is a growing field in the Marcellus Shale exploration region. We expect there will be significant employment opportunities for good students in this area. The required courses are in geology, physics, petroleum engineering, GIS, surveying, energy law, and petroleum geology, and are discussed below.

We encourage students to take minors. But you should remember that you want to take a minor that distinguishes you from other job candidates and shows that you have some background in a different field. So a minor in economics, while easy to obtain, is not likely to help you very much. (Think about trying to explain to your prospective
employer how you obtained double credit for doing one thing.) Look for a minor in something different. A foreign language minor is always a good choice, if you have some aptitude there. Art and music minors are helpful. For students coming from an engineering program, a minor in one of the engineering programs in the Energy and Mineral Engineering Department or engineering entrepreneurship makes a lot of sense.

We also encourage students to know their advisors. Meeting with your advisor regularly can save you lots of trouble. If you do not know who your advisor is, look on your degree audit or email Crystal Renaud at cdr125@psu.edu. If there is a question your advisor cannot answer, please contact the program officer. But do not contact the program officer first with an issue your advisor can handle. You will simply be directed to talk to your advisor.

Almost all EBF students have course petitions to be signed in order to graduate. So when you need this done, find a petition form (the student center has them, as well as 110 Hosler), fill it out, and give it to your advisor to sign. Then put the petition in Dr. Kleit’s mailbox in Hosler 110.

We strongly encourage students with GPAs greater than 3.7 and at least an A- in EBF 200 who have not entered their junior year to apply to the Schreyer Honors College. See http://www.shc.psu.edu/future/gateway.cfm. If you are in the Honors College, you are required to take ECON 490/306 or STATS 462 as an advanced level elective. Honors students in the Energy Systems Option do not have to take INS 301. If you wish to apply to the Honors College at the end of your freshman year, please contact Dr. Kleit about getting into EBF 200.

We have also adding choices of courses that will count for honors credit. We are offering an honors version of EBF 304 (EBF 304M) sponsored by the Hess Corporation Fall ’12 and Fall’13. Honors students can also take the graduate versions of EBF 484 (EME 500, offered Fall term), a graduate version of EBF 483/EGEE 497A (Electricity Economics, spring term.

There is now an EBF term abroad program in Dalian, China. The courses, in English, address Chinese energy and environmental issues. Successful completion of the program gives you 6 credits toward your 400 level electives. The program runs May 15 to July 1. If you are interested, please contact Dr. Lei, zlei@psu.edu.

We are working to create a term abroad program with ESAN, a business school in Lima, Peru. See http://www.ue.edu.pe/programa-cbem. The ESAN program lasts for one semester, either March to July or August to September. Successful students gain a certificate in business in emerging markets, and nine credits toward your 400 level electives. You can go on your own for the March 2014 term. See Dr. Kleit, ankl1@psu.edu, with any questions.

For students interested in studying abroad through other programs, please contact the EMS faculty person who coordinates this, Dr. Kevin Furlong, kpf1@psu.edu.
We have had some students express an interest in graduate school in economics or a related field. If this applies to you, please meet with Dr. Kleit as soon as possible. In particular, we have found that these students need to enhance their background by taking additional math and statistics classes. On the other hand, if you are interested in going to law school, it helps to have classes in writing.

There are a variety of classes students can take in the summer that count toward the EBF degree. They are listed in an accompanying document posted on the EBF website.

Some students wish to get summer credit for internships. Students in the general option can get 3 credits counting toward your 400 level elective requirement. To do so, you need 4 things:

1) An internship that focuses on energy issues.
2) You must get permission of your advisor by May 15 of the relevant year.
3) You need to sign up for 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 graded by your advisor.

Our department has now adopted an IUG program which allows successful students to graduate in 5 years with both an undergraduate and a graduate degree. EBF students who wish to be in this program need to have a GPA of 3.5 or better. They also need to be in the process of taking 30 credit hours in engineering and science class (math classes do not count.) (Students in the Energy Systems Option meet this requirement.) IUG students are asked to take EME 500 fall term of their fourth year instead of EBF 484. If you are interested in the IUG, we ask you to contact your advisor as soon as possible.

Students who are interested in the Energy Systems option should be aware that it is very challenging. Our view is that any student who has a GPA less than 3.0 should not be in this option.

The Energy Systems option has difficult scheduling issues. This is because students in it need to take EME 301 and EME 303 fall term junior year. (The courses are not offered in the spring.) This, in turn, implies you should have all your chemistry and physics classes finished before then.

Course descriptions from largely from the Penn State “Blue Book,” http://www.psu.edu/bulletins/bluebook/
**Required Core Classes**

**ECON 102 (GS) INTRODUCTORY MICROECONOMIC ANALYSIS AND POLICY** (3) Methods of economic analysis and their use; price determination; theory of the firm; distribution.

Students should take this as early as possible. 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

This should be taken immediately after students take ECON 102, though not before sophomore year. It can be taken in the summer at the UP 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.

This is the introductory course to the major. It should be taken sophomore year (unless you are trying to get into the Honors College under “sophomore gate,” see discussion above). It is offered both fall and spring semesters, in person and on the web. It is offered on-line in the summer. It is not offered at any other campus or university.

There are some potential substitutes for the class. CED 201 is offered in the spring by the Agricultural College and is a very similar class. Unfortunately, it now has controls on it. ECON 428 is offered once a year (extremely difficult to get into) and is basically an advanced version of EBF 200. So ECON 428 can count for EBF 200. But if you count ECON 428 for EBF 200, you cannot have ECON 428 count as a 400 level elective.

**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.

EBF 301 focuses on commodity markets. Students should take this the first fall after they have taken ECON 102. This course is on-line, 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 20

We offer this class both semesters. The “W” limits the seats, making this class very hard to get into. Energy Systems Options students can take EME 464W instead. Students with two majors can have the “W” class in their other major count for this requirement. We are offering an Honors version of this class, EBF 304M, sponsored by the Hess Corporation, in Fall ’13.

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

This course is offered both semesters. The EME 460 prerequisite is not relevant until Fall 14.

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: MSIS 200 or STAT 200 or EBF472.

Any of the statistics classes below serve as the prerequisite. This is the most challenging, and most relevant to employment opportunities, course in the major. 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 of EBF 301 and EBF 401 previously or concurrently

EBF 483 Introduction to Electricity Markets (3) Electricity in the U.S. is a $250 billion dollar per year industry, and electricity is considered vital for the functioning of modern society. Demand for electricity is increasing, and meeting this demand while keeping costs and environmental impacts low is a significant challenge. The electricity industry has undergone major transformations in structure, regulation and market design in the past decade. 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 a 400 level elective course. EBF 483 will be offered spring term only AY 13-14.
**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](#)

IUG and Honors students should take the graduate version of this class, EME 500, offered in the fall. See note above for EBF 483. This class is offered Fall term only AY 12-13. 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 EBF credit for both EBF 484 and ECON 427.

**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 or ENGL 030](#); fourth-semester standing

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

**I B 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 or during the summer.

**R M 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.

This class does not appear to be taught at other PSU campuses or during the summer.
Supporting Classes Required

**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 took EMSC 100. If you did not, 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.

**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 every university in the country. Most UP courses are now offered on-line. Unfortunately, the Smeal College has made it difficult to take this course in the Fall term. In the summer, you may wish to take the World Campus version. Which 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, the university 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: 2 entrance units in mathematics.

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

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

These classes, or their equivalents, are offered in a large number of places and times. We have put in a “C” requirement for this class. Frankly, if you got a “D” in calculus, you are probably in the wrong major. If you took a 3 credit calculus class elsewhere, you can get an exemption sheet signed to have it count for MATH 140 for the major.

Many students take pre-calculus courses in the math department (i.e., Math 26, Math 40, etc.) According to EMS College rules, these classes do not count toward your 120 credit hours required for University graduation. 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.

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

Some students will take 3 credit calculus classes at other universities. We will accept these as substitutes for MATH 141, as relevant.

**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.
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

BLAW 243 is offered in the summer at various PSU campuses. There may be alternatives available in the summer at other universities. Do not worry about the prerequisite for ERM 411. ERM 411 is offered Fall term. You can take ERM 411 in place of BLAW 243 or as a 400 level elective, but not both. You can also take BA 241 and BA 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.

If you are in the GIS option, you are required to take GEOG 126. If you are in the General option, you can take either, though you need a signed exemption sheet if you want to take GEOG 126.

ECON 104 is more relevant to the curriculum that GEOG 126. Some students prefer the smaller class size of GEOG 126. ECON 104, however, is part of the minor in economics, which many EBF students take. 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**

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 is taught spring only.

Options at other universities are limited because we require a higher level of statistics than other programs. What you would need is 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 statistics requirement.

**EME 460 (P N G 489) 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 on line spring and summer. 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.
Introductory EMS Electives

There are a large number of potential classes here, not all of which are listed on the checksheet. Basically any GN Class offered by the College of Earth and Mineral Sciences counts. Below is a discussion of a few classes more relevant to the major.

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 on-line.

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 on-line.

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. It is only offered on-line.

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.

Students are required to take 9 credits of EMS introductory electives. However, you can use 3 credits (but no more than 3) of a “soft” science class (say ASTRO 001) from another college or 6 credits of a “hard science” class (say Physics 211). But if you are in the general option you can only have 6 credits of substitutes (so you can’t get 3 soft + 6 hard.) Hopefully this makes sense.
Advanced EMS 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. Kleit.

**ECON 428 Environmental Economics** (3) Environmental pollution, the market economy, and optimal resource allocation; alternative control procedures; levels of environmental protection and public policy. Prerequisite: ECON 302 or ECON 323

This is a well-regarded 400 level elective, offered once a year.

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

This course is offered on-line during the summer. The prerequisites are not enforced.

**EME 444 Global Energy Enterprise** (3) Industry perspective on the resources, technologies, engineering approaches and externalities involved in satisfying worldwide energy demand profitably and sustainably. Prerequisite: ECON 004 or equivalent EGEE 102, EGEE 120

This course is offered on-line Spring term. Which means you cannot get into it unless there are seats not taken by World Campus students. These seats become available seven days before the start of term. The prerequisites are not enforced.

**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. Take EBF 401 instead

**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. Take EBF 401 instead.
**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. STATS 200 or STATS 301 or EBF 473). 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 201C, or CMPSC 201F. This is a challenging class. If you are not also 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 100. You only any need 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.
In addition, some classes not listed in the Blue Book:

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**

**ADVANCED TECHNICAL ELECTIVES**

EBF students in the general option are required to take 9 credits in 400 level electives. Many students have expressed an interest in taking some technical courses from the Department of Energy and Mineral Engineering.

Below is a list of EME classes that will count toward 400 level elective requirements for the general option. Make sure you have the relevant prerequisites. Please contact Dr. Kleit at ank1@psu.edu if you have any questions.

Available classes:

**EBF 402 Energy Law and Contracts** (3) This course is designed to introduce students to legal issues concerning energy exploration property. It will focus on ownership and rights in the mineral estate. It will then move to explaining the concepts embedded in the standard oil and gas lease. Once the basic lease is examined, the course will move to studying many of the possible variants in the basic lease.

Offered spring term ’14.

**ECON 306 INTRODUCTION TO ECONOMETRICS** (3) Use of simple and multiple regression models in measuring and testing economic relationships. Problems including multicollinearity, heterskedasticity, and serial correlation. Prerequisite: MATH 110, **ECON 106** (or EBF 472 or STAT 301 or STAT 401). This class or STATS 462 below is required for honors students.

Or

**STAT 462 Applied Regression Analysis** (3) Introduction to linear and multiple regression; correlation; choice of models, stepwise regression, nonlinear regression. Prerequisite: **STAT 200, STAT 220, STAT 240, STAT 250, STAT 301** or **STAT 401**

You cannot take both ECON 306 and STATS 462 for EBF advanced elective credit. STATS 462 has smaller class sizes (45 versus 200). The students in STATS 462 generally have stronger quantitative background, which would imply it is a more challenging course.
**ECON 402** Decision Making and Strategy in Economics (3) Development and application of the tools for decision making under uncertainty and for game theoretic analysis of economic problems. Prerequisite: ECON 302, SCM 200 or STAT 200 (or any statistics class discussed above.)

**ECON 441** Introduction to Business Economics (3) The study of economic theory as it relates to the problems of the firm. Prerequisite: ECON 102, ECON 4/104

**ECON 442** Managerial Economics (3) Application of economic theory to managerial decision making; risk, uncertainty; models and statistical techniques. Prerequisite: ECON 102

**ECON 443** Economics of Law and Regulation (3) An economic analysis of property rights, contractual arrangements, illegal activities, and regulation; competitive problems due to externalities and market failure. Prerequisite: ECON 302 or ECON 342

**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. Prerequisite: ECON 302

**EGEE 401** Energy in a Changing World (3) Energy is in transition, with increased international energy demand and increasing environmental pressures. Energy transitions, approaches, and outcomes are addressed.

Prerequisite: EGEE 101 or EGEE 102 or CHEM 112
The prerequisites do not seem to be required. This is taught on-line, usually in the summer.

**EGEE 437** Design of Solar Energy Conversion Systems (3) A review of fundamental concepts in solar energy conversion including photovoltaic (PV) and solar thermal conversion systems.
Prerequisite: EGEE 304 or permission of program

The instructor welcomes EBF students. The prerequisite is not enforced.

**GEOG 469** Energy Industry Applications of GIS (3) Roles of geographic information systems in energy siting decisions focusing on electric energy transmission networks.
Prerequisite: GEOG 030, EGEE 102, EME 444

Offered on-line only. Do not worry about the prerequisites.
**IHS 400 Safety Engineering** (3) An examination of the engineering aspects of the safety discipline and its management in the work environment.
Prerequisite: CHEM 110, E MCH 210, MATH 141, PSYCH 100
The instructor is willing to accommodate students without the prerequisites. If you have concerns, contact the instructor.

**IHS 450 Environmental Health and Safety** (3) Overview of toxicology, exposure assessment, industrial hygiene, environmental laws, and contemporary issues in environmental health and safety.
Prerequisite: CHEM 110
This class is taught fall term. The chemistry prerequisite is not strictly enforced.

**METEO 469 From Meteorology to Mitigation: Understanding Global Warming** (3) Introduction to global warming and climate change: the basic, science, projected impacts, and approaches to mitigation.
Prerequisite: MATH 110

**MN PR 301 Elements of Mineral Processing** (3) Introduction to mineral process engineering. Sampling, sizing, physical and chemical processes, applications to industrial practice. Pollution control.
Prerequisite: CHEM 110 or CHEM 106; MATH 141
Math 141 is not really required, but chemistry is. This class is taught fall term.

**MNG 230 Introduction to Mining Engineering** (3) Examination, development, and exploitation of mineral deposits; mining methods; unit operations; mining equipment; fundamentals of explosives.

A much harder class than it looks on paper. This class is taught fall term.

**PNG 405 Rock and Fluid Properties** (3) Reservoir rock properties, rock and fluid properties (interaction between rock and fluids), flow behavior in reservoir, and fluid properties.
Prerequisite: PHYS 211

Taught fall term. Make sure you have the physics class.

**Courses in the GIS Option**
Below are the courses required for the GIS option.
PRESCRIBED COURSES

**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.

**GEOG 160** (GS) MAPPING OUR CHANGING WORLD (3) Fundamental concepts of GIS, cartography, remote sensing, and GPS in the context of environmental and social problems.

This is the introduction to the GIS series. So if you are interested in the GIS option, this is the class to try.

**GEOG 363** GEOGRAPHIC INFORMATION SYSTEMS (3) Principles and use of geographic information; emphasis is on data acquisition and techniques for computer-aided analysis. Prerequisite: **GEOG 160**

Select 3 credits from the below list.

**GEOG 361** CARTOGRAPHY--MAPS AND MAP CONSTRUCTION (3) The art and science of creating small-scale maps as a medium for communication and research. Prerequisite: **GEOG 160**

Or

**GEOG 362** IMAGE ANALYSIS (3) Introduction to the basic principles of remote sensing, and the analysis of aerial and satellite data. Prerequisite: **GEOG 160**

Or

**GEOG 464** ANALYSIS AND GIS (3) Normative and probabilistic models of spatial behavior; adaptive systems in geographic space; interaction and system stability. Prerequisite: **GEOG 364**

Select 9 credits from courses listed below.

**GEOG 461W** DYNAMIC CARTOGRAPHIC REPRESENTATION (3) Theory and practice of mapping and geo-representation in a hypermedia context. Applications in science, policy, travel, and education. Prerequisite: **GEOG 361, GEOG 330, GEOG 362, GEOG 356**, or **GEOG 363**

**GEOG 463** GEOSPATIAL INFORMATION MANAGEMENT (3) This course examines geospatial data representations and algorithmic techniques that apply to
spatially-organized data in digital form. Prerequisite: any earth science computer application course; familiarization with databases and information systems.

**GEOG 464 Advanced Spatial Analysis** (3) Skills and knowledge for applying quantitative methods to analyze information with spatial distributions. Prerequisite: **GEOG 364**

**GEOG 467 Applied Cartographic Design** (3) Applied computer-assisted map production methods with emphasis on geographic information design and color use for multiple presentation media. Prerequisite: **GEOG 361**

**GEOG 468 Geographic Information Systems Design and Evaluation** (3) Design and evaluation of Geographic Information Systems and other forms of integrated spatial data systems. Prerequisite: **GEOG 363**

**GEOG 469 Energy Industry Applications of GIS** (3) Roles of geographic information systems in energy siting decisions focusing on electric energy transmission networks. Prerequisite: **GEOG 030, EGEE 102, EME 444**

Offered on-line only. Do not worry about the prerequisites.

**GEOG 485 GIS Programming and Customization** (3) Customizing GIS software to extend its built-in functionality and to automate repetitive tasks. Prerequisite: **GEOG 363** or **GEOG 484, CMPSC 101** or equivalent

**ENERGY SYSTEMS OPTION**

See the Blue Book for listings. We note that Math 250/1 is listed as a prerequisite for EME 301 and 303. But for students entering the option prior to August 2014 it is not required. So if this includes you, you don’t have to take Math 250/1. We encourage you, however, to take this class.

**PRESCRIBED COURSES**

To avoid scheduling problems, these courses should be completed by the end of sophomore year.

**CHEM 110** (GN) **Chemical Principles I** (3) Basic concepts and quantitative relations. Students may take only one course for General Education credit from CHEM 110 or CHEM 101. Prerequisite: satisfactory performance on the Chemistry and Math FTCAP tests-- i.e. placement beyond the level of CHEM 101 and MATH 022; or **CHEM 101** and **MATH 022** or **MATH 041**
**CHEM 111** (GN) **Experimental Chemistry I** (1) Introduction to quantitative experimentation in chemistry. 
Prerequisite: or concurrent: CHEM 110 or CHEM 106

**CHEM 112** (GN) **Chemical Principles II** (3) Continuation of CHEM 110, including an introduction to the chemistry of the elements. 
Prerequisite: CHEM 110 or CHEM 106

**PHYS 211** (GN) **General Physics: Mechanics** (4) Calculus-based study of the basic concepts of mechanics: motion, force, Newton's laws, energy, collisions, and rotation. 
Concurrent: MATH 140

**PHYS 212** (GN) **General Physics: Electricity and Magnetism** (4) Calculus-based study of the basic concepts of electricity and magnetism. 
Prerequisite: MATH 140, PHYS 211 Concurrent: MATH 141

**SUPPORTING COURSES AND RELATED AREAS**
9 credits in Engineering Principles:

**EME 301** **Thermodynamics in Energy and Mineral Engineering** (3) Treatment of classical thermodynamics targeted to the needs of students in the Department of Energy and Mineral Engineering. 
Prerequisite: CHEM 112, PHYS 212 and MATH 250 or MATH 251

**EME 303** **Fluid Mechanics in Energy and Mineral Engineering** (3) Treatment of fluid mechanics targeted to the needs of students in the Department of EME. 
Prerequisite: MATH 250 or MATH 251 and PHYS 212

EME 301 and EME 303 are only offered fall term, and are required for advanced courses in the option. So it is best to take them junior hear.

Take 3 credits from the below:

**EGEE 302** **Principles of Energy Engineering** (3) Basic engineering calculations and mathematical methodologies on material and energy balances and reaction rates during chemical transformations in energy systems. 
Prerequisite: CHEM 112 and MATH 141

**EGEE 304** **Heat and Mass Transfer** (3) Introduces the fundamentals of heat and mass transfer. Conduction, convection, radiation, and diffusion mass transfer will be emphasized. 
Prerequisite: EME 301 and EGEE 302
**EGEE 430** (M E 430) **Introduction to Combustion** (3) Concepts related to laminar and turbulent premixed and nonpremixed combustion with applications to propulsion and stationary systems. Prerequisite: M E 201 or M E 300 or EME 301

Select 9 credits is Engineering Applications from:

**EGEE 401** Energy in a Changing World (3) Energy is in transition, with increased international energy demand and increasing environmental pressures. Energy transitions, approaches, and outcomes are addressed. Prerequisite: EGEE 101 or EGEE 102 or CHEM 112

The prerequisites do not seem to be required. This is taught on-line, usually in the summer.

**EGEE 420** Hydrogen and Fuel Cells (3) Course will cover the fundamental principles of electrochemical engineering, hydrogen production and storage, and the design and application of the main types of fuel cells. Prerequisite: EME 301

**EGEE 437** Design of Solar Energy Conversion Systems (3) A review of fundamental concepts in solar energy conversion including photovoltaic (PV) and solar thermal conversion systems. Prerequisite: EGEE 304 or permission of program

**EGEE 438** Wind and Hydropower Energy Conversion (3) Principles of sustainability and renewable energy conversion with emphasis on wind and hydrokinetic energy resources. Prerequisite: EGEE 302, EME 303

**EGEE 441** Electrochemical Energy Conversion (3) Course covers fundamental principles of electrochemistry, including electrochemical thermodynamics, kinetics, catalysis, and corrosion and focuses on applications such as fuel cells, batteries, and photovoltaics. Each application covers: principles of method, criteria determining performance, present state of development, and advantages/disadvantages. Laboratory demonstration of the performance (current-voltage) measurements of an electrochemical converter is scheduled in this course. Prerequisite: EME 301, EGEE 302
**EGEE 451 Energy Conversion Processes** (3) Emphasizes processes for conversion of fossil fuels, nuclear and biomass to other fuel forms as transportation fuels and electricity. 
Prerequisite: F SC 431

**EGEE 464W Energy Design Project** (3) A team and capstone design project on an industrial energy-related problem. 
Prerequisite: seventh-semester standing in energy engineering or chemical engineering

ENGL 202C

This can count for either EBF 304W or an energy system option class, but not both.

**EGEE 470 (ME 470)** (if not taken for requirement above), **Air Pollutants from Combustion Sources** (3) Generation of pollutants in combustion chambers; reduction by combustion control; pre- and post-combustion treatment of fuels and effluents. 
Prerequisite: EME 301

**F SC 431 The Chemistry of Fuels** (3) Nature and properties of fossil and other fuels, including aerospace, in relation to use; preparation of fuels; by-products; fuel analysis. 
Prerequisite: CHEM 210; EGEE 302 or equivalent

**F SC 432 (CH E 432) Petroleum Processing** (3) A study of physical and chemical processes to convert crude oil into desired products with an outlook from present to future. 
Prerequisite: CHEM 210

**Courses for the ELM Option:**

**GEOSC 001 Physical Geology** (3) Earth processes and their effects on the materials, structure, and morphology of the earth's crust. Practicum includes field work, study of rocks, minerals, dynamic models, and topographic maps.

**PHYS 211 (GN) General Physics: Mechanics** (4) Calculus-based study of the basic concepts of mechanics: motion, force, Newton's laws, energy, collisions, and rotation. 
Concurrent: MATH 140

**P N G 405 Rock and Fluid Properties** (3) Reservoir rock properties, rock and fluid properties (interaction between rock and fluids), flow behavior in reservoir, and fluid properties. 
Prerequisite: PHYS 211

Taught fall term. Make sure you have the physics class.
**GEOSC 451 Natural Resources: Origins, Economics and Environmental Impact** (3)  
Geologic, economic and environmental issues related to exploitation of non-renewable natural resources (metals, minerals, rocks, and fossil fuels).  
Prerequisite: [GEOSC 001](#) or [GEOSC 020](#)  

We hope to have a substitute class available for this Fall ’14.

**MNG 223 Mineral Land and Mine Surveying** (2) Surveying theory and practice applied to mineral lands and mines, traversing, leveling, mapping, underground surveying, microcomputer drafting and graphics.

Or, if you can get in the class:

**C E 310 Surveying** (3) Fundamental surveying measurements, traverse computations, coordinate geometry, mapping, GPS and GIS, circular and parabolic curves, earthwork, boundary surveys, CAD applications.

**GEOG 160 (GS) MAPPING OUR CHANGING WORLD** (3) Fundamental concepts of GIS, cartography, remote sensing, and GPS in the context of environmental and social problems.

Or

**GEOG 469 Energy Industry Applications of GIS** (3) Roles of geographic information systems in energy siting decisions focusing on electric energy transmission networks.  
Prerequisite: [GEOG 030](#), [EGEE 102](#), [EME 444](#)  

Offered on-line only. Do not worry about the prerequisites.

**EBF 402 Energy Law and Contracts** (3) This course is designed to introduce students to legal issues concerning energy exploration property. It will focus on ownership and rights in the mineral estate. It will then move to explaining the concepts embedded in the standard oil and gas lease. Once the basic lease is examined, the course will move to studying many of the possible variants in the basic lease. This part will focus on the development and modern application of implied covenants in oil and gas leases and the application of such covenants to specific fact situations.

Offered spring term ’14.