

ECONOMICS AND BUSINESS (EBGN)

EBGN198. SPECIAL TOPICS IN ECONOMICS AND BUSINESS. 1-6 Semester Hr.

(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Prerequisite: none. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.

EBGN199. INDEPENDENT STUDY. 0.5-6 Semester Hr.

(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

EBGN201. PRINCIPLES OF ECONOMICS. 3.0 Semester Hrs.

(I,II,S) Introduction to microeconomics and macroeconomics. This course focuses on applying the economic way of thinking and basic tools of economic analysis. Economic effects of public policies. Analysis of markets for goods, services and resources. Tools of cost-benefit analysis. Measures of overall economic activity. Determinants of economic growth. Monetary and fiscal policy. Prerequisites: None. 3 hours lecture; 3 semester hours.

EBGN230. INTRODUCTION TO BUSINESS. 3.0 Semester Hrs.

An introduction to everything business. In this class, you will explore why businesses are formed, what gives them a competitive advantage in the market, and how businesses report information to the public. You will also learn best practices for individual behavior and success when operating in a business environment, including what makes for a good business presentation, leading and communicating with teams, and project decision analysis. Being business smart is the foundation of every career path moving forward.

EBGN280. INTRODUCTION TO BUSINESS ANALYTICS. 3.0 Semester Hrs.

Business analytics implements a data-driven approach to the business world, leveraging statistics and data modeling to generate new business insights. In this introductory course, students will learn how to manage, visualize, and analyze data for business decision making. Students will use a variety of statistical methods, visualization tools, and data cleaning techniques to generate business insights from large data sets. Prerequisite: MATH201. Co-requisite: CSCI303.

Course Learning Outcomes

EBGN298. SPECIAL TOPICS IN ECONOMICS AND BUSINESS. 1-6 Semester Hr.

(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Prerequisite: none. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.

EBGN299. INDEPENDENT STUDY. 1-6 Semester Hr.

(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

EBGN301. INTERMEDIATE MICROECONOMICS. 3.0 Semester Hrs.

Equivalent with EBG411,

This course introduces the theoretical and analytical foundations of microeconomics and applies these models to the decisions and interactions of consumers, producers and governments. Develops and applies models of consumer choice and production with a focus on general equilibrium results for competitive markets. Examines the effects of market power and market failures on prices, allocation of resources and social welfare. Prerequisite: EBG201 and MATH213.

EBGN302. INTERMEDIATE MACROECONOMICS. 3.0 Semester Hrs.

Equivalent with EBG412,

Intermediate macroeconomics provides a foundation for analyzing both short-run and long-run economic performance across countries and over time. The course discusses macroeconomic data analysis (including national income and balance of payments accounting), economic fluctuations and the potentially stabilizing roles of monetary, fiscal and exchange rates policies, the role of expectations and intertemporal considerations, and the determinants of long-run growth. The effects of external and internal shocks (such as oil price shocks, resource booms and busts) are analyzed. Prerequisite: EBG201 and MATH213.

EBGN303. ECONOMETRICS. 3.0 Semester Hrs.

Equivalent with EBG390,

Introduction to econometrics, including ordinary least-squares and single- equation models; two-stage least-squares and multiple-equation models; specification error, serial correlation, heteroskedasticity, and other problems; distributive-lag models and other extensions, hypothesis testing and forecasting applications. Prerequisite: EBG201 and MATH201.

EBGN304. PERSONAL FINANCE. 3.0 Semester Hrs.

The management of household and personal finances. Overview of financial concepts with special emphasis on their application to issues faced by individuals and households: budget management, taxes, savings, housing and other major acquisitions, borrowing, insurance, investments, meeting retirement goals, and estate planning. Survey of principles and techniques for the management of a household's assets and liabilities. Study of financial institutions and their relationship to households, along with a discussion of financial instruments commonly held by individuals and families.

EBGN305. SURVEY OF ACCOUNTING. 3.0 Semester Hrs.

An introduction to financial and managerial accounting topics of importance to managers and users of financial information. Topics include the origin, connection and purpose of financial statements, financial ratio computation and analysis, cash flow analysis for planning and decision making, inventory methods and cost accounting, fixed asset accounting, and fair value accounting. The course will focus on the use of accounting information for managerial decision making as well as the implications of business decisions on financial outcomes.

EBGN306. MANAGERIAL ACCOUNTING. 3.0 Semester Hrs.

Introduction to cost concepts and principles of management accounting including cost accounting. The course focuses on activities that create value for customers and owners of a company and demonstrates how to generate cost-accounting information to be used in management decision making. Prerequisite: EBG201, EBG305.

EBGN307. BUSINESS COMMUNICATIONS. 3.0 Semester Hrs.

Communication is one of the most vital skills in today's professional world, and effectiveness in communicating ideas, feelings, instructions, and thoughts are vital to both personal and professional success. Business Communications is designed to introduce you to skills and practices that will enable you to be an effective communicator for yourself, your business, and your clients and stakeholders. The course focuses on approaches for planning, creating, and transmitting business information within a variety of business situations found in the

global marketplace. The course will focus on written, oral, and digital communication.

Course Learning Outcomes

- Analyze communication situations and audiences to make choices about the most effective and efficient way to communicate and deliver messages
- Conduct research that includes the use of print and electronic library resources and the Internet; use the results of the research to complete written and oral reports
- Conduct research that includes the use of print and electronic library resources and the Internet; use the results of the research to complete written and oral reports
- Deliver effective business presentations in contexts that may require either extemporaneous or impromptu oral presentations
- Provide feedback, accept feedback, and use feedback to improve communication skills
- Write business documents that are grammatically correct and use appropriate business style
- Develop effective interpersonal communication skills
- Develop skills in international and cross-cultural business communication and awareness of challenges required for successful communication in global organizations
- Use communication technology appropriately and effectively

EBGN308. PRINCIPLES OF MARKETING. 3.0 Semester Hrs.

Principles of Marketing will introduce students to the concepts, analyses, and activities that comprise marketing management and to provide practice in assessing and solving marketing problems. Marketing involves identifying customer needs, satisfying those needs through the right products and services, assuring availability to customers through the best distribution channels, using promotional activities in ways that motivate purchases as effectively as possible, and choosing a suitable price to boost firm profitability while maintaining customer satisfaction. These decisions of product, distribution, promotion, and price, together with a rigorous analysis of the customers, competitors, and the overall business environment serve as the foundations for sound marketing management.

Course Learning Outcomes

- Define marketing and outline the steps in the marketing process
- Explain the importance of understanding consumers and the marketplace, and identify the core marketplace concepts
- Identify the key elements of a customer-driven marketing strategy and discuss the marketing management orientations that guide market strategy
- Analyze qualitative and quantitative consumer data for use in determining appropriate marketing techniques that align with an organization's strategic focus, culture, and current business procedures
- Recommend product, price, promotional, and distribution strategies for a pre-defined target market through organizational marketing plans
- Maximize internal and external opportunities through the integration of marketing concepts, theories, and models
- Develop effective marketing strategies that address commercial, legal, and cultural aspects in global business environments
- Analyze marketing practices for compliance with legal systems, regulatory standards, and ethical practices

EBGN309. FUNDAMENTALS OF MANAGEMENT. 3.0 Semester Hrs.

This course provides a survey of fundamental principles of management and their application to the operations of a complex, modern organization. Topics covered include managerial functions (planning, organizing, leading, and controlling) as well as organizational behavior, human resources, and operations management.

EBGN310. ENVIRONMENTAL AND RESOURCE ECONOMICS. 3.0 Semester Hrs.

Application of microeconomic theory to topics in environmental and resource economics. Topics include analysis of pollution control, benefit/cost analysis in decision-making and the associated problems of measuring benefits and costs, non-renewable resource extraction, measures of resource scarcity, renewable resource management, environmental justice, sustainability, and the analysis of environmental regulations and resource policies. 3 hours lecture; 3 semester hours. Prerequisite: EBGN201.

EBGN315. THE ECONOMICS OF STRATEGY. 3.0 Semester Hrs.

An introduction to game theory and industrial organization (IO) principles at a practical and applied level. Topics include economies of scale and scope, the economics of the make-versus-buy decision, market structure and entry, dynamic pricing rivalry, strategic positioning, and the economics of organizational design. Prerequisite: EBGN201.

Course Learning Outcomes

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EBGN320. ECONOMICS AND TECHNOLOGY. 3.0 Semester Hrs.

The theoretical, empirical and policy aspects of the economics of technology and technological change. Topics include the economics of research and development, inventions and patenting, the Internet, e-commerce, and incentives for efficient implementation of technology. 3 hours lecture; 3 semester hours. Prerequisite: EBGN201.

EBGN321. ENGINEERING ECONOMICS. 3.0 Semester Hrs.

Equivalent with CHEN421,

Time value of money concepts of present worth, future worth, annual worth, rate of return and break-even analysis applied to after-tax economic analysis of mineral, petroleum and general investments. Related topics on proper handling of (1) inflation and escalation, (2) leverage (borrowed money), (3) risk adjustment of analysis using expected value concepts, (4) mutually exclusive alternative analysis and service producing alternatives.

EBGN330. ENERGY ECONOMICS. 3.0 Semester Hrs.

Equivalent with ENGY330,

Study of economic theories of optimal resource extraction, market power, market failure, regulation, deregulation, technological change and resource scarcity. Economic tools used to analyze OPEC, energy mergers, natural gas price controls and deregulation, electric utility restructuring, energy taxes, environmental impacts of energy use, government R&D programs, and other energy topics. Prerequisite: EBGN201.

EBGN340. ENERGY AND ENVIRONMENTAL POLICY. 3.0 Semester Hrs.

This course considers the intersection of energy and environmental policy from an economic perspective. Policy issues addressed include climate change, renewable resources, externalities of energy use, transportation, and economic development and sustainability. Prerequisites: EBGN201. 3 hours lecture; 3 semester hours.

EBGN345. PRINCIPLES OF CORPORATE FINANCE. 3.0 Semester Hrs.

Introduction to corporate finance, financial management, and financial markets. Time value of money and discounted cash flow valuation, risk and returns, interest rates, bond and stock valuation, capital budgeting and financing decisions. Introduction to financial engineering and financial risk management, derivatives, and hedging with derivatives. 3 hours lecture; 3 semester hours. Prerequisite: EBGN305.

EBGN346. INTRODUCTION TO INVESTMENTS. 3.0 Semester Hrs.

This course is an introduction to the principles of investment in competitive financial markets. The course will provide an overview to: 1) the structure of capital markets, 2) theories and practice of portfolio construction and management, 3) asset pricing theories used to analyze securities, 4) equity and debt securities, and 4) derivative instruments. 3 hours lecture; 3 semester hours. Prerequisites: EBGN305.

Course Learning Outcomes

- Identify and describe a wide variety of financial assets.
- Discuss securities markets and how they operate.
- Determine the intrinsic value of stocks and bonds.
- Determine the efficient diversification of a portfolio.
- Calculate the value of options.
- Apply investment theory to real world problems.

EBGN351. INTRODUCTION TO DECISION SCIENCE. 3.0 Semester Hrs.

This course focuses on how to unwind complex situations to gain clarity, model uncertainty, and enable confident decision making. Students will learn how to frame the problem correctly, ensure clarity around the objectives, develop creative alternative strategies, and qualitatively or quantitatively evaluate those alternatives. Several tools for accomplishing these goals will be introduced. Topics will include decision trees, common psychological biases and traps, scenario analysis, game theory, modeling techniques, and subject-matter-expert interviews. Students will learn to analyze and present model outputs and how to avoid common pitfalls.

Course Learning Outcomes**EBGN360. INTRODUCTION TO ENTREPRENEURSHIP. 3.0 Semester Hrs.**

This course introduces students to the entrepreneurial process, focusing on the concepts, practices, and tools of the entrepreneurial world.

This will be accomplished through a combination of readings, cases, speakers, and projects designed to convey the unique environment of entrepreneurship and new ventures. The mastery of concepts covered in this course will lead to an initial evaluation of new venture ideas. In this course students will interact with entrepreneurs, participate in class discussion, and be active participants in the teaching/learning process. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- no change

EBGN381. PREDICTIVE BUSINESS ANALYTICS. 3.0 Semester Hrs.

Predictive analytics employs mathematical modeling techniques, utilizing known data to generate predictions about unknown events. This course offers an introduction to predictive analytics. In this course, students will learn the core concepts of supervised and unsupervised learning approaches. The course also addresses performance metrics for evaluating the prediction models and introduces ensemble modeling to enhance the precision and robustness of predictive models.

Course Learning Outcomes**EBGN382. PRESCRIPTIVE BUSINESS ANALYTICS. 3.0 Semester Hrs.**

Prescriptive analytics strives to identify the best operational, tactical, and strategic decisions for organizations. In this course, students will learn the art of model building and will use linear, integer, and mixed-integer programming for a variety of business applications. Additionally, the course will provide an overview of specially structured models and model enhancement techniques. Prerequisite: EBGN280.

Course Learning Outcomes**EBGN398. SPECIAL TOPICS IN ECONOMICS AND BUSINESS. 1-6 Semester Hr.**

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EBGN399. INDEPENDENT STUDY. 1-6 Semester Hr.

(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

EBGN401. ADVANCED TOPICS IN ECONOMICS. 3.0 Semester Hrs.

Application of economic theory to microeconomic and macroeconomic problems. This course will involve both theoretical and empirical modeling. Specific topics will vary by semester depending on faculty and student interest. Topics may include general equilibrium modeling, computational economics, game theory, the economics of information, intertemporal allocations, economic growth, microfoundations of macroeconomic models and policy simulation. 3 hours lecture; 3 semester hours. Prerequisites: EBGN301, EBGN302 and EBGN303.

EBGN403. ECONOMICS CAPSTONE. 1-4 Semester Hr.

Equivalent with EBGN402,

This is the capstone course for the economics major. Students will apply the tools they learned throughout the program to (1) conduct original economics research or (2) conduct an economic analysis for a client. In addition to the project, the capstone course will provide students opportunities to interact with practitioners of economics and business as well as prepare a career plan. Prerequisite: EBGN301, EBGN302, EBGN303.

EBGN409. MATHEMATICAL ECONOMICS. 3.0 Semester Hrs.

Application of mathematical tools to economic problems. Coverage of mathematics needed to read published economic literature and to do graduate study in economics. Topics from differential and integral calculus, matrix algebra, differential equations, and dynamic programming. Applications are taken from mineral, energy, and environmental issues, requiring both analytical and computer solutions using programs such as GAMS and MATHEMATICA. Prerequisite: MATH213, EBGN301, EBGN302.

EBGN425. BUSINESS ANALYTICS. 3.0 Semester Hrs.

With the increasing availability of large volumes of raw business data, the process of converting it into meaningful insights has become critical for organizations to stay competitive. Driven by massive volumes of business data, business analytics has become instrumental in unveiling such managerial practices which guide the decision making process in companies at every operational stage. This course includes various descriptive, predictive and prescriptive business analytics strategies. It provides fundamental skills using quantitative tools to organize, process, and critically interpret business data, as well as key concepts

in quantitative decision making to model and solve real-world problems.
Prerequisite: EBG201, MATH112.

Course Learning Outcomes

- How managers handle their data
- Different strategies and the use of technology in analyzing the data
- Quantitative decision making tools used to model and solve real-world problems
- Critical thinking skills used to interpret and learn from data, and derive meaningful insights

EBGN430. ADVANCED ENERGY ECONOMICS. 3.0 Semester Hrs.

(WI) Application of economic models to understand markets for oil, gas, coal, electricity, and renewable energy resources. Models, modeling techniques and applications include market structure, energy efficiency, demand-side management, energy policy and regulation. The emphasis in the course is on the development of appropriate models and their application to current issues in energy markets. Prerequisites: EBG301, EBG330. 3 hours lecture; 3 semester hours.

EBGN434. PROPERTY RIGHTS AND NATURAL RESOURCES. 3.0 Semester Hrs.

When choosing how to allocate our scarce resources, institutions serve as constraints at any given time. Over time, these institutions form and evolve when it appears profitable to do so. This course focuses on the North American story of resource use and draws on economics, law, and history to understand those processes and their implications. The course will provide a framework to understand why certain institutions were adopted and how they now shape our economic decisions today. Prerequisite: EBG201.

Course Learning Outcomes

- Distinguish between legal and economic rights
- Understand how the distribution of economic rights impacts economic decisions
- Understand the impetus and frictions of changing economic property rights
- Be able to apply the property right theory to any example
- Have a better understanding of historical and current resource development in the American West

EBGN435. ECONOMICS OF WATER RESOURCES. 3.0 Semester Hrs.

This course seeks to develop the underlying economic problems of water use and how policy impacts the allocation of water in our economy. Water is a critical input for a number of sectors; from our basic sustenance to agriculture production, from industrial processes to ecological services, and from mineral extraction to energy production. Meanwhile, the supply of water is highly variable across space and through time while pollutants can further diminish the useable extent, making the policies to allocate and manage the resource central to understanding how the resource is utilized. The course will survey topics across sectors and water sources while applying economic theory and empirical/policy analysis. Prerequisite: EBG409 or MATH213.

Course Learning Outcomes

- Apply economic modelling to water systems
- Analyze water policies empirically
- Review valuation techniques for water resources
- Conduct Cost-Benefit Analysis
- Comprehend how institutional structure effect development
- Use economic tools to asses water allocation and water pollution

- Analyze water use in specific sectors (ag, energy, mining, recreation, etc.)

EBGN437. REGIONAL ECONOMICS. 3.0 Semester Hrs.

(WI) Analysis of the spatial dimension of economies and economic decisions. Interregional capital and labor mobility. Location decisions of firms and households. Agglomeration economies. Models of regional economic growth. Measuring and forecasting economic impact and regional growth. Local and regional economic development policy. Urban and regional spatial structure. Emphasis on application of tools and techniques of regional analysis. Prerequisite: EBG201.

Course Learning Outcomes

- no change

EBGN441. INTERNATIONAL ECONOMICS. 3.0 Semester Hrs.

Theories and determinants of international trade, including static and dynamic comparative advantage and the gains from trade. The history of arguments for and against free trade. The political economy of trade policy in both developing and developed countries. Prerequisite: EBG301.

EBGN443. PUBLIC ECONOMICS. 3.0 Semester Hrs.

This course covers public-sector economics, including the fundamental institutions and relationships between the government and private decision makers. It covers the fundamental general equilibrium welfare theorems and their interaction with government policy instruments that affect efficiency and distribution. Normative topics include an intensive study of the causes and consequences of, and policy prescriptions for, market failure due to public goods, or other problems associated with externalities and income distribution. Positive analysis focuses on policy formation in the context of political- economy and public choice theories. Prerequisite: EBG201.

EBGN444. INNOV8X. 3.0 Semester Hrs.

Innovate X introduces concepts and tools to accelerate the design, validation and adoption of innovations in support of creative problem solving. Using an entrepreneurial mindset, we learn how to identify and frame problems that beneficiaries and stakeholders face. We attempt to design and test practical solutions to those problems in collaboration with those who experience the problems. We apply beneficiary discovery, prototyping, business model design (social, economic and environmental), constrained creativity, efficient experimentation, and rapid iteration. While resolving challenges involves technical solutions, an important aspect of this course is directly engaging beneficiaries and stakeholders in social contexts to develop solutions with strong impact potential. Innov8x is grounded in collaborative creativity theory at the intersection of organizational behavior (social psychology), design principles, entrepreneurship and innovation management.

Course Learning Outcomes

- Frame and translate complex ambiguous problems into actionable opportunities for innovation
- Conduct effective, objective and ongoing beneficiary discovery in efficient ways
- Combine tools and methods to quickly test assumptions and secure beneficiary acceptance
- Develop creative approaches to navigate real and perceived constraints
- Leverage mentor and stakeholder support through credible communication based on research
- Launch innovative solutions with the advocacy of beneficiaries and stakeholders

- Create value by solving complex problems that straddle technical and social domains

EBGN453. PROJECT MANAGEMENT. 3.0 Semester Hrs.

Project management has evolved into a business process broadly used in organizations to accomplish goals and objectives through teams. This course covers the essential principles of traditional project management consistent with professional certification requirements (the Project Management Institute's PMP certification) as well as an introduction to current agile project management methodologies. The traditional project management phases of project initiation, planning, execution, monitoring and control, and project closure are covered including related scheduling, estimating, risk assessment and other analytical tools. Students will gain experience using Microsoft Project. Organizational structure and culture issues are analyzed to understand how they can impact project management success, and the concepts of project portfolios and project programs are applied from the organizational perspective. Agile project management methodologies are introduced, including adaptive and iterative processes, scrum, lean and other Agile tools and techniques. By the end of the course, students will understand how traditional and agile project differ.

Course Learning Outcomes

- 1) Create a work breakdown structure for a proposed project
- 2) Define the five process groups of traditional project management as defined by the Project management Institute (PMI)
- 3) Investigate the role and responsibilities of a Project Manager and stakeholders
- 4) Compare the tools and techniques for small, medium and large projects.
- 5) Interpret your own leadership abilities and how to grow as a leader
- 6) Create a project statement of work document with schedule, and financial analysis
- 7) Formulate the project issues, scope changes, and the resulting risk profile changes for a project.
- 8) Perform a basic project risk assessment
- 9) Assess Agile project management and how it differs from traditional project management.
- 10) Recognize the golden rules of change management
- 11) Create a business case and financial justification for a large project.

EBGN455. LINEAR PROGRAMMING. 3.0 Semester Hrs.

This course addresses the formulation of linear programming models, examines linear programs in two dimensions, covers standard form and other basics essential to understanding the Simplex method, the Simplex method itself, duality theory, complementary slackness conditions, and sensitivity analysis. As time permits, multi-objective programming, an introduction to linear integer programming, and the interior point method are introduced. Applications of linear programming models discussed in this course include, but are not limited to, the areas of manufacturing, finance, energy, mining, transportation and logistics, and the military. Prerequisite: MATH332 or EBGN409.

EBGN459. SUPPLY CHAIN MANAGEMENT. 3.0 Semester Hrs.

As a quantitative managerial course, the course will explore how firms can better organize their operations so that they more effectively align their supply with the demand for their products and services. Supply Chain Management (SCM) is concerned with the efficient integration of suppliers, factories, warehouses and retail-stores (or other forms of distribution channels) so that products are provided to customers in the

right quantity and at the right time. Topics include managing economies of scale for functional products, managing market- mediation costs for innovative products, make-to order versus make-to-stock systems, quick response strategies, risk pooling strategies, supply-chain contracts and revenue management. Additional "special topics" will also be introduced, such as reverse logistics issues in the supply-chain or contemporary operational and financial hedging strategies. Prerequisite: None.

EBGN460. BUSINESS MODEL DEVELOPMENT. 3.0 Semester Hrs.

This course leads students through the process of developing and validating a business model for an innovative product or service by a start-up or an established organization. The creation of a business model can be challenging, frustrating, fascinating and fulfilling. Building on skills learned in EBGN360, students explore ways to sustain and scale a promising new product or service in any context: commercial/for-profit, social/non-profit or government. It is an iterative process that involves uncovering beneficiary needs and leads to an in-depth understanding of how value is delivered, differentiated and captured. Students work in teams since new ventures are started by teams with complementary skills and a shared purpose. This is a demanding, hands-on course that integrates knowledge from entrepreneurship, business, economics and engineering classes. Students are expected to initiate and drive an intense beneficiary discovery process that involves reaching out to beneficiaries and engaging them outside class. Prerequisite: EBGN360. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- no change

EBGN461. STOCHASTIC MODELS IN MANAGEMENT SCIENCE. 3.0 Semester Hrs.

As a quantitative managerial course, the course is an introduction to the use of probability models for analyzing risks and economic decisions and doing performance analysis for dynamic systems. The difficulties of making decisions under uncertainty are familiar to everyone. We will learn models that help us quantitatively analyze uncertainty and how to use related software packages for managerial decision-making and to do optimization under uncertainty. Illustrative examples will be drawn from many fields including marketing, finance, production, logistics and distribution, energy and mining. The main focus of the course is to see methodologies that help to quantify the dynamic relationships of sequences of "random" events that evolve over time.

EBGN470. ENVIRONMENTAL ECONOMICS. 3.0 Semester Hrs.

(WI) This course considers the role of markets as they relate to the environment. Topics discussed include environmental policy and economic incentives, market and non-market approaches to pollution regulation, property rights and the environment, the use of benefit/cost analysis in environmental policy decisions, and methods for measuring environmental and nonmarket values. Prerequisite: EBGN301. 3 hours lecture; 3 semester hours.

EBGN474. INVENTING, PATENTING AND LICENSING. 3.0 Semester Hrs.

(S) (WI) This course provides an introduction to the legal framework of inventing and patenting and addresses practical issues facing inventors. The course examines patent law, inventing and patenting in the corporate environment, patent infringement and litigation, licensing, and the economic impact of patents. Methods and resources for market evaluation, searching prior art, documentation and disclosure of invention, and preparing patent applications are presented. Prerequisite: None. 3 hours lecture; 3 semester hours.

EBGN485. BUSINESS STRATEGY. 3.0 Semester Hrs.

Business strategy is focused on formulating and implementing the major goals of the firm in relation to changing competitive environmental conditions, firm resources, and individuals' motives and values. This course is about the issues and challenges of running a firm in a competitive environment from the perspective of a senior manager. The challenge for senior managers goes well beyond applying an appropriate formula to a problem because to date there are not any universal formulas for successful companies. Rather, senior managers must be able to identify that a problem exists and then to bring resolution, despite partial information. This course requires identifying, analyzing, and solving firm problems with original thinking and execution. A key instructional objective of this course is to help you develop a rigorous approach for addressing complex business problems. Prerequisites: EBG308 or EBG345.

Course Learning Outcomes

- Understand the fundamental concepts associated with Strategic Management, such as conducting analyses of the competitive environment a firm faces, assessing firm resources and potential sources of competitive advantages
- Be able to identify problems in a complex business scenario
- Understand what pieces of information are important in diagnosing a strategic challenge and to apply the correct tools in addressing that challenge
- Develop an understanding of how to design and implement firm level strategies that develop, exploit and sustain competitive advantage

EBGN490. ANALYTICS. 3.0 Semester Hrs.

The business analytics capstone course provides an opportunity for students to integrate and apply the skills and tools learned in previous business analytics courses to define, formulate, analyze, and recommend a solution for a significant, real-world business problem. Students will work as a team, and will draw on the breadth and depth of the curriculum to address an industry supplied problem.

Course Learning Outcomes**EBGN495. ECONOMIC FORECASTING. 3.0 Semester Hrs.**

An introduction to the methods employed in business and econometric forecasting. Topics include time series modeling, Box- Jenkins models, vector autoregression, cointegration, exponential smoothing and seasonal adjustments. Covers data collection methods, graphing, model building, model interpretation, and presentation of results. Topics include demand and sales forecasting, the use of anticipations data, leading indicators and scenario analysis, business cycle forecasting, GNP, stock market prices and commodity market prices. Includes discussion of links between economic forecasting and government policy. Prerequisite: EBG301, EBG302, EBG303.

EBGN496. PAYNE SCHOLARS PROGRAM. 1.0 Semester Hr.

The Payne Scholars program is a one-credit, independent study course that helps students perform research, collaborate across campus, and engage with a broad network of international experts on global policy challenges. Students are taught how to write academic papers on the important issues we are facing today, and once the students finish the course, the papers they write can be published as Payne Commentaries on our website. Payne Scholars will participate in the Payne Institutes guest lecture series, discuss developing policy trends and concerns, and write on the evolving public policy landscape. As a part of School of Mines, the Payne Institute for Public Policy is dedicated to fostering the essential relationship between technical knowledge and public policy. Mines graduates often go on to become corporate

leaders and are responsible for many of the innovations and changes seen across industries. In much the same way, the research done at Mines has far reaching implications for many of the social, economic, and environmental challenges faced around the world.

Course Learning Outcomes

- Analyze policy issues using tools from a variety of relevant disciplines
- Write clear and concise academic and policy documents
- Translate technical information into digestible policy narratives
- Collaborate with industry professionals
- Apply appropriate research techniques
- Properly cite and format their work for different audiences and purposes

EBGN498. SPECIAL TOPICS IN ECONOMICS AND BUSINESS. 0.5-6 Semester Hr.

(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Prerequisite: none. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.

EBGN499. INDEPENDENT STUDY. 1-6 Semester Hr.

(I, II) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit; 1 to 6 credit hours. Repeatable for credit.

EBGN502. POLITICAL ECONOMY OF THE ENERGY TRANSITION. 3.0 Semester Hrs.

This course provides an overview of economics, business, and political topics that are commonly found in the energy transition. Many of the assignments relate back to skills that are needed to interact with economics, business, and policy professionals. The course is designed for students with little, if any, social science or business training. Students will build a basic knowledge of economics, finance, and business issues that are relevant to energy markets and industries.

Course Learning Outcomes

1. Interpret and assess basic economic intuition and lingo so that one can contribute to projects on the business side
2. Evaluate and critique standard investment analysis techniques
3. Describe common market structures for natural resource commodities and theorize its impact on firm behavior
4. Name the location of basic data on energy price, production, and consumption and demonstrate its evolution over time
5. Analyze the politics behind an aspect of the energy transition
6. Identify key political actors in the transition
7. Design a presentation for the business community that provides a clear value proposition.
8. Execute an "elevator pitch" (concise and persuasive speech to spark interest) about an energy/natural resource topic.

EBGN504. ECONOMIC EVALUATION AND INVESTMENT DECISION METHODS. 3.0 Semester Hrs.

Time value of money concepts of present worth, future worth, annual worth, rate of return and break-even analysis are applied to after-tax economic analysis of mineral, petroleum and general investments. Related topics emphasize proper handling of (1) inflation and escalation, (2) leverage (borrowed money), (3) risk adjustment of analysis using expected value concepts, and (4) mutually exclusive alternative analysis and service producing alternatives. Case study analysis of a mineral

or petroleum investment situation is required. Students may not take EBG504 for credit if they have completed EBG321.

EBGN509. MATHEMATICAL ECONOMICS. 3.0 Semester Hrs.

This course reviews and re-enforces the mathematical and computer tools that are necessary to earn a graduate degree in Mineral Economics. It includes topics from differential and integral calculus; probability and statistics; algebra and matrix algebra; difference equations; and linear, mathematical and dynamic programming. It shows how these tools are applied in an economic and business context with applications taken from the mineral and energy industries. It requires both analytical as well as computer solutions. At the end of the course you will be able to appreciate and apply mathematics for better personal, economic and business decision making. Prerequisites: Principles of Microeconomics, and MATH111.

EBGN510. NATURAL RESOURCE ECONOMICS. 3.0 Semester Hrs.

The threat and theory of resource exhaustion; commodity analysis and the problem of mineral market instability; cartels and the nature of mineral pricing; the environment; government involvement; mineral policy issues; and international mineral trade. This course is designed for entering students in mineral economics. Prerequisite: Principles of Microeconomics.

EBGN511. MICROECONOMICS. 3.0 Semester Hrs.

(I, II, S) This is a graduate course dealing with applied microeconomic theory. The course concentrates on the behavior of individual segments of the economy, the theory of consumer behavior and demand, duality, welfare measures, policy instruments, preferences over time and states of nature, and the fundamentals of game theory. Prerequisites: MATH111, EBG509. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- No change

EBGN512. MACROECONOMICS. 3.0 Semester Hrs.

This course will provide an introduction to contemporary macroeconomic concepts and analysis. Macroeconomics is the study of the behavior of the economy as an aggregate. Topics include the equilibrium level of inflation, interest rates, unemployment and the growth in national income. The impact of government fiscal and monetary policy on these variables and the business cycle, with particular attention to the effects on the mineral industry. Prerequisites: Principles of Microeconomics, MATH111.

EBGN515. ECONOMICS AND DECISION MAKING. 3.0 Semester Hrs.

The application of microeconomic theory to business strategy. Understanding the horizontal, vertical, and product boundaries of the modern firm. A framework for analyzing the nature and extent of competition in a firm's dynamic business environment. Developing strategies for creating and sustaining competitive advantage.

EBGN521. MICROECONOMICS OF MINERAL AND ENERGY MARKETS. 3.0 Semester Hrs.

(I) This is a graduate course dealing with applied microeconomic theory. This course concentrates on the behavior of the minerals and energy segment of the economy, the theory of production and cost, the theory of consumer behavior and demand, derived demand, price and output level determination by firms, and the competitive structure of product and input markets. Prerequisites: MATH111, EBG509. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- No change

EBGN523. MINERAL AND ENERGY POLICY. 3.0 Semester Hrs.

(II) An analysis of current topics in the news in mineral and energy issues through the lens of economics. Since many of the topics involve government policy, the course provides instruction related to the economic foundations of mineral and energy policy analysis. 3 credit hours.

EBGN525. BUSINESS ANALYTICS. 3.0 Semester Hrs.

The process of converting data into meaningful insights has become critical for organizations to stay competitive. Driven by the availability of massive volumes of business data, business analytics has become instrumental in informing managerial practices and strategies in companies at every stage of their operations. This course introduces fundamental concepts for descriptive analytics and statistical methods which provide primary skills to students that enable them to use quantitative tools for organizing, processing, and critically interpreting business data. Students will learn to use data analytics toolkits and libraries in Excel and Python to address real-world business problems in a variety of industries and disciplines, including energy, production, logistics, scheduling, marketing, and finance.

Course Learning Outcomes

- Understand the basics of probability theory
- Gain skills in cleaning raw business data by imputing missing cells, identifying and handling outliers, eliminating unnecessary attributes using Excel
- Explore, visualize and critically interpret business data using Python
- Understand and perform linear regression analysis and interpret the results using tools in Python
- Address real-world business problems in a variety of disciplines using analytical thinking skills in cleaning, processing and analyzing raw business data and converting them into meaningful managerial insights

EBGN526. STOCHASTIC MODELS IN MANAGEMENT SCIENCE. 3.0 Semester Hrs.

(II) This course introduces the tools of stochastic modeling that are very useful in solving analytical problems in business. We cover methodologies that help to quantify the dynamic relationships of sequences of random events that evolve over time. Topics include static and dynamic Monte-Carlo simulation, discrete and continuous time Markov chains, probabilistic dynamic programming, Markov decision processes, queuing processes and networks, Brownian motion and stochastic control. Applications from a wide range of fields will be introduced including marketing, finance, production, logistics and distribution, energy and service systems. In addition to an intuitive understanding of analytical techniques to model stochastic processes, the course emphasizes how to use related software packages for managerial decision-making. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- Have a good understanding of static and dynamic Monte-Carlo simulation.
- Have a good understanding of discrete and continuous time Markov chains and decision processes.
- Have a good understanding of probabilistic dynamic programming, queuing processes and networks.
- Have a good understanding of Brownian motion and stochastic control.

EBGN527. BUSINESS OPTIMIZATION MODELS. 3.0 Semester Hrs.

Business optimization is one of the most important actions taken by businesses at the strategic, tactical, operational levels in order to stay competitive and successful. Prescriptive analytics aim to identify the optimal solutions for organizations. This course provides quantitative skills to solve real-world business problems using analytics by focusing on the art of model building using linear, integer and mixed-integer programming for business applications in several areas such as production, supply chain management, and finance. To this end, several real-world business problems will be examined. It also provides insights into specially structured models, and fundamental skills on model enhancement techniques. Prerequisite: Admission to the ETM program or permission of the instructor.

Course Learning Outcomes

- Develop a high-level understanding of what prescriptive analytics is and its difference from descriptive and predictive analytics.
- Develop skills on the art of formulating deterministic optimization models for business problems.
- Develop insights into specially structured models that provide skills in identifying and using them in business applications.
- Identify objectives, limitations and necessary inputs for business problems.
- Develop optimization models for business problems and solve them to obtain optimal decisions using AMPL with different solvers (e.g., CPLEX, GUROBI).
- Gain skills in model enhancement techniques to develop efficient optimization models.
- Develop skills in analyzing the optimal solution and extracting insights from it.

EBGN528. INDUSTRIAL SYSTEMS SIMULATION. 3.0 Semester Hrs.

The course focuses on creating computerized models of real or proposed complex systems for performance evaluation. Simulation provides a cost effective way of pre-testing proposed systems and answering "what-if" questions before incurring the expense of actual implementations. The course is instructed in the state-of-the-art computer lab (CTLM), where each student is equipped with a personal computer and interacts with the instructor during the lecture. Professional version of a widely used commercial software package, "Arena", is used to build models, analyze and interpret the results. Other business analysis and productivity tools that enhance the analysis capabilities of the simulation software are introduced to show how to search for optimal solutions within the simulation models. Both discrete-event and continuous simulation models are covered through extensive use of applications including call centers, various manufacturing operations, production/inventory systems, bulk-material handling and mining, port operations, high-way traffic systems and computer networks.

EBGN529. HEALTH SYSTEMS ENGINEERING ANALYTICS. 3.0 Semester Hrs.

This course provides skills on modeling and forecasting through the avenue of a hospital-wide learning system to develop, implement, and assess clinical operational excellence strategies for care delivery transformation across diverse health system settings. This course utilizes the science of improvement to understand and prioritize solutions to reduce flow failures and delays and achieve efficient hospital-wide patient flow, which is crucial for safe and quality care and effective utilization of healthcare resources. The emphasis is on the DMAIC problem-solving approach that drives Lean Six Sigma performance improvement project within the macro system dynamics. Prerequisite: None Co-requisite: None.

Course Learning Outcomes

- Learning Outcome 1 (LO1): 'D' Define
- Learning Outcome 2 (LO2): 'M' Measure
- Learning Outcome 3 (LO3): 'A' Analyze
- Learning Outcome 4 (LO4): 'I' Improve
- Learning Outcome 5 (LO5): 'C' Control

EBGN530. ECONOMICS OF INTERNATIONAL ENERGY MARKETS. 3.0 Semester Hrs.

Application of models to understand markets for oil, gas, coal, electricity, and renewable energy resources. Models, modeling techniques, and issues included are supply and demand, market structure, transportation models, game theory, futures markets, environmental issues, energy policy, energy regulation, input/output models, energy conservation, and dynamic optimization. The emphasis in the course is on the development of appropriate models and their application to current issues in energy markets. Prerequisites: Principles of Microeconomics, MATH111, EBG509, EBG510, EBG511.

EBGN535. ECONOMICS OF METAL INDUSTRIES AND MARKETS. 3.0 Semester Hrs.

(I, II, S) Metal supply from main product, byproduct, and secondary production. Metal demand and intensity of use analysis. Market organization and price formation. Public policy, comparative advantage, and international metal trade. Metals and economic development in the developing countries and former centrally planned economies. Environmental policy and mining and mineral processing. Students prepare and present a major research paper. Prerequisites: EBG201, MATH111, EBG509, and EBG510. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- Same as before

EBGN536. MINERAL POLICIES AND INTERNATIONAL INVESTMENT. 3.0 Semester Hrs.

Identification and evaluation of international mineral investment policies and company responses using economic, business and legal concepts. Assessment of policy issues in light of stakeholder interests and needs. Theoretical issues are introduced and then applied to case studies, policy drafting, and negotiation exercises to assure both conceptual and practical understanding of the issues. Special attention is given to the formation of national policies and corporate decision making concerning fiscal regimes, project financing, environmental protection, land use and local community concerns and the content of exploration and extraction agreements. Prerequisites: Principles of Microeconomics, MATH111, EBG509, EBG510, EBG511.

EBGN537. ECONOMICS OF WATER. 3.0 Semester Hrs.

(II) This course seeks to develop the underlying economic logic of water use and how policy impacts the allocation of water in our economy. Water is a critical input for a number of sectors; from our basic sustenance to agriculture production, from industrial processes to ecological services, and from mineral extraction to energy production. Meanwhile, the supply of water is highly variable across space and through time while pollutants can further diminish the useable extent, making the policies to allocate and manage the resource central to understanding how the resource is utilized. The course will survey topics across sectors and water sources while applying economic theory and empirical/policy analysis. Prerequisite: EBG509 or MATH213 or GEGN580. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- 1. Economic modelling of water systems
- 2. Empirical assessment of water policies
- 3. Valuation techniques for water resources
- 4. How institutional structure effect development
- 5. Economic tools to assess water allocation and water pollution
- 6. Application to specific sectors

EBGN540. ACCOUNTING AND FINANCE. 3.0 Semester Hrs.

(I) Included are the relevant theories associated with capital budgeting, financing decisions, and dividend policy. This course provides an in-depth study of the theory and practice of corporate accounting and financial management including a study of the firm's objectives, investment decisions, long-term financing decisions, and working capital management. Preparation and interpretation of financial statements and the use of this financial information in evaluation and control of the organization. 3 hours lecture; 3 semester hours.

EBGN541. INTERNATIONAL TRADE. 3.0 Semester Hrs.

Theories and evidence on international trade and development. Determinants of static and dynamic comparative advantage. The arguments for and against free trade. Economic development in nonindustrialized countries. Sectoral development policies and industrialization. The special problems and opportunities created by extensive mineral resource endowments. The impact of value-added processing and export diversification on development. Prerequisites: Principles of Microeconomics, MATH111, EBG509, EBG511.

EBGN542. ECONOMIC DEVELOPMENT. 3.0 Semester Hrs.

Role of energy and minerals in the development process. Sectoral policies and their links with macroeconomic policies. Special attention to issues of revenue stabilization, resource largesse effects, downstream processing, and diversification. Prerequisites: Principles of Microeconomics, MATH111, EBG509, EBG511, EBG512.

EBGN546. INVESTMENT AND PORTFOLIO MANAGEMENT. 3.0 Semester Hrs.

This course covers institutional information, valuation theory and empirical analysis of alternative financial investments, including stocks, bonds, mutual funds, ETS, and (to a limited extent) derivative securities. Special attention is paid to the role of commodities (esp. metals and energy products) as an alternative investment class. After an overview of time value of money and arbitrage and their application to the valuation of stocks and bonds, there is extensive treatment of optimal portfolio selection for risk averse investors, mean-variance efficient portfolio theory, index models, and equilibrium theories of asset pricing including the capital asset pricing model (CAPM) and arbitrage pricing theory (APT). Market efficiency is discussed, as are its implications for passive and active approaches to investment management. Investment management functions and policies, and portfolio performance evaluation are also considered. Prerequisites: Principles of Microeconomics, MATH111, MATH530.

EBGN547. FINANCIAL RISK MANAGEMENT. 3.0 Semester Hrs.

Analysis of the sources, causes and effects of risks associated with holding, operating and managing assets by individuals and organizations; evaluation of the need and importance of managing these risks; and discussion of the methods employed and the instruments utilized to achieve risk shifting objectives. The course concentrates on the use of derivative assets in the risk management process. These derivatives include futures, options, swaps, swaptions, caps, collars and floors. Exposure to market and credit risks will be explored and ways of handling them will be reviewed and critiqued through analysis of case studies from the mineral and energy industries. Prerequisites: Principles of

Microeconomics, MATH111, MATH530, EBG505; EBG545 or EBG546. Recommended: EBG509, EBG511.

EBGN553. PROJECT MANAGEMENT. 3.0 Semester Hrs.

(I, II) Project management has evolved into a business process broadly used in organizations to accomplish goals and objectives through teams. This course covers the essential principles of traditional project management consistent with professional certification requirements (the Project Management Institute's PMP certification) as well as an introduction to current agile project management methodologies. The traditional project management phases of project initiation, planning, execution, monitoring and control, and project closure are covered including related scheduling, estimating, risk assessment and other analytical tools. Students will gain experience using Microsoft Project. Organizational structure and culture issues are analyzed to understand how they can impact project management success, and the concepts of project portfolios and project programs are applied from the organizational perspective. Agile project management methodologies are introduced, including adaptive and iterative processes, scrum, lean and other agile tools and techniques. By the end of the course, students will understand how traditional and agile project. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- At the conclusion of this course students will be able to: 1. Identify the role and responsibilities of a Project Manager and the project team. 2. Identify project stakeholders, and define project stakeholder needs and processes for capturing information on those needs. 3. Define the five process groups of traditional project management as defined by the Project Management Institute (PMI). 4. Prepare a preliminary project scope document. 5. Create a work breakdown structure for a proposed project. 6. Develop a project schedule, and identify the critical path for the project. 7. Identify project resource needs, and prepare an estimated cost baseline for a set of tasks within a project. 8. Perform a basic project risk assessment. 9. Identify and analyze project scope changes and identify resulting risk profile changes for the project. 10. Describe agile project management and how it differs from traditional project management. 11. Define the envision, speculate, explore, and the adapt and close phases of agile project management

EBGN555. LINEAR PROGRAMMING. 3.0 Semester Hrs.

This course addresses the formulation of linear programming models, examines linear programs in two dimensions, covers standard form and other basics essential to understanding the Simplex method, the Simplex method itself, duality theory, complementary slackness conditions, and sensitivity analysis. As time permits, multi-objective programming and stochastic programming are introduced. Applications of linear programming models discussed in this course include, but are not limited to, the areas of manufacturing, finance, energy, mining, transportation and logistics, and the military. 3 hours lecture; 3 semester hours.

EBGN559. SUPPLY CHAIN ANALYTICS. 3.0 Semester Hrs.

The focus of the course is to show how a firm can achieve better "supply-demand matching" through the implementation of rigorous mathematical models and various operational/tactical strategies. We look at organizations as entities that must match the supply of what they produce with the demand for their products. A considerable portion of the course is devoted to mathematical models that treat uncertainty in the supply-chain. Topics include managing economies of scale for functional products, managing market-mediation costs for innovative products, make-to order versus make-to-stock systems, quick response strategies, risk pooling strategies, supply-chain contracts and revenue management.

Additional "special topics" may be introduced, such as reverse logistics issues in the supply-chain or contemporary operational and financial hedging strategies, as time permits.

EBGN560. DECISION ANALYTICS. 3.0 Semester Hrs.

Introduction to the science of decision making and risk theory. Application of decision analysis and utility theory to the analysis of strategic decision problems. Focuses on the application of quantitative methods to business problems characterized by risk and uncertainty. Choice problems such as decisions concerning major capital investments, corporate acquisitions, new product introductions, and choices among alternative technologies are conceptualized and structured using the concepts introduced in this course.

Course Learning Outcomes

- same as before

EBGN562. STRATEGIC DECISION MAKING. 3.0 Semester Hrs.

(I, II, S) This course covers how to unwind complex situations to gain clarity and enable confident decisions. The focus is on thinking as opposed to calculating, framing the problem correctly, ensuring clarity around the objectives, developing creative alternative strategies, and qualitatively evaluating these alternatives. Tools for accomplishing these goals will be introduced. Discussion topics include common psychological biases and traps, scenario analysis, game theory, cultural influences, and decision making in complex (as opposed to merely complicated) systems. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- Know how to unwind complex problems to facilitate good decision making
- Understand how different types of key issues are incorporated into the decision process
- Characterize uncertainty appropriately in decision making
- Understand the use of objectives hierarchies
- Use strategy tables to generate creative alternative strategies
- Be aware of human psychological weaknesses, and know how to avoid the resulting pitfalls
- Distinguish between complicated and complex problems, and know how to approach each

EBGN563. MANAGEMENT OF TECHNOLOGY AND INNOVATION. 3.0 Semester Hrs.

Lectures, case studies and reading assignments explore strategies for profiting from technology assets and technological innovation. The roles of strategy, core competencies, product and process development, manufacturing, R&D, marketing, strategic partnerships, alliances, intellectual property, organizational architectures, leadership and politics are explored in the context of technological innovation. The critical role of organizational knowledge and learning in a firm's ability to leverage technological innovation to gain competitive advantage is explored. The relationships between an innovation, the competencies of the innovating firm, the ease of duplication of the innovation by outsiders, the nature of complementary assets needed to successfully commercialize an innovation and the appropriate strategy for commercializing the innovation are developed. Students explore the role of network effects in commercialization strategies, particularly with respect to standards wars aimed at establishing new dominant designs.

EBGN565. MARKETING FOR TECHNOLOGY-BASED COMPANIES. 3.0 Semester Hrs.

This class explores concepts and practices related to marketing in this unique, fast-paced environment, including the defining characteristics of

high-technology industries; different types and patterns of innovations and their marketing implications; the need for (and difficulties in) adopting a customer-orientation; tools used to gather marketing research/intelligence in technology-driven industries; use of strategic alliances and partnerships in marketing technology; adaptations to the "4 P's"; regulatory and ethical considerations in technological arenas.

EBGN566. TECHNOLOGY ENTREPRENEURSHIP. 3.0 Semester Hrs.

Technology entrepreneurship is a distinct activity in technology enterprises and start-ups that require a disciplined approach to forming product concepts and justifying financial investment. This course covers technology categories, venture opportunity and strategy, product design, industry and competitive analysis, concept development, venture development, intellectual property, funding and financial projections. In addition, the course explores creativity, problem solving, business modeling, market analysis and business planning for technology-oriented solutions. A Venture Plan project will allow students to develop a start-up business concept with a technology product of their choosing. Venture Planning topics include: product design, product forecasting, revenue forecasting, operations planning, staffing plan, financial analysis, financial statements, funding sources and uses. A start-up venture plan will be created with 3-year projections for income statements, cashflow and balance sheet.

EBGN567. BUSINESS LAW AND ETHICS. 3.0 Semester Hrs.

(I) This course incorporates a broad range of legal topics and ethical issues relevant to technology-based organizations, from start-ups to mature Fortune 100 international corporations. The topics encompass numerous aspects of U.S. business law, including but not limited to: the U.S. court system, contracts, e-commerce, managerial ethics, white collar crimes, early stage business formation, intellectual property, product liability, agency law, employment law, mergers and acquisitions, antitrust, and unfair competition law. The course is discussion based, with some lecture, and is 3 semester credit hours. There are no prerequisites required for this course. A significant portion of class time will be applied to exploring and discussing assigned topics through relevant abbreviated court case descriptions, ethics reader assignments and current and recent events in global business. The overall goal of this course is not to make students legal experts but to make them better managers and leaders by equipping them with relevant legal. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- At the conclusion of this course students will be able to: 1. Describe the sources of U.S. law and explain the differences between law, ethics and the social responsibility of business. 2. Integrate business law considerations into business decision processes, and demonstrate how this integration can identify important questions that must be considered from a risk context. 3. Gain business skills by exercising advocacy of alternative positions in class and online discussions. 4. Analyze business cases to identify legal and ethical considerations. 5. Demonstrate how ethical issues and considerations can impact personal and managerial decisions in business organizations. 6. Define the structure of the U.S. court system, the general stages of the civil litigation process and forms of alternative dispute resolution available to commercial enterprises. 7. Apply the elements of contract formation, performance and discharge to commercial transaction scenarios to identify potential contractual legal risks and liabilities. 8. Analyze contract breach scenarios and determine damages calculations and possible equitable remedies. 9. Identify business and white-collar crimes, and describe the U.S. criminal legal procedure. 10. Define intentional and unintentional torts that can apply to business conduct, and identify activities that

could expose an organization to risks of legal liability under the legal theories of negligence. 11. Describe the different forms of intellectual property protection, including patents, trademarks, copyrights and trade secrets and how they may apply to different forms of technology development. 12. Identify express and implied warranties, and define the sources of product liability. 13. Define the different types of bankruptcy available under federal law, and describe federal bankruptcy procedure. 14. Apply agency law to different employment and agency business situations to identify potential legal risks and obligations. 15. Analyze an entrepreneurial business opportunity and identify the available forms of legal entity creation applicable to those opportunities. 16. Explain the elements of good corporate governance. 17. Define three different forms of business mergers and acquisitions, and how the general antitrust laws can impact potential business combinations. 18. Identify at least three labor and employment practices that can expose businesses to legal liability.

EBGN568. ADVANCED PROJECT ANALYSIS. 3.0 Semester Hrs.

An advanced course in economic analysis that will look at more complex issues associated with valuing investments and projects. Discussion will focus on development and application of concepts in after-tax environments and look at other criteria and their impact in the decision-making and valuation process. Applications to engineering and technology aspects will be discussed. Effective presentation of results will be an important component of the course. Prerequisite: EBG504.

EBGN570. ENVIRONMENTAL ECONOMICS. 3.0 Semester Hrs.

The role of markets and other economic considerations in controlling pollution; the effect of environmental policy on resource allocation incentives; the use of benefit/cost analysis in environmental policy decisions and the associated problems with measuring benefits and costs. Prerequisites: Principles of Microeconomics, MATH111, EBG509, EBG510.

EBGN571. MARKETING ANALYTICS. 3.0 Semester Hrs.

The purpose of this course is to gain an understanding of how data about customers and markets can be used to support and improve decision making. Using market data to evaluate alternatives and gain insight from past performance is the essence of marketing analytics. The course is focused on the marketing research decisions facing product managers in technology based companies and will appeal to students who want to gain a deeper understanding of such topics as the problems of target market selection, new product introductions, pricing, and customer retention. While the specifics of market analytics can vary across industries and firms, three main commonalities are: (1) defining the decision problem, (2) collection and analysis of high quality market data, and (3) implementing strategy through marketing mix decisions. In this course students will develop an understanding of available marketing analytic methods and the ability to use marketing research information to make strategic and tactical decisions.

Course Learning Outcomes

- Have an understanding of how to define and operationalize marketing decision problems.
- Have a good understanding of how to identify and collect high quality market data.
- Have a good understanding of core marketing analytic tools such as cluster analysis, perceptual mapping, and conjoint analysis.
- Be able to apply core marketing analytic tools to make strategic and tactical marketing decisions.

EBGN572. INTERNATIONAL BUSINESS STRATEGY. 3.0 Semester Hrs.

The purpose of this course is to gain understanding of the complexities presented by managing businesses in an international environment. International business has grown rapidly in recent decades due to technological expansion, liberalization of government policies on trade and resource movements, development of institutions needed to support and facilitate international transactions, and increased global competition. Due to these factors, foreign countries increasingly are a source of both production and sales for domestic companies.

EBGN575. ADVANCED MINING AND ENERGY ASSET VALUATION. 3.0 Semester Hrs.

(I) The use of option pricing techniques in mineral and energy asset valuation. Mining and energy valuation standards and guidelines. Differentiation between static decision making, intertemporal decision making, and dynamic decision making under uncertainty. The comparison sales and cost approaches to valuation. Commodity price simulation and price forecasting. Risk-neutral valuation. Prerequisites: EBG504, EBG509, EBG510, EBG511, EBG521, EBG590. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- n/a

EBGN576. MANAGING AND MARKETING NEW PRODUCT DEVELOPMENTS. 3.0 Semester Hrs.

(II) This course provides a scientific approach to developing and marketing new products which are often critical to the success of firms competing in technology based industries. We will start with an overview of core marketing and then develop prototypes of a new product design. We will step through the new product development process in detail, learning about available tools and techniques to execute each process step along the way. New product prototypes will be used to gather data from prospective target markets and assess the viability of the design in the marketplace. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- At the conclusion of this course students will be able to: 1. Understand the stages of the product development process 2. Understand core marketing fundamentals 3. To be able to generate product concepts using a variety of approaches, 4. To be familiar with techniques to elicit customer input, and 5. To understand how marketing research methods can be used to improve the product development process 6. Develop a marketing plan for new product developments

EBGN577. LEADING & MANAGING HIGH PERFORMING TEAMS. 3.0 Semester Hrs.

(I) Effective leaders contribute significantly to their organization's performance. When they take advantage of a technological innovation or respond to a crisis, leaders rely on critical skills to communicate their vision and coordinate tasks performed by others. This course is about developing your unique leadership skills and style whether you lead a small engineering team or, eventually, a large global corporation. We review key theories of leadership and examine the lessons learned from those who applied them. We synthesize and translate these lessons into specific behaviors that enhance your ability to lead. We discuss how generational shifts, economic and political factors impact the workplace in ways that call for effective, quality leadership. Ultimately, you have to understand how to lead and motivate individuals who don't look or think like you. This may involve motivating followers and involving them in making decisions. Following a learning-by-doing approach,

we complement class discussions and case studies with a hands-on simulation of a leadership team facing a series of crises.

Course Learning Outcomes

- Gain a holistic perspective on effective leadership
- Differentiate between effective leadership and management
- Demonstrate understanding of human capital, collaborative relationships and conflict resolution
- Students develop awareness of own leadership skills
- Apply effective leadership concepts in the context of organizational change
- Identify various leadership styles and understand when a particular style is most likely to be successful
- Recognize how leaders influence, motivate and empower others

EBGN578. BUSINESS OPERATIONS AND SUPPLY CHAIN MANAGEMENT. 3.0 Semester Hrs.

Business Operations and Supply Chain Management is an elective course for ETM, approved masters and undergrad students who wish to learn how businesses operations support the business strategy. This course focuses on business operations for manufacturing and service industries, as well as Supply Chain Management. Students will gain an understanding of the businesses that they will shortly be involved with as they start their first career positions. Hands-on exercises to learn how to design processes, trouble shoot operational problems with root cause analysis, prepare business case studies, and conduct process simulations during the course. Key Business Operations topics include: operations strategy and objectives, product design, manufacturing production types, Lean Manufacturing, distribution, process design, productivity, optimization, control system theory, quality control, Total Quality Management (TQM), forecasting, and Six Sigma. Key Supply Chain Management topics include: capacity and demand planning, inventory management, distribution strategies, supplier risk mitigation and global supply chain management.

Course Learning Outcomes

- See the big picture of a company, like a CEO perceives the business.
- Understand a variety of value-adding business models and their associated operations.
- Learn about operations for manufacturing, service, petroleum, distribution, aerospace and software development organizations.
- Engage in multiple case studies that support the lecture materials
- Understand the role and list the components of information systems and datacenters.
- Review cybersecurity trends, challenges and solutions
- Apply workflow tools and design processes.
- Analyze a quality control system with a statistical process control simulation.
- Explain and evaluate operations management strategies and metrics.
- List the elements of Six Sigma methodology and apply root cause analysis
- Explain the key concerns of information systems management
- Describe the interaction of operations and information systems to support the business goals
- Develop a business/operations plan of 20-30 pages with value chain mapping, operations strategy, departmental expense and staffing levels, and a 5-year financial analysis with income statements, cash flow and balance sheets.

EBGN580. EXPLORATION ECONOMICS. 3.0 Semester Hrs.

Exploration planning and decision making for oil and gas, and metallic minerals. Risk analysis. Historical trends in exploration activity and productivity. Prerequisites: EENG480 or instructor consent.

EBGN585. ENGINEERING AND TECHNOLOGY MANAGEMENT CAPSTONE. 3.0 Semester Hrs.

This course represents the culmination of the ETM Program. This course is about the strategic management process ? how strategies are developed and implemented in organizations. It examines senior management's role in formulating strategy and the role that all an organization's managers play in implementing a well thought out strategy. Among the topics discussed in this course are (1) how different industry conditions support different types of strategies; (2) how industry conditions change and the implication of those changes for strategic management; and (3) how organizations develop and maintain capabilities that lead to sustained competitive advantage. This course consists of learning fundamental concepts associated with strategic management process and competing in a web-based strategic management simulation to support the knowledge that you have developed.

EBGN590. ECONOMETRICS I. 3.0 Semester Hrs.

(II) This course covers the statistical methods used by economists to estimate economic relationships and empirically test economic theories. Topics covered include hypothesis testing, ordinary least squares, specification error, serial correlations, heteroskedasticity, qualitative and limited dependent variables, time series analysis and panel data. Prerequisites: MATH111, MATH530, EBGN509. 3 hours lecture and discussion; 3 semester hours.

EBGN594. TIME-SERIES ECONOMETRICS. 3.0 Semester Hrs.

(II) This is a course in applied time-series econometrics. It covers contemporary approaches for interpreting and analyzing time-series economic data. Hypothesis testing and forecasting both receive attention. Topics include stochastic difference equations, applied forecasting, stationary univariate models, models with constant and time-varying variance, deterministic and stochastic trend models and associated unit root and structural break tests, as well as single-equation and multiple-equation time-series models that include error-correction techniques and cointegration tests. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- No changes

EBGN598. SPECIAL TOPICS IN ECONOMICS AND BUSINESS. 6.0 Semester Hrs.

(I, II, S) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once, but no more than twice for the same course content. Prerequisite: none. Variable credit: 0 to 6 credit hours. Repeatable for credit under different titles.

EBGN599. INDEPENDENT STUDY. 0.5-6 Semester Hr.

(I, II, S) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit: 0.5 to 6 credit hours. Repeatable for credit under different topics/ experience and maximums vary by department. Contact the Department for credit limits toward the degree.

EBGN610. ADVANCED NATURAL RESOURCE ECONOMICS. 3.0 Semester Hrs.

Optimal resource use in a dynamic context using mathematical programming, optimal control theory and game theory. Constrained optimization techniques are used to evaluate the impact of capital constraints, exploration activity and environmental regulations. Offered when student demand is sufficient. Prerequisites: Principles of Microeconomics, MATH111, MATH5301, EBG509, EBG510, EBG511.

EBGN611. ADVANCED MICROECONOMICS. 3.0 Semester Hrs.

A second graduate course in microeconomics, emphasizing state-of-the-art theoretical and mathematical developments. Topics include consumer theory, production theory and the use of game theoretic and dynamic optimization tools. Prerequisites: Principles of Microeconomics, MATH111, MATH5301, EBG509, EBG511.

EBGN632. PRIMARY FUELS. 3.0 Semester Hrs.

(II) Application of models to understand markets for oil, gas, coal exploration and extraction. Empirical, theoretical and quantitative models and modeling techniques are stressed. The issues included are identification of cause and effect, market structure, game theory, futures markets, environmental issues, energy policy, energy regulation. The emphasis in the course is on the development of appropriate models and their application to current issues in primary fuel/upstream markets. Prerequisites: EBG590. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- 1. Rigorous identification of issues affecting coal, oil and gas extraction
- 2. Market structure effects on production
- 3. The impact of policies on production and investment
- 4. Where to find basic data on energy supply and investment
- 5. How to organize basic information in a paper/presentation
- 6. How to write/present your thoughts in a clear and concise manner

EBGN645. COMPUTATIONAL ECONOMICS. 3.0 Semester Hrs.

(II) This course is about learning the skills required to construct and manipulate numerical models as an instrument of economic research. In the first part of the course, students will learn about basic classes of optimization problems as ways to operationalize models of equilibrium behavior from economics and how to formulate and solve these problems on the computer. In the second part of the course, students will focus on the techniques used specifically in computable general equilibrium (CGE) analysis and developing applications of CGE models to topics in energy, environmental and natural resource economics. Prerequisites: MATH111, MATH530, Principles of Microeconomics, EBG509, EBG511. 3 hours lecture; 3 semester hours.

Course Learning Outcomes

- Understand basic classes of mathematical programming problems.
- Formulate and solve economic models on the computer.
- Calibrate numerical models for quantitative economic analysis.

EBGN655. ADVANCED LINEAR PROGRAMMING. 3.0 Semester Hrs.

Equivalent with EBG650,

As an advanced course in optimization, this course will expand upon topics in linear programming. Specific topics to be covered include advanced formulation, column generation, interior point method, stochastic optimization, and numerical stability in linear programming. Applications of state-of-the-art hardware and software will emphasize solving real-world problems in areas such as mining, energy,

transportation and the military. Prerequisites: EBG555. 3 hours lecture; 3 semester hours.

EBGN690. ECONOMETRICS II. 3.0 Semester Hrs.

A second course in econometrics. Compared to EBG590, this course provides a more theoretical and mathematical understanding of econometrics. Matrix algebra is used and model construction and hypothesis testing are emphasized rather than forecasting. Prerequisites: Principles of Microeconomics, MATH111, MATH530, EBG509, EBG590. Recommended: EBG511.

EBGN695. RESEARCH METHODOLOGY. 3.0 Semester Hrs.

Lectures provide an overview of methods used in economic research relating to EPP and QBA/OR dissertations in Mineral Economics and information on how to carry out research and present research results. Students will be required to write and present a research paper that will be submitted for publication. It is expected that this paper will lead to a Ph.D. dissertation proposal. It is a good idea for students to start thinking about potential dissertation topic areas as they study for their qualifier. This course is also recommended for students writing Master's thesis or who want guidance in doing independent research relating to the economics and business aspects of energy, minerals and related environmental and technological topics. Prerequisites: MATH530, EBG509, EBG510, EBG511, EBG590.

EBGN698. SPECIAL TOPICS IN ECONOMICS AND BUSINESS. 6.0 Semester Hrs.

(I, II, S) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once, but no more than twice for the same course content. Prerequisite: none. Variable credit: 0 to 6 credit hours. Repeatable for credit under different titles.

EBGN699. INDEPENDENT STUDY. 0.5-6 Semester Hr.

(I, II, S) Individual research or special problem projects supervised by a faculty member, also, when a student and instructor agree on a subject matter, content, and credit hours. Prerequisite: ?Independent Study? form must be completed and submitted to the Registrar. Variable credit: 0.5 to 6 credit hours. Repeatable for credit under different topics/experience and maximums vary by department. Contact the Department for credit limits toward the degree.

EBGN707. GRADUATE THESIS / DISSERTATION RESEARCH CREDIT. 1-15 Semester Hr.

(I, II, S) Research credit hours required for completion of a Masters-level thesis or Doctoral dissertation. Research must be carried out under the direct supervision of the student's faculty advisor. Variable class and semester hours. Repeatable for credit.