

- ECE 4680\* Embedded Computing 3(2)** Principles of using computing in the larger context of a system. Topics include bus and processor design types (e.g. microprocessor, microcontroller, DSP), codecs, digital circuit power management, real time scheduling, and embedded operating systems. Lab work consists of projects on embedded hardware (e.g. PC-104+). Preq: ECE 2230 and ECE 3710, each with a C or better. Coreq: ECE 4681.
- ECE 4681\* Embedded Computing Laboratory 0(2)** Non-credit laboratory to accompany ECE 4680. Coreq: ECE 4680.
- ECE 4700 Vehicle Electronics 3(3)** Introduction to vehicle electronic systems and networks. Topics include a review of electronic systems in automotive and aerospace applications; vehicle components, sensors and actuators; communication busses; electric power generation and distribution in vehicle systems; vehicle diagnostics; reliability; and trends in vehicle system design. Preq: ECE 3200 with a C or better.
- ECE 4710 Electric Vehicles and Energy Storage 3(3)** Introduction to hybrid electric propulsion systems and energy storage systems. Topics include a review of fundamentals of electric vehicles and hybrid electric vehicles architectures covering reasons for hybridization, energy analysis of architecture and components; overview of energy storage systems (batteries and supercapacitors); modeling of components; vehicle simulation; and supervisory control. Preq: ECE 3200 with a C or better.
- ECE 4730\* Introduction to Parallel Systems 3(3)** Introduces parallel computer architectures and their programming. Includes an introduction to MPI and OpenMP and a number of engineering problems, including numerical simulations. Introduces scalability analysis. Preq: ECE 3220 or ECE 3290, each with a C or better.
- ECE (CPSC) 4780\* General Purpose Computation on Graphical Processing Units 3(3)** Instruction in the design and implementation of highly parallel, GPU-based solutions to computationally intensive problems from a variety of disciplines. The OpenCL language with inter-operable OpenGL components is used. Applications to models of physical systems are discussed in detail. May also be offered as CPSC 4780. Preq: CPSC 2120 or ECE 2230.
- ECE 4910 Undergraduate Honors Research 1-6(1-6)** Individual research projects conducted under the direct supervision and guidance of a faculty member. May be repeated for a maximum of six credits.
- ECE 4920\* Special Problems 1-3(1-3)** Special assignment in electrical or computer engineering. Some typical assignments include computer programs, term papers, technical literature searches, hardware projects, and design project leadership. May be taken only once for credit.
- ECE 4930\* Selected Topics 1-3(1-3)** Classroom study of current and new technical developments in electrical and computer engineering. May be repeated for a maximum of six credits, but only if different topics are covered. Preq: Consent of instructor.
- ECE 4950 Integrated System Design I 2(1)** Considers engineering design of systems in a continuous process of project definition, planning, execution, and evaluation. This process includes consideration of both technical and non-technical factors in design. Strong emphasis is placed on the development of effective technical communications skills, particularly oral communications competency. Preq: Electrical Engineering major and ECE 3200 and ECE 3300 and ECE 3600 and ECE 3800, each with a C or better; or Computer Engineering major and ECE 3200 and ECE 3220 and ECE 3300 and ECE 3520 and ECE 3710, each with a C or better. Preq or concurrent enrollment: ECE 4090 with a C or better. Coreq: ECE 4951.
- ECE 4951 Integrated System Design I Laboratory 0(3)** Non-credit laboratory to accompany ECE 4950. Coreq: ECE 4950.
- ECE 4960 Integrated System Design II 2 (6)** Project-oriented course which brings together electrical and computer engineering students of dissimilar training in teams or project groups. Group assignments are designed to develop an appreciation for individual and creative thinking, as well as team effort. Preq: Electrical Engineering major and ECE 3210 and ECE 3710 and ECE 3810 and ECE 4090 and ECE 4950, each with a C or better; or Computer Engineering major and ECE 4090 and ECE 4950, each with a C or better.
- ECE 4990 Creative Inquiry—Electrical and Computer Engineering 1-4(1-4)** In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits. Includes Honors sections. Preq: Consent of faculty member/mentor.
- ECONOMICS**  
*Professors:* S.L. Baier, H. Bodenhorn, W.R. Dougan, M. Espey, R.K. Fleck, T. W. Hazlett, R.D. Sauer, Jr., *Chair:* C.J. Simon, Jr., R.F. Tamura, R.D. Tollison, P.W. Wilson; *Associate Professors:* F.A. Hanssen, M.J. Jermianowski, M. Lewis, S. Mityakov, S.R. Templeton, K.K. Tsui, P. Warren; *Assistant Professors:* S. Barkowski, P. Blair, C. Lam, D. Miller, J. Oliveira, D. Wood; *Visiting Professor:* G.P. Dwyer, Jr.
- ECON 2000 Economic Concepts 3(3)** One-semester survey of basic economic concepts that offers an overview of both microeconomics and macroeconomics. Not intended for business majors or other students seeking a comprehensive introduction to economic analysis and its applications. Credit will not be given to students who have received credit for ECON 2110 or 2120.
- ECON 2110 Principles of Microeconomics 3(3)** Introduction to economic reasoning and its application to the study of the behavior of consumers and business firms. Particular topics include competition, monopoly, international trade, and the impact of selected public policies. Intended as the first of a two-semester sequence in the foundations of economics. Includes Honors sections.
- ECON 2120 Principles of Macroeconomics 3(3)** Continuation of ECON 2110 in which fundamental economic principles are applied to the study of aggregate economic performance. Topics include the forces determining the rates of inflation, unemployment, and economic growth, with particular emphasis on the influence of fiscal and monetary policies through financial markets. Includes Honors sections. Preq: ECON 2110.
- ECON 3010 Economics of Labor 3(3)** Introduces students to the economics of the labor market and labor relations. Considers the theories of wages and employment, determination, unemployment, investment in human capital, discrimination, and public policy toward the labor market. Also considers the role of labor unions. May not be used to satisfy requirements for a degree in Economics. Preq: ECON 2110.
- ECON 3020 Money and Banking 3(3)** Considers the function of money and banking in both the product and financial markets. Special emphasis is placed on monetary theory and current problems of monetary policy. May not be used to satisfy requirements for a degree in Economics. Preq: ECON 2120.
- ECON 3030 Economics and Sports 3(3)** Economic analysis of sports teams, leagues, and institutions. Analyzes basic economic issues using sports data. May not be used to satisfy requirements for a degree in Economics. Credit will not be given to students who have completed ECON 4260. Preq: ECON 2110.
- ECON (MGT) 3060 Managerial Economics 3(3)** Uses tools of economic analysis in classifying problems in organizing and evaluating information, and in comparing alternative courses of action. Bridges the gap between economic theory and managerial practices. May not be used to satisfy requirements for a degree in Economics. May also be offered as MGT 3060. Preq: ECON 2110.
- ECON 3070 Arbitration 3(3)** Analyzes dispute settlement procedures emphasizing mediation, fact-finding, and arbitration as they are used to resolve labor-management disputes in the public and private sectors. Preq: Consent of instructor.
- ECON 3090 Government and Business 3(3)** Relationships between government and business, including, among other topics, government efforts to enforce competition; to regulate public utilities; and to protect the special interest of laborers, farmers, and consumers. May not be used to satisfy requirements for a degree in Economics. Preq: ECON 2110.
- ECON 3100 International Economy 3(3)** Studies of the process of international commerce. Covers basic theory of trade and exchange rates, institutional and legal environment, current policy issues. Not open to students who have taken ECON 4120. May not be used to satisfy requirements for a degree in Economics. Preq: ECON 2110 and ECON 2120.
- ECON 3140 Intermediate Microeconomics 3(3)** Analytical study of basic concepts of value and distribution under alternative market conditions. Includes Honors sections. Preq: ECON 2110.

- ECON 3150 Intermediate Macroeconomics 3(3)** Macroeconomic problems of inflation and unemployment are focal points. Includes statistics (measures of real output and the price level) and theory (covering the sources of short-run fluctuations and long-run growth). Analyzes appropriate public policies addressing these issues. Includes Honors sections. Preq: ECON 2120.
- ECON 3190 Environmental Economics 3(3)** Study of the application of economic logic to issues surrounding environmental management and policy. Examines individual, firm, and collective decision making as well as the evolution of regulatory approaches for controlling environmental use. Preq: ECON 3140.
- ECON (ELE) 3210 Economics of Innovation 3(3)** Examines the nature of entrepreneurship and the contribution of innovation to economic growth. Investigates the organizational and institutional sources of innovation in different firms and different countries as well as the work of economic theorists concerning the role entrepreneurs play in bringing new products to market. May also be offered as ELE 3210. Preq: ECON 3060 or ECON 3140.
- ECON 3250 Personnel Economics 3(3)** Study of various compensation and personnel practices firms employ. Explains when each of those practices should be followed to elicit the desired employee effort and labor force quality. Topics include piece-rate and time-rate systems, seniority-based incentive schemes, promotion contests, evaluation systems, mandatory retirement, and up-or-out rules. Preq: ECON 2110.
- ECON 3400 Behavioral Economics 3(3)** Introduces the economic, sociological, and psychological aspects of decision making under uncertainty. Presents the psychology of prediction, intuitive prediction: biases and corrective procedures. Topics also include framing, choice with costly information, and social influences on individual behavior. Preq: ECON 2110.
- ECON 3440 Economics of Institutions and Property Rights 3(3)** Study of fundamental property rights structures and institutions in the capitalist economy and the arrangements that create incentives to produce and exchange. Preq: ECON 2110 and ECON 2120.
- ECON 3500 Moral and Ethical Aspects of a Market Economy 3(3)** Can a market system produce results that are fundamentally just? Is justice possible without voluntary exchange? Applies both economic and philosophical analyses to these questions. Emphasizes the causes, consequences, and morality of the distribution of wealth and income in a free-market system. Includes Honors sections. Preq: ECON 3140.
- ECON 3600 Public Choice 3(3)** Covers the economic approach to political activities and institutions. Topics include voting, voting rules, constitutions, political competition, political business cycles, vote trading, interest groups, bureaucracy, committees, legislators, executives, and judges. Designed for Economics and non-Economics majors and requires only basic skills in microeconomics. Preq: ECON 2110.
- ECON 3900 Junior Honors Research 1(1)** Readings and research in conjunction with an approved economics course at the 3000 or 4000 level. Honors status required. May be repeated for a maximum of three credits.
- ECON 3970 Creative Inquiry—in Economics I 1-4(1-4)** In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of four credits.
- ECON 4010 Labor Market Analysis 3(3)** Develops the methods of economic analysis of labor markets. Requires students to apply these methods to problems of the labor market. Topics include labor demand and supply, human capital, occupational choice, compensating wage differentials, organizational wage structures and incentive systems, unemployment, and discrimination. Preq: ECON 3140.
- ECON 4020\* Law and Economics 3(3)** Application of economics to the law of property, torts, and contracts; regulation of markets, business organizations, and financial transactions; distribution of income and wealth; and criminal law. Preq: ECON 2110.
- ECON 4040 Comparative Economic Systems 3(3)** Comparative analytical and historical study of the principal economic systems which have been important in the modern world including, among others, capitalism and socialism. Preq: ECON 3140.
- ECON 4050\* Introduction to Econometrics 4(3)** Introduction to methods of quantitative analysis of economic data. Reviews basic statistical methods and probability distribution. Topics include data management using professional statistical software applications; multiple regression analysis; hypothesis testing under conditions of multicollinearity, heteroscedasticity, and serial correlation. Preq: ECON 2110 and ECON 2120; and either MATH 1080 or MATH 2070; and MATH 3020 or STAT 3090 or STAT 3300. Coreq: ECON 4051.
- ECON 4051\* Introduction to Econometrics Laboratory 0(3)** Non-credit laboratory to accompany ECON 4050. Coreq: ECON 4050.
- ECON 4060\* Advanced Econometrics 3(3)** Reviews statistical inference using multiple regression (OLS) analysis and model specification. Topics include multicollinearity, heteroscedasticity, and serial correlation; two-staged least squares and instrumental variables models; simultaneous equations models; limited dependent variable models using maximum likelihood estimation and time-series analysis; and presentation of results in technical writing. Preq: ECON 4050.
- ECON 4100\* Economic Development 3(3)** Consideration and analysis of economic and related problems of underdeveloped countries. Attention is given to national and international programs designed to accelerate solution of these problems. Preq: ECON 3140.
- ECON 4110\* Economics of Education 3(3)** Analysis of economic issues related to education. The decision to invest in education, elementary and secondary school markets and reform, the market for college education, teacher labor markets, and education's effects on economic growth and income distribution. Preq: ECON 3140.
- ECON 4120\* International Microeconomics 3(3)** Analysis of the essential aspects of international economic linkages. Discusses gains and redistributive effects of trade and the barriers to trade within the context of a variety of economic models. Also discusses the history of trade policy and the political economy of its determination. Preq: ECON 3140.
- ECON 4130\* International Macroeconomics 3(3)** Examination of macroeconomic linkages between an individual country and the rest of the world and how these linkages are affected by the choice of exchange rate regimes. Topics include the relation between domestic and foreign interest rates and exchange rates and the ability to pursue independent monetary policies. Preq: ECON 3150.
- ECON 4190 Economics of Defense 3(3)** Examines the American defense establishment in terms of resources utilized, alternative uses, and the contribution to the national economy and scientific progress generated by resources in a defense use. Discusses economic problems inherent in shifting resources between defense and nondefense uses and among alternative defense uses. Preq: ECON 3140.
- ECON 4200 Public Sector Economics 3(3)** Study of the role of government and its proper functions and limitations in a market. Provision of goods and services by all levels of government and instruments of taxation are evaluated according to efficiency and equity criteria. Contemporary public sector issues are emphasized throughout. Preq: ECON 3140.
- ECON 4220\* Monetary Economics 3(3)** Intensive study of the role of monetary factors in economic change. Modern monetary theories and their empirical relevance for policy are developed against a background of monetary history and institutions. Preq: ECON 3140 and ECON 3150.
- ECON 4230\* Economics of Health 3(3)** Applies microeconomic theory to examine the demand for health services and medical care, the market for medical insurance, the behavior of physicians and hospitals, and the role of government in health-care provision and regulation. Preq: ECON 3140.
- ECON 4240\* Organization of Industries 3(3)** Empirical, historical, and theoretical analyses of market structure and concentration in American industry: the effects of oligopoly, monopoly, and cartelization upon price, output, and other policies of the firm; antitrust and other public policies and problems are studied. Preq: ECON 3140.
- ECON 4250\* Antitrust Economics 3(3)** Analysis of the economic and legal issues created by the exercise of market power. The motivation and execution of government policy towards mergers, predatory conduct, and various restraints of trade are intensively examined. Preq: ECON 3090 or ECON 3140.

- ECON 4260\* Seminar in Sports Economics 3(3)** Economic analysis of sports teams, leagues, and institutions. Topics include antitrust issues, public funding of sports venues, labor relations, wagering markets, athlete compensation, and application of economic principles to sports settings. Empirical research project is cornerstone of course. Includes Honors sections. Preq: ECON 3140 and ECON 4050.
- ECON 4270\* Development of the American Economy 3(3)** Explores several topics relevant to understanding the American experience. Considers the institutions and developments critical to America's ascendancy from a small country to a dominant global economic power. Investigates immigration, innovation, education, finance, and the changing role of race and gender in the economy. Preq: ECON 3140 and ECON 3150.
- ECON 4280\* Cost-Benefit Analysis 3(3)** Develops techniques for the appraisal of public expenditure programs with particular emphasis on investment in infrastructure. Topics include choice of an appropriate discount rate and the calculation of social costs and benefits in the presence of market distortions. Preq: ECON 3140.
- ECON 4290\* Economics of Energy Markets 3(3)** This course examines the economics of energy markets and energy policy. The unique features and characteristics of these important and interrelated markets are explored, and participants gain practical experience in connecting economic concepts to recent energy-related events and energy policy issues. Preq: ECON 3140.
- ECON 4300\* Topics in Mathematical Economics 3(3)** This course develops the mathematical tools underlying economic analysis and prepares students for doing advanced theoretical work in economics. The topics covered in this course provide excellent preparation for advanced economics courses, and lay the foundation for doing quantitative analysis associated with both career work and graduate study in economics. Preq: ECON 3140; and either MATH 1080 or MATH 2070.
- ECON 4350 Family Economics 3(3)** Analysis of economic aspects of the family. Economics of marriage, divorce, fertility, public policies affecting the family, women's labor force participation, and the gender gap are studied using main economic theories and empirical studies. Preq: ECON 3140.
- ECON 4400\* Game Theory 3(3)** Introduction to the formal analysis of strategic interaction among rational, self-interested rivals. Basic theoretical aspects of games are discussed and applied to such topics as bargaining, voting, auctions, and oligopoly. Preq: ECON 3140 and either MATH 1060 or MATH 2070; or ECON 4300.
- ECON 4550\* Applied Microeconomic Research 3(3)** Students conduct research in applied microeconomics. Topics vary according to student and professor interests. Students read papers in the literature, formulate their own economic hypotheses, and collect and analyze data to test those hypotheses. May be repeated for a maximum of nine credits, but only if different topics are covered. Preq: ECON 3140.
- ECON (AGRB) 4570\* Natural Resource Use, Technology, and Policy 3(3)** Focuses on economic analyses of actual, efficient, and sustainable uses of natural resources, impacts of technologies that affect these uses, and policies that affect development and use of such technologies. Resource-technology-policy combinations may vary, but an example is crude oil, hybrid automotive engines, and fuel economy standards. May also be offered as AGRB 4570. Preq: MATH 1020 or MATH 1060; and AGRB 3570 or ECON 3140.
- ECON 4910 Senior Honors Thesis Research 3(3)** Reading and research for the Senior Honors Thesis. Preq: ECON 3140 and ECON 3150 and senior honors standing.
- ECON 4920 Senior Honors Thesis Writing 3(3)** Writing and oral presentation of the Senior Honors Thesis. Preq: ECON 4910.
- ECON 4960 Independent Study 1-3(1-3)** Research and writing on a selected economics topic chosen by the student. A written proposal must be approved by the instructor prior to the start of the semester. May be repeated for a maximum of six credits. Preq: ECON 3140.
- ECON 4970 Creative Inquiry—in Economics II 1-3(1-3)** Engages students in research projects selected by the Economics Department faculty. Research projects vary depending on faculty and student interest. May be repeated for a maximum of six credits. Preq: ECON 3140.
- ECON 4980 Selected Topics in Economics 3(3)** In-depth treatment of topics not covered fully in regular courses. Topics vary from year to year. May be repeated for a maximum of nine credits, but only if different topics are covered. Includes Honors sections. Preq: ECON 3140 and ECON 3150.
- ECON 4990 Senior Seminar in Economics 1-3(1-3)** Discussion of topics of current interest in economics. Students conduct directed research on a particular topic. Preq: Consent of instructor.
- EDUCATION**  
*Associate Professor: S.N. Rosenblith, Chair*
- ED 1010 Effective Strategies for College Success 3(3)** Provides knowledge of specific strategies to increase academic success for college students. Includes instruction in strategies to address engagement and participation, organizational and study skills, test taking, note taking, reading content area text, and writing.
- ED 1030 Introduction to Content Specific Learning Strategies 2(2)** Through direct experiences, students develop strategies to become proficient problem solvers, design and perform experiments to test hypotheses, analyze connections between core content areas, construct meaning from reading in various disciplines, identify and use resources to improve learning, and communicate effectively. Students must be accepted into and have completed the first two years of the Emerging Scholars pre-college program to enroll in this course.
- ED 1050 Orientation to Education 2(2)** Introduction to teaching addresses basic program requirements, SoE Conceptual Framework, state evaluation system, the nature of the diverse and multicultural classroom, standards and practices of professional conduct and requirements in teaching. A field experience involving tutoring in a P-12 classroom is required. Coreq: ED 1051.
- ED 1051 Orientation to Education Laboratory 0(1)** Non-credit laboratory to accompany ED 1050. Coreq: ED 1050.
- ED 1900 Leadership, Citizenship, and Community Service 3(3)** Provides active learning opportunities for students to understand better the system of government, learn the mechanics of how leadership can influence education and other initiatives, and develop interpersonal skills that will assist them throughout their professional lives. Culminates with a service learning plan for the students' local community.
- ED 1970 Creative Inquiry—Education 1-4(1-4)** In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits.
- ED 2970 Creative Inquiry—Education 1-4(1-4)** In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits.
- ED 3220 Responding to Emergencies 3(2)** Provides the citizen responder with the knowledge and skills necessary in a variety of emergencies to help sustain life and to minimize pain and the consequences of injury until professional help arrives. Includes first aid, CPR, and automated external defibrillation (AED). Coreq: ED 3221.
- ED 3221 Responding to Emergencies Laboratory 0(1)** Non-credit laboratory to accompany ED 3220. Coreq: ED 3220.
- ED 3970 Creative Inquiry—Education 1-4(1-4)** In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of eight credits.
- ED 4050 Multiculturalism 3(3)** Introduces prospective teachers to the influence of culture on learning from an anthropological and historical perspective. Preq: HIST 1720 or HIST 1730.
- ED 4380 Selected Topics in Education 1-3(1-3)** Specific education topics not found in other courses are selected for in-depth study. May be repeated for a maximum of 12 credits, but only if different topics are covered.