

Economics—EC

881 Labor Economics II
Spring, 3(3-0) P:NM: (EC 805 and EC 809) or (EC 812A and EC 813A)

Theories of human capital. Internal labor markets and the economics of personnel. Economics of discrimination. Wage distributions. Job search and matching. Macroeconomic issues.

895 Graduate Reading in Economics
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 6 credits in all enrollments for this course.

Faculty guided research projects.

911 Strategic Behavior in Economic Environments
Fall, 3(3-0) P:NM: (EC 812B)

Topics in cooperative and non-cooperative game theory. Applications include: oligopoly and bargaining theories, strategic voting and principal agent models, endogenous coalition formation, signalling, strategic trade, and auctions theories.

912 Risk, Uncertainty and Information
Spring, 3(3-0) P:NM: (EC 812A)

Effects of risk in economic environments. Topics include: expected utility theory, risk aversion, stochastic dominance, mean-variance models, state preference models, general equilibrium models with risk, information theory.

923 Advanced Environmental and Resource Economics

Spring of even years. 3(3-0) Interdepartmental with Agricultural Economics; Forestry; Park, Recreation and Tourism Resources; Resource Development. Administered by Department of Agricultural Economics. P:NM: (AEC 829 and EC 805)

Advanced economic theory of environmental management and policy. Treatment of externalities and market and non-market approaches to environmental improvement. Topics in conservation and sustainable economic growth. Applications to research and policy.

925 Environmental and Resource Economics Research

Spring of odd years. 3(3-0) Interdepartmental with Agricultural Economics; Forestry; Resource Development; Park, Recreation and Tourism Resources. Administered by Department of Agricultural Economics. P:NM: (AEC 829 and EC 805) SA: AEC 991H

Topics such as contingent or non-market valuation, institutional analysis, pollution prevention, environmental quality and location, recreational demand modeling, and environmental risk management. Research process in environmental and resource economics.

999 Doctoral Dissertation Research

Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 99 credits in all enrollments for this course. R: Open only to Ph.D. students in Economics.

Doctoral dissertation research.

EDUCATIONAL ADMINISTRATION EAD

Department of Educational Administration College of Education

315 Student Leadership Training
Fall, Spring. 3(2-2)

Student leadership role, skills, and technique, consistent with the principles and demands of a democratic multicultural society.

451 Models of Special Education Administration and Services
Spring. 3(2-2) Interdepartmental with Counseling, Educational Psychology and Special Education. Administered by Department of Counseling, Educational Psychology, and Special Education. R: Open only to students admitted to the teacher certification program in emotional impairment or learning disabilities or to master's students in the Special Education major.

Application of theory and research to special education program design and implementation.

800 Organization Theory in Education
Fall, Spring, Summer. 3(3-0)

Organizational theory and research applied to educational administration. Topics include comparative organization settings, external environments, organizational effectiveness, and ethics.

801 Leadership and Organizational Development
Spring, Summer. 3(3-0)

Interaction of leadership with organizational culture and development within a variety of educational organizations.

802 Building a Learning Organization
Spring. 3(3-0)

Disciplines and practices for crafting a learning organization. Examination of Eastern, Western, and Quantum models of organization dynamics. Emphasis on strategies and skills for increasing human capacity.

803 Planning, Budgeting, and Evaluation
Spring. 3(3-0)

Planning, budgeting, and evaluation in educational organizations. Topics include needs assessment, funding sources, and processes for estimating costs and revenues.

804 Administration of Human Resources in Education
Fall, Summer. 3(3-0)

Tasks of personnel management in schools, colleges, and other educational organizations, including recruitment, selection, orientation, development, compensation, and evaluations. Focus on attracting and retaining a quality workforce in education.

805 Administration in Higher Education
Fall. 3(3-0)

Theories, systems, structures and processes of college and universities. Comparison of the organization, leadership, and governance of higher education institutions to other non-profit organizations.

806 Learning Leadership and Organizational Analysis I
Fall. 2(2-0) R: Open only to graduate students in K-12 Educational Administration.

Leadership of K-12 schools and associated community organizations. Theory and skills to discern organizational dynamics of schools and community. Professional ethics of K-12 school leadership.

807 Learning Leadership and Organizational Analysis II
Spring. 2(2-0) P: M: (EAD 806) R: Open only to graduate students in K12 Educational Administration.

Data-based organizational analysis of K-12 schools and school-community relations. Leadership skills to define vision strategies. Case analysis and double-loop learning.

808 Professional Inquiry and Reflection Seminar

Fall, Spring. 1(1-0) P:M: (EAD 806) P:NM: (EAD 807) R: Open only to graduate students in K-12 Educational Administration.

Skills and methods of disciplined reflection applied to issues of leadership practice. Methods of reflection and applications of multiple theories to cases of practice.

809 Interpersonal Dimensions of Leadership

Spring, Summer. 1(1-0) P:M: (EAD 806 and EAD 807 and EAD 808) P:NM: (EAD 820 and EAD 821) R: Open only to graduate students in K-12 Educational Administration.

Assessment of different approaches to school leadership. School leader as reflective practitioner and effective communicator in school and community contexts.

820 Internship in Educational Administration I

Fall, Spring. 1 to 3 credits. R: Open only to graduate students in K12 Educational Administration.

Supervised internship in an educational institution focused on school leadership issues.

821 Internship in Educational Administration II

Spring, Summer. 1 to 3 credits. R: Open only to graduate students in K12 Educational Administration.

Supervised internship in an educational and/or community organization focused on school-community leadership issues.

845 Teaching, Learning, and School Restructuring
Spring. 3(3-0)

Relationship between school-wide interventions and improvement in classroom teaching: school restructuring and reculturing, strategies for school improvement, approaches to teaching and learning.

852A Elementary and Middle School Administration
Fall, Summer. 3(3-0)

Administration and supervision of elementary and middle schools. Alternative organizational arrangements, curricula, and practices. Problems and strategies for improving K-8 education.

852B Secondary School Administration
Fall, Summer. 3(3-0)

Administration and supervision of secondary schools. Alternative organizational arrangements, curricula, and practices. Problems and strategies for improving secondary schools.

- 853A Legal, Fiscal, and Policy Environment of Schools**
Fall, Summer. 3(3-0)
External determinants of school policy and practice. Nature of policy-making process. History of school finance. Effect of fiscal policy on education. Equity issues. Impact of constitutional, legislative, and administrative requirements.
- 853B Schools, Families, and Communities**
Fall. 3(3-0)
Comparative and historical analysis of education within the broader social context. Families, communities, and the private sector. Social problems, social policies, and school practice.
- 853C Instructional Supervision**
Spring, Summer. 3(3-0) P:NM: (EAD 800)
Supervision and evaluation of teaching and learning, and strategies for improvement of K-12 education.
- 854 Introduction to Inquiry for Educational Leaders**
Fall. 3(3-0) R: Open only to graduate students in K-12 Educational Administration.
Inquiry and applied research methods and skills to inform school-based decisionmaking for school improvement. Constructing, analyzing, and interpreting student and school-level databases. Evaluating, assessing, and creating strategic instructional and organizational development plans.
- 855 Research in Educational Administration**
Fall, Spring, Summer. 3(3-0) P:NM: (CEP 822 and EAD 800)
Applications of research techniques to educational organizations. Developing research proposals, conducting research, and writing formal papers.
- 856 Applied Inquiry for Educational Leaders**
Spring, Summer. 2(2-0) P:M: (EAD 854) P:NM: (EAD 806 and EAD 807 and EAD 808 and EAD 820) R: Open only to graduate students in K-12 Educational Administration.
Research techniques and application to current educational organizations and their associated community issues. Design, implement, and evaluate school-level research projects.
- 858 Special Education Law**
Fall of even years. 3(3-0) Interdepartmental with Counseling, Educational Psychology and Special Education. Administered by Department of Counseling, Educational Psychology, and Special Education. R: Open only to seniors or graduate students.
Analysis of State and Federal regulations, guidelines and court decisions related to special education and examination of their impact.
- 860 Concept of a Learning Society**
Fall. 3(3-0)
Learning in the Knowledge Age with special focus on the role of technology as a partner in the learning process and in extending intelligence.
- 861 Adult Learning**
Fall. 3(3-0) SA: EAD 861A
Learning and change in the adult years. Motivation and barriers to participation. Cognitive, emotional, developmental, and socio-cultural processes involved in adult learning. Understanding differences among adults in approaches to learning.
- 863 Training and Professional Development**
Fall. 3(3-0) SA: EAD 862A
Design of training and professional development programs for postsecondary education contexts.
- 864 Adult Career Development**
Spring. 3(3-0) SA: EAD 862B
Psychological, social and institutional elements of careers. Cases and theories of career and adult development in the context of changing conditions of work and learning across the life-span.
- 865 Policy and Practice in Developmental Education**
Spring of odd years. 3(3-0)
Key policy questions and pedagogical issues in the practice of developmental education in postsecondary institutions. Providers of developmental education. Issues of assessment and placement. Literacy as skill versus social practice. Organizational and curricular approaches.
- 866 Teaching in Postsecondary Education**
Spring. 3(3-0) SA: EAD 861B
Philosophies and beliefs undergirding teaching strategies. Effective teaching strategies and formal learning environments. Assessment of teaching and of student learning.
- 870 Foundations of Postsecondary Education**
Fall. 3(3-0)
Historical, philosophical and social forces that shaped development of colleges and universities. Emphasis on higher education in the United States.
- 871 Collegiate Contexts for Teaching and Learning**
Spring. 3(3-0) SA: EAD 871B
Sociocultural contexts of teaching and learning in collegiate environments. Organizational strategies to improve learning contexts for diverse students.
- 872 Legal Issues in Higher Education**
Spring. 3(3-0)
Legal aspects of administrative practice in institutions of higher education. Governance, academic freedom, due process, and anti-discrimination.
- 873 The College Student Experience**
Fall. 3(3-0)
Research, theory, and literature related to student development in the college years.
- 874 Student Affairs in Collegiate Settings I**
Fall. 3(3-0) SA: EAD 874A
History, development, philosophy, organization and administration of college student personnel as a profession. Needed services, programs and skills.
- 875 Student Affairs in Collegiate Settings II**
Spring. 3(3-0) SA: EAD 874B
College students as members of groups. Peer and group influence. Impact of diversity on behavior. Professional staff development.
- 876 Budgeting and Finance in Higher Education**
Spring. 3(3-0) SA: EAD 971C
Fundamentals of higher education budgeting and finance including external sources of funding, internal resource allocation processes, social and economic principles and values regarding the distribution of resources among competing concerns.
- 877 Program Planning and Evaluation in Postsecondary Contexts**
Fall. 3(3-0) SA: EAD 871A
Planning and evaluating programs for learning in diverse educational contexts.
- 881 Workshops in Educational Administration**
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course.
Laboratory experiences focused on common supervisory and administrative problems.
- 882 Seminars in Educational Administration (MTC)**
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Seminars in various fields in K-12 educational administration and in higher, adult, and lifelong education.
- 890 Independent Study**
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course. R: Approval of department.
Individual study in an area of K-12 administration or higher, adult, and lifelong education.
- 893 Practicum in Student Affairs**
Fall, Spring, Summer. 2(2-0) A student may earn a maximum of 4 credits in all enrollments for this course. P:M: (EAD 874) R: Open only to students in the Master of Arts in Student Affairs Administration. Approval of department. SA: EAD 894A
Supervised work experience in student affairs.
- 894 Laboratory and Field Experiences**
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 9 credits in all enrollments for this course.
Supervised graduate practica, observations, internships, or externships in K-12 administration and in higher, adult, and lifelong education.
- 895 Research Ethics**
Summer. 1(1-0) Interdepartmental with Kinesiology; Teacher Education; Counseling, Educational Psychology and Special Education; Sociology; Romance Languages. Administered by Department of Kinesiology. R: Open only to graduate students in the Department of Counseling, Educational Psychology and Special Education or Department of Educational Administration or Department of Kinesiology or Department of Teacher Education.
Identifying and resolving ethical problems in research, including issues related to collegial interactions; authorship, publication, and reviewing practices; data management; ownership of data and intellectual property; conflicts of interest; protection of human and animal subjects; and lab safety and compliance.
- 899 Master's Thesis Research**
Fall, Spring, Summer. 1 to 9 credits. A student may earn a maximum of 15 credits in all enrollments for this course.
Master's thesis research.
- 925 Policy and Practice in Education**
Fall of odd years. 3(3-0) SA: EAD 944
Multiple conceptions of the relationship between policy and practice in K-12 education.
- 928 Proseminar in Educational Policy**
Fall. 3(3-0) A student may earn a maximum of 3 credits in all enrollments for this course. Interdepartmental with Teacher Education.
Disciplinary perspectives on policy issues. Influence of research on policy process. Politics and educational practice as determinants of policy choice.

Educational Administration—EAD

- 931 Qualitative Methods in Educational Research**
Fall. 4(4-0) Interdepartmental with Teacher Education; Counseling, Educational Psychology and Special Education. Administered by Department of Teacher Education. P:NM: (CEP 930) R: Open only to doctoral students. Approval of department.
Multiple traditions of qualitative research in education. Approaches to theory, research questions and design, data collection and analysis, and reporting. Ethical issues. Appraising qualitative research.
- 940 Organizational Analysis of Education**
Fall, Summer. 3(3-0) P:NM: (EAD 800)
Theoretical perspectives on schools and universities as organizations. Relationship of organization theory to administrative practices.
- 941 Administrative Behavior in Educational Organizations**
Spring. 3(3-0) P:NM: (EAD 800)
Concepts and models of leadership, management, and organization as they apply to the administration of educational institutions.
- 942 Economic Analysis in Educational Policy Making**
Spring of even years. 3(3-0) Interdepartmental with Teacher Education.
Economic effects of education. Economic analysis of policy issues in education. Alternative theoretical perspectives. Applications to the United States and other countries.
- 943 Politics of Education**
Fall of odd years. 3(3-0)
Education as a political enterprise. Interplay of federal relations, democratic principles, and contending sources of authority in shaping educational policy and practice.
- 950A Proseminar I in K-12 Educational Administration**
Fall. 2(2-0)
Disciplinary perspectives of K-12 educational leadership and management. Influence of research on leadership practice.
- 950B Proseminar II in K-12 Educational Administration**
Spring. 2(2-0) P:M: (EAD 950A)
Synthesis and analysis of disciplinary perspectives of K-12 educational leadership and management. Influence of research on leadership practice.
- 951A Educational Finance**
Spring. 3(3-0)
Political and economic contexts of educational finance. Role of government and policy criteria. Acquisition and distribution of public resources. Emerging issues in elementary and secondary education. Comparative and international analyses.
- 951B Planning Change in K-12 Education**
Fall. 3(3-0)
Behavioral change processes in educational institutions. Concepts and methods that have been tested by laboratory and field experiences.
- 951C Educational Law**
Spring, Summer. 3(3-0)
Legal aspects of school administration. Governance, compulsory attendance, student discipline, due process, search, free speech rights of students and teachers, church and state, and discrimination law.
- 952A Externship in Educational Administration**
Fall, Spring. 3(3-0) Fall: Given only at various off-campus sites. Spring: Given only at various off-campus sites. A student may earn a maximum of 21 credits in all enrollments for this course.
Current administrative problems and solution strategies in education.
- 953 Organizational Change in Postsecondary Education**
Spring of even years. 3(3-0) R: Open only to doctoral students in the Higher, Adult, and Lifelong Education major.
Theories of organizational change as they apply to postsecondary organizations. Strategies for facilitating organizational change in universities and colleges.
- 955B Field Research Methods in Educational Administration**
Spring. 3(3-0)
Methods used in conducting field studies in educational organizations, with emphasis on interviews, observation, and participant observation.
- 960 Proseminar in Postsecondary Education**
Fall. 3(3-0) R: Open only to doctoral students in the Higher, Adult, and Lifelong Education major.
Questions, trends, issues and resources in higher, adult, and lifelong education. Development of skills in problem identification, literature analysis, and scholarly writing.
- 963 Leadership in Postsecondary Education**
Spring. 3(3-0)
Leadership as a complex social phenomenon in higher, adult, and lifelong educational settings. Interdisciplinary theories of leadership as applied to postsecondary education.
- 965 Diversity and Equity in Postsecondary Education**
Fall. 3(3-0)
Promise, challenge, and management of diversity and equity in higher education. Analysis of data and policy. Management responses and strategies.
- 966 Students in Postsecondary Education**
Spring. 3(3-0) R: Open only to doctoral students in the Higher, Adult, and Lifelong Education major.
Research and theoretical foundations concerning traditional and non-traditional college students. Literature from diverse fields such as higher education, adult learning, and multicultural education. Psychosocial and cognitive development of college students, learning and development across the life span, experiences of diverse populations, impact of collegiate environments and structures on students.
- 967 Policy Development and Analysis in Postsecondary Education**
Fall. 3(3-0) R: Open only to doctoral students in the Higher, Adult, and Lifelong Education major.
Higher education policy issues, policy-related research and development approaches.
- 968 Teaching, Learning, and Curriculum in Postsecondary Education**
Spring. 3(3-0) R: Open only to doctoral students in the Higher, Adult, and Lifelong Education major.
Theories and current issues about teaching, learning, and curriculum in postsecondary education. Topics include learning contexts, learners, teachers, the learning process, curriculum.
- 969 Pedagogical Issues in Postsecondary Education**
Fall. 3(3-0) R: Open only to doctoral students in the Higher, Adult, and Lifelong Education major.
Theories of learning for teaching adults in postsecondary contexts. Transformative pedagogy, socio-cultural dimensions of teaching and learning, teacher formation and development, learning within technologically mediated environments. Authentic approaches to assessing teaching and learning.
- 970 Organization and Administration in Postsecondary Education**
Fall. 3(3-0) R: Open only to doctoral students in the Higher, Adult, and Lifelong Education major. SA: EAD 970A
Principles and patterns of organization and governance characteristic of colleges and universities. Administrative, trustee, faculty, and student roles.
- 971 Planning, Evaluation, and Decision Making in Postsecondary Education**
Spring of odd years. 3(3-0) R: Open only to doctoral students in the Higher, Adult, and Lifelong Education major. SA: EAD 971B
Concepts, theories and models of planning, evaluation, and decision making in the leadership and management of postsecondary institutions. Application to and usefulness for addressing complex problems facing institutions of postsecondary education.
- 990 Independent Study**
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 9 credits in all enrollments for this course.
Advanced individual study in an area of K12 administration or higher, adult, and lifelong education.
- 991A Special Topics in K-12 Administration**
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Special topics in K-12 administration.
- 991B Special Topics in Higher, Adult, and Lifelong Education**
Fall, Spring, Summer. 3(3-0) A student may earn a maximum of 9 credits in all enrollments for this course.
Special topics in the field of higher, adult and lifelong education.
- 994 Laboratory and Field Experience in Educational Administration**
Fall, Spring, Summer. 1 to 6 credits. A student may earn a maximum of 6 credits in all enrollments for this course. R: Open only to doctoral students.
Supervised advanced graduate practica, observations, internships, or externships in K-12 administration and in higher, adult, and lifelong education.
- 995 Research Practicum in Educational Administration**
Fall, Spring, Summer. 1 to 3 credits. A student may earn a maximum of 3 credits in all enrollments for this course. R: Open only to doctoral students in the College of Education. Approval of department.
Supervised research practicum. Design, execution, analysis, presentation, critique, and revision of research projects.

999 Doctoral Dissertation Research
Fall, Spring, Summer. 1 to 24 credits. A student may earn a maximum of 54 credits in all enrollments for this course. R: Open only to doctoral students in the Department of Educational Administration.
Doctoral dissertation research.

ELECTRICAL AND COMPUTER ENGINEERING ECE

Department of Electrical and Computer Engineering College of Engineering

200 Electric Circuits
Fall, Spring. 4(4-0) P:M: (CSE 131 or CSE 231) and (MTH 235 or concurrently or LBS 119 or concurrently or MTH 255H or concurrently) SA: EE 200
Resistive circuits. Loop and nodal analysis. Network theorems. Capacitor and inductor circuits. Transient analysis. Forced response. Sinusoidal steady-state response. Frequency response. Introduction to computer-aided analysis.

230 Digital Logic Fundamentals
Fall, Spring, Summer. 3(3-0) P:M: (CSE 131 or CSE 231) SA: ECE 330
Binary information. Switching algebra, combinational logic, minimization. Programmable logic devices. Sequential system fundamentals and state machines. Arithmetic operations and circuits. Memory elements and systems. Design tools. Design problems.

302 Electronic Circuits
Fall, Spring. 3(3-0) P:M: (ECE 200) P:NM: (ECE 200) R: Open only to students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering. SA: EE 302
Volt-ampere characteristics of diodes and transistors. SPICE modeling. Differential, multistage and integrated circuit amplifiers. High frequency effects.

303 Electronics Laboratory
Fall, Spring. 1(0-3) P:M: (ECE 200) R: Open only to students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering. SA: EE 303 C: ECE 302 concurrently.
Electronic test equipment and measurement fundamentals. Experimental verification of topics covered in ECE 200 and ECE 302.

305 Electromagnetic Fields and Waves I
Fall, Spring. 3(3-0) P:M: (MTH 235 or concurrently or LBS 119 or concurrently or MTH 255H or concurrently) and (PHY 184 or PHY 184B or PHY 234B) R: Open only to students in the Department of Electrical and Computer Engineering. SA: EE 305
Vector analysis. Static electric field and scalar potential. Dielectric materials. Electric force and energy. Potential problems. Steady currents, magnetic field and vector potential. Magnetic materials and circuits. Magnetic force and torque.

306 Electromagnetic Fields and Waves II
Spring, Summer. 4(3-3) P:M: (ECE 305) SA: EE 306, ECE 307
Faraday's law. Maxwell's equations. EM energy conservation. Wave equations and EM waves. Transmission lines. Transient waves. Travelling and standing waves. EM plane waves. EM radiation and antennas. Experimental investigation of topics in electromagnetic fields and waves.

313 Control Systems
Fall, Spring. 3(3-0) P:M: (ECE 200 or ECE 345) RB: (ECE 200 or ECE 345) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering, the Department of Computer Science and Engineering, and the Manufacturing Engineering major. SA: EE 413, ECE 413
Analysis and design of control systems using transfer functions and state variable methods.

320 Energy Conversion and Power Electronics
Fall, Spring. 3(3-0) P:M: (ECE 302 and ECE 303 and ECE 305) SA: EE 320
Power and energy. Magnetics and transformers. Elementary and induction machines. Power semiconductors. Controlled rectifiers and inverters. Power supplies and motor drives.

331 Microprocessors and Digital Systems
Fall, Spring. 4(3-3) P:M: (CSE 231 and ECE 230) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering. SA: EE 331
Microcomputers. Microprocessor architecture. Addressing modes. Assembly language programming. Parallel and serial input and output. Interfacing. Interrupts. Peripheral device controllers. Applications, design.

345 Electronic Instrumentation and Systems
Fall, Spring, Summer. 3(2-3) P:M: (MTH 235 or MTH 255H or LBS 119) and (PHY 184 or PHY 184B or PHY 234B) and completion of Tier I writing requirement. R: Open only to students in the College of Engineering with the exception of students in the Department of Electrical and Computer Engineering. SA: EE 345
Electrical and electronic components, circuits and instruments. Circuit laws and applications, frequency response, operational amplifiers, semi-conductor devices, digital logic, counting circuits.

360 Signals and Linear Systems
Fall, Spring. 4(4-0) P:M: (ECE 200 or concurrently) and (MTH 235 or concurrently or LBS 119 or concurrently or MTH 255H or concurrently) R: Open only to students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering. SA: EE 360
Continuous and discrete signals and systems. Convolution, impulse response, system classifications, state variables, differential and difference equations. Fourier series, Fourier transform, Laplace transform. Z-transform. Transfer functions and stability.

410 VLSI Design
Fall, Spring. 4(3-3) P:M: (ECE 302 and ECE 303 and ECE 230) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering. SA: EE 410

Digital integrated circuit design fundamentals. Design specifications: functionality, performance, reliability, manufacturability, testability, cost. Standards, silicon compilers, foundries. Design layout rules, rule checking. Circuit extraction, simulation, verification. Team-based design.

411 Electronic Design Automation
Fall, Spring. 4(3-3) P:M: (CSE 320 or ECE 331) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering or Department of Computer Science and Engineering. SA: EE 411
Electronic circuit design hierarchy and the role of methodology. Application specific integrated circuits. Hardware description languages. Behavioral and structural circuit modeling. Design algorithms and design tools. Design projects.

415 Computer Aided Manufacturing
Fall. 3(2-3) P:M: (ECE 313 or ME 451) R: Open only to juniors or seniors in the Manufacturing Engineering major. SA: EE 415
CAD/CAM fundamentals, programmable controllers, numerical control, NC part programming, sensors, data acquisition systems.

418 Algorithms of Circuit Design
Fall. 3(3-0) P:M: (ECE 302 and ECE 303 and ECE 360) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering. SA: EE 418
Design of analog electrical circuits, filter functions, ladder synthesis, inductor simulation. Vector Newton-Raphson method. Lossy inductance and capacitance. Statistical tolerance analysis. Optimization by multi-dimensional search. Software algorithms.

421 Power System Analysis
Spring. 4(3-3) P:M: (ECE 320) SA: EE 421
Synchronous machines: models and measurements of power components. Symmetrical components. Short circuit analysis and equipment protection. Load flow. Voltage and frequency control. Operation and planning of power systems.

435 Electromagnetic Waves and Applications
Fall. 4(3-3) P:M: (ECE 306) SA: EE 435
Open and closed-boundary waveguides. Resonators. Microwave circuit theory. Scattering parameters. Electromagnetic radiation. Properties of antennas. Wave propagation. Measurement of antenna characteristics. Computer-aided design and testing.

457 Communication Systems
Spring. 3(3-0) P:M: (ECE 302 and ECE 360 and STT 351) R: Open only to juniors or seniors or graduate students in the Department of Electrical and Computer Engineering. SA: EE 457
Representation and processing of signals in the presence of noise. System performance. Modulation, detection, and coding of information. System design applications in radar, sonar, radio, television, satellite communications, digital telephony, and wireless systems.