College of Engineering

Jay Kunze, Ph.D., Dean
D. T. Neill, Ph.D., Associate Dean for Graduate Studies
R. E. Stuffle, Ph.D., Associate Dean for Undergraduate Studies
Professors: Campo, Kunze, Naidu, Neill, Robinson, Smedley, G. Stuffle
Associate Professors: Moore, Rao, Sadid, Sato, Wabrek
Assistant Professors: Bennion, Blotter, Leung, McWhirter
Industry Shared Professor: Morrison
Adjunct Faculty: Beitel, Blacker, Comparini, Edinborough, Gansuage, Gostomski, Hart, Hofle, Imel, Jones, Larson, Lineberry, O'Brien, Singleterry, Smart, Squires, L. Stuffle
Affiliate Faculty: Adams, Ambrose, Bennett, Buzzi, Caffrey, Carlson, Eberle, Goff, Halderson, Khericha, Lussie, Mariani, McFarlane, Moore, Nigg, Paulson, Power, Schaefer, Sisson, Start, Trybus, Wood, Zaltzman
Professors Emeriti: Smith, Stephens, Wilson

The goal of the College of Engineering is to provide students with the education necessary to enter the engineering profession. The Bachelor of Science (B.S.) degree program in Engineering, which is accredited by the Engineering Accreditation Commission of the Accreditation Board for Engineering and Technology (EAC/ABET), is designed to be as flexible as possible to accommodate individual areas of interest within the requirements of the EAC/ABET. The B.S. degree program in Engineering Management is designed to provide graduates with a background in both engineering and management disciplines. ISU engineering graduates are successfully employed in many areas of the engineering profession. Many have chosen to continue advanced studies in a wide variety of specialized engineering disciplines.

The emphasis in the program at Idaho State University is to develop design competence in multi-disciplinary engineering. Each student entering the engineering program is assigned a faculty advisor to guarantee an appropriate plan of study and to insure continuity throughout the program. Each student completes 91 credit hours of general education and engineering core courses, which account for more than five semesters. They devote their last three semesters to more specialized, design-oriented courses. The College of Engineering offers sequences in the disciplines of structures, geotechnics, control systems, analog and digital electronic systems, energy systems, nuclear science and engineering, and mechanical systems. The student will select two of the seven sequences for a total of 26 credit hours and, with advisor approval, 11 credit hours of elective courses from science, mathematics and engineering. During the last two semesters, each student completes senior design projects and is also expected to complete the national standardized Fundamentals of Engineering exam.

Students entering the program are expected to meet the following preparatory requirements: (a) adequate algebra and trigonometry to enter the calculus sequence; (b) one year of computer studies or demonstrated familiarity with computer language and computer fundamentals; and (c) one year of high school mechanical drawing, or equivalent. Preparatory mathematics, computer and mechanical drawing courses are available at ISU.

Pledge of Engineering Academic Standards: (1) Prior to formally declaring engineering as their major, students must complete ENGR 105, MATH 170, CHEM 111, ENGR 223 with a grade point average of at least 2.0 overall and for these four courses. Upon making this declaration and submitting the proper form, students are eligible to select their sequences. (2) Students who fail a specific engineering course twice will be dismissed from the college for a period of one year. (3) Students who have been dismissed from the college may not enroll in engineering courses. (4) A student who enrolls in an engineering class while petitioning for a waiver of applicable prerequisites must secure the waiver within the first month of classes or be dropped from the course in question.

Under the Graduate School, the College of Engineering administers a program leading to the Master of Science and Ph.D. degrees. The M.S. program comprises majors in Nuclear Science & Engineering, Measurement & Control Engineering and Environmental Engineering. The study of Hazardous Waste Management may be selected as an option under each M.S. degree major. The Ph.D. is in Engineering and Applied Science. For more information, see the Graduate Catalog. Additional graduate programs are available through interdisciplinary majors with mathematics and the physical sciences.

Bachelor of Science in Engineering

The University requirement of 128 credits for the Bachelor of Science in Engineering degree must include the completion of the following courses:

ENGL 101	English Composition (Goal 1)	3 cr
ENGL 201	Critical Reading and Writing (Goal 1)	3 cr
COMM 101	Principles of Speech OR Satisfactory completion of proficiency exam (Goal 2)	2 cr
IN ADDITION:	Humanistic and Social Sciences	18 cr

Note: Students must complete two of the three General Education Goals 6, 7, and 8, and three of the four Goals 9, 10A or B, 11, and 12 in satisfying the humanistic and social sciences requirement. Three more credits must be completed in an advanced level course in a subject area of a completed Goal course. (An approved list of advanced level courses is available in the College of Engineering Office.)

All Sequences

CHEM 111	General Chemistry I*	5 cr
PHYS 211-212	Engineering Physics*	8 cr
MATH 170	Calculus I**	4 cr
MATH 175	Calculus II**	4 cr
MATH 230	Introduction to Linear Algebra	2 cr
MATH g360	Differential Equations	3 cr
ENGR 101	Engineering Methods	2 cr
ENGR 105	Computer Aided Drawing	2 cr
ENGR 206	Statics	3 cr
ENGR 208	Dynamics	3 cr
ENGR 213	Electrical Circuits	3 cr
ENGR 223	Materials and Measurements	4 cr
ENGR 264	Numerical Analysis of Engineering Problems	3 cr
ENGR 307	Thermodynamics	3 cr
ENGR 309	Transport Phenomena	3 cr
ENGR 313	Fundamentals of Electrical Devices	4 cr
ENGR 321	Mechanics of Materials	3 cr
ENGR 363	Engineering Economy	2 cr
ENGR 496	Project Design I	2 cr
ENGR 497	Project Design II	2 cr
IN ADDITION:	Science Elective#	3 cr
	Math Elective#	3 cr
	Technical Electives#	3 cr
	Free Electives##	2 cr

Notes:

** The chemistry and physics requirements collectively satisfy Goals 4 and 5.*

*** Satisfies Goal 3.*

#Lists of approved science, mathematics and technical electives are available from the College of Engineering office. Students are encouraged to consult with their advisor and choose courses which will complement their engineering education.

##Free Electives: A free elective may be any university course.

In addition to the above, each student must complete at least two of the following sequences.

Sequence A (Structures)

CE 361	Structural Analysis	3 cr
CE 461	Advanced Structural Analysis	3 cr
CE 462	Design of Steel Structures	3 cr
CE 464	Design of Concrete Structures	3 cr
CE 467	Structural Engineering Laboratory	1 cr

Sequence B (Geotechnics)

CE g332	Basic Geotechnics	3 cr
CE 434	Geotechnical Design	3 cr
CE 435	Hydraulic Design	3 cr
CE 436	Roadway Design	3 cr
CE 437	Geotechnical Engineering Laboratory	1 cr

Sequence C (Control Systems)

EE 344	Instrumentation Systems	3 cr
EE 345	Signals and Systems	
EE g473	Automatic Control Systems	3 cr
EE g475	Digital Signal Processing	
EE 494	Control Engineering Laboratory	1 cr

Sequence D (Analog and Digital Electronic Systems)

EE 329	Introduction to Electronics	3 cr
EE 374	Introduction to Digital Systems	3 cr
EE g426	Microprocessors	3 cr
EE g429	Advanced Electronics	3 cr
EE g430	Analog and Digital Electronic Systems Laboratory	1 cr

Sequence E (Energy Systems)

ME 341	Fluid Mechanics	3 cr
ME g416	Thermal Power Cycles	3 cr
ME g419	Energy Systems and Resources	3 cr
ME 443	Thermal Fluids Laboratory	1 cr
ME g476	Heat Transfer	3 cr

Sequence F (Nuclear Science and Engineering)

NS&E 371	Introduction to Nuclear Science and Engineering	3 cr
NS&E g445	Neutron Reactions and Transport	3 cr
NS&E g446	Design of Fuel Cycle Systems	3 cr
NS&E g447	Nuclear Systems Laboratory	1 cr
NS&E g448	Design, Control and Use of Radiation Systems	3 cr

Sequence G (Mechanical Systems)

ME 323	Machine Design	3 cr
ME 353	Manufacturing Processes	3 cr
ME 405	Measurement Systems Design	3 cr
ME 406	Measurement Systems Laboratory	1 cr
ME 440	Mechanical Vibrations	3 cr

The requirements listed above for a Bachelor of Science in Engineering provide an interdisciplinary emphasis which provides excellent preparation for students who plan to pursue an engineering specialty at the graduate level, or who plan to practice engineering in an interdisciplinary role. Students who wish to add a specialty designation to their degree should complete the requirements for the Bachelor of Science in Engineering with appropriate sequence selections plus an additional 9 credits as follows:

Civil Engineering: Sequence A + Sequence B + ENVE g410 + 6 credits chosen from CE emphasis electives.

Electrical Engineering: Sequence C + Sequence D + EE 325, + EE g472 + 3 credits chosen from EE emphasis electives.

Mechanical Engineering: Sequence E + Sequence G + 9 credits chosen from ME emphasis electives + 3 credits from any other sequence.

Bachelor of Science in Engineering Management

The engineering management curriculum consists of two curricular paths. One leads to the Bachelor of Science in Engineering Management, the other to the Bachelor of Science in Engineering Management with Emphasis in Nuclear Engineering. Both paths share a common core of courses. Each path concludes with a specialized course sequence specific to its requirements.

All engineering management students must complete two of the three General Education Goals 6, 7 and 8; and two of the three Goals 9, 10A or B and 12 in satisfying the humanities and social science requirements. The 12 credits of humanities and social science electives must conform to college requirements for breadth and depth of study.

The mathematics courses in the core curriculum satisfy the requirements of Goal 3.

The chemistry and physics courses in the core curriculum satisfy the requirements of Goals 4 and 5.

Engineering Management Core

ENGL 101	English Composition	3 cr
ENGL 201	Critical Reading and Writing	3 cr
COMM 101	Principles of Speech	2 cr
GOALS:	Humanities and Social Sciences	12 cr
CHEM 111	General Chemistry I	5 cr
MATH 170	Calculus I	4 cr
MATH 175	Calculus II	4 cr
MATH 230	Introduction to Linear Algebra	2 cr
MATH g353	General Statistics	3 cr
MATH g355	Operations Research	3 cr
MATH g360	Differential Equations	3 cr
PHYS 211-212	Engineering Physics	8 cr
ENGR 101	Engineering Methods	2 cr
ENGR 105	Engineering Drawing	2 cr
ENGR 206	Statics	3 cr
ENGR 208	Dynamics	3 cr
ENGR 213	Electrical Circuits	3 cr
ENGR 223	Materials and Measurements	4 cr
ENGR 264	Numerical Analysis of Engineering Problems	3 cr
ENGR 307	Thermodynamics	3 cr
ENGR 309	Transport Phenomena	3 cr
ENGR 313	Fundamentals of Electrical Devices	4 cr
ENGR 321	Mechanics of Materials	3 cr
EE 345	Analysis of Linear Systems	3 cr
ENGR 496	Project Design I	2 cr
ENGR 497	Project Design II	2 cr
ACCT 201	Principles of Accounting I	3 cr
ACCT 202	Principles of Accounting II	3 cr
ECON 201-202	Principles of Macroeconomics and Microeconomics	6 cr
FIN 315	Corporate Financial Management	3 cr
MGT g312	Individual and Organizational Behavior	3 cr
MGT 329	Operations/Production Management	3 cr
MGT g441	Organization Behavior	3 cr
MKTG 325	Basic Marketing Management	3 cr

To complete the engineering management program, each student must select and complete one of the following sequences of courses:

Sequence I: Leading to the Bachelor of Science in Engineering Management

ENGR 202	Manufacturing Processes	3 cr
EE g473	Feedback Control Systems	3 cr
EE 475	Digital Signal Processing	3 cr
MGT g430	Advanced Operations/ Production Management	3 cr
MGT g434	Productivity and Quality	3 cr
MGT g450	Manufacturing Strategy	3 cr
IN ADDITION:	Engineering Design Electives*	6 cr

**A list of approved engineering design electives is available from the College of Engineering office.*

Sequence II: Leading to the Bachelor of Science in Engineering Management with Emphasis in Nuclear Engineering

NS&E 371	Introduction to Nuclear Engineering	3 cr
ENGR g421	Advanced Engineering Mathematics I	3 cr
NS&E g444	Nuclear Fuel Cycles	3 cr
NS&E g445	Neutron Reactions and Transport	3 cr
NS&E g447	Nuclear Systems Laboratory	1 cr
NS&E g446	Design of Fuel Cycle Systems	3 cr
NS&E g448	Design, Control and Use of Radiation Systems	3 cr
ENGR g478	Probabilistic Design	3 cr
CIS 381	Management Information Systems	3 cr
PHYS g301	Modern Physics	3 cr

Interdisciplinary Engineering Courses

ENGR 101 Engineering Methods 2 credits. Introduction to problems and solution methods in engineering. Use of tables and graphs, vectors, logarithms and trigonometric functions. Organization of calculations, and calculator and computer use. COREQ: ENGR 102 OR EQUIVALENT, MATH 170. F, S

ENGR 102 Elementary Mechanical Drawing 2 credits. Instrument and freehand drawing, lettering, dimensioning, sectioning, multiview projections. For students without one year of high school mechanical drawing of equivalent. F, S

ENGR 105 Computer Aided Drawing 2 credits. Intermediate engineering drawing emphasizing projections, sketching and descriptive geometry. Introduction to CAD software for preparing engineering drawings. PREREQ : MATH 147 OR EQUIVALENT, ENGR 102 OR EQUIVALENT. F, S

ENGR 164 Computer Programming 2 credits. Credits may not be used toward a degree in engineering. Introduction to programming techniques and languages suitable for technical problem solving. For students without one year of high school computer experience. COREQ: MATH 147. F, S

ENGR 202 Manufacturing Processes 3 credits. Basics of metal working and metal joining processes covered. Also practical metallurgy, general manufacturing processes and NC machining included. (Two lectures, one lab per week) PREREQ: MATH 147 OR EQUIVALENT AND ENGR 102 OR EQUIVALENT. D

ENGR 206 Statics 3 credits. Concepts of force vectors and equilibrium with emphasis on free body diagrams. Trusses, beams, frames, centroids, fluid statics, and friction. PREREQ: ENGR 101; COREQ: ENGR 105, PHYS 211, MATH 175. F, S

ENGR 208 Dynamics 3 credits. Principles of kinetics. Angular and linear displacement, velocity, and acceleration analysis. Rigid bodies in motion and types of motion. Application of principles of force-mass acceleration, work-kinetic energy, and impulse-momentum to solution of problems of force systems acting on moving particles and rigid bodies. PREREQ: ENGR 206, MATH 175, AND PHYS 211. F, S

ENGR 213 Electrical Circuits 3 credits. Principles and analysis of DC and AC circuits. Introduction to simple electronic devices, instruments, and electrical measurements. PREREQ: MATH 175; COREQ: PHYS 212. F, S

ENGR 223 Materials and Measurements 4 credits. Structure and behavior of metals, ceramics, polymers and composite materials. Laboratory measurement of material properties. (Three lectures and one lab per week.) PREREQ: CHEM 111; COREQ: ENGR 101, MATH 170. F, S

ENGR 264 Numerical Analysis of Engineering Problems 3 credits. Numerical techniques and computer applications to solve engineering problems. PREREQ: ENGR 101, ENGR 164 OR EQUIVALENT EXPERIENCE; MATH 175, MATH 230. F, S

ENGR 307 Thermodynamics 3 credits. Quantitative course in the fundamental concepts of thermal energy equations. Applications to ideal and real gases, liquids, and solids in static and transient systems. PREREQ: CHEM 111, PHYS 212, MATH 175. F, S

ENGR 309 Transport Phenomena 3 credits. Study of momentum, energy, and mass transport; momentum, heat, and mass transfer coefficients; steady and unsteady rate processes and transport properties. PREREQ: ENGR 208, 307. F, S

ENGR 313 Fundamentals of Electrical Devices 4 credits. Continuation of ENGR 213. Advanced circuit analysis, operation and design of electrical devices. (Three lectures, one lab per week.) PREREQ: ENGR 213, 223; PHYS 212. F, S

ENGR 321 Mechanics of Materials 3 credits. Theories of stresses and strains for ties, shafts, beams, columns and connections. Determination of deflections and the investigation of indeterminate members. An introduction to design. PREREQ: ENGR 206, 223; MATH 175. F, S

ENGR 363 Engineering Economy 2 credits. Economic analysis and comparison of engineering alternatives by annual cost, present worth and rate of return methods. Study of cost factors upon which management decisions are based. PREREQ: ENGR 223. F, S

ENGR 400 Essentials of Engineering 2 credits. Preparation for Fundamentals of Engineering Exam. May not be used as a technical elective. May be repeated once for a total of 4 credits. PREREQ: SENIOR IN ENGINEERING. Graded S/U. F, S

ENGR g415 Model Theory 3 credits. Theory of design and testing of scaled system models. Dimensional analysis with application to physical models. True and distorted models, linear and nonlinear models and analogies. Laboratory work required. PREREQ: ENGR 309, ENGR 321. D

ENGR g421 Advanced Engineering Mathematics I 3 credits. Cross-listed as Math g421. Analysis of complex linear and nonlinear engineering systems using advanced techniques including Laplace transforms, Fourier series and classical partial differential equations. PREREQ: MATH 360, ENGR 264. F

ENGR g422 Advanced Engineering Mathematics II 3 credits. Cross-listed as Math g422. Analysis of complex linear and nonlinear engineering systems using advanced techniques, including probability and statistics, advanced numerical methods and variational calculus. PREREQ: ENGR g421 OR MATH g421. S

ENGR g425 Mechatronics 3 credits. Basic kinematics, sensors, actuators, measurements, electronics, microprocessors, programmable logic controllers, feedback control, robotics and intelligent manufacturing. PREREQ: ENGR 313, MATH 360. D

ENGR g478 Probabilistic Design 3 credits. Probabilistic methods applied to analysis and design. Setting probabilistic design objectives and calculating probabilistic performance emphasized. PREREQ: ENGR 264, MATH g360 AND SENIOR STANDING IN ENGINEERING. F

ENGR 481 Independent Problems 1-3 credits. Students are assigned to, or request assignment to, independent problems on the basis of interest and preparation. May be repeated for a maximum of 6 credits. PREREQ: PERMISSION OF INSTRUCTOR. D

ENGR 483 Ethics and Professionalism 2 credits. Exploration of ethics and professionalism applied to engineering, including professional registration, state laws, national technical and professional societies. PREREQ: SENIOR STANDING IN ENGINEERING. D

ENGR g491 Seminar in Engineering 1 credit. A series of lectures on current topics in the literature by participants or guest lecturer chosen from industry. PREREQ: PERMISSION OF INSTRUCTOR. D

ENGR 496 Project Design I 2 credits. Preliminary design of equipment or systems relevant to student's sequences. Individual projects emphasizing problem definition and conceptual design, decision process and report preparation. Two two-hour labs. PREREQ: SECOND SEMESTER PRIOR TO GRADUATION. F, S

ENGR 497 Project Design II 2 credits. Performance and final design of equipment or systems. Individual or team projects emphasizing optimization, equipment selection, safety and cost. Two two-hour labs. PREREQ: ENGR 496 AND SEMESTER PRIOR TO GRADUATION. F,S

Civil Engineering Courses

CE 301 Surveying 3 credits. Fundamental principles of surveying. Electronic and conventional angle and distance measurement, leveling traversing, stadia, solar observation, surveying computations, mapping. Application to engineering, geology and architecture. PREREQ: MATH 147 OR EQUIVALENT. D

CE 302 Roadway Geometrics 1 credit. Selected topics from CE 301 including curves, cut-fill computations, COGO and photogrammetry applied to roadways. Self-study course using tutorials. Credit not granted for both CE 301 and CE 302. F, S, Su

CE 303 Surveying Law 3 credits. History and development of U.S. Public Land Survey System, Congressional and Idaho statutes, and court decisions pertaining to surveying problems and practice. PREREQ: CE 301. D

CE g332 Basic Geotechnics 3 credits. Classification, analysis and evaluation of soils as engineering material. Water movement through soils. Soil mechanics applied to analysis of foundations, earth slopes and other structures. PREREQ: ENGR 223; COREQ: ENGR 309. S

CE 361 Structural Analysis 3 credits. Analysis of forces and displacements in trusses, beams, and frames under static loadings. Moving loads. Application of static equilibrium equations to structures. Introduction to classical methods of indeterminate structural analysis. PREREQ: ENGR 321. S

CE 434 Geotechnical Design 3 credits. Application of soil mechanics to design of foundations, retaining wall, stable slopes, buried conduits and pavement structures. Computer methods utilized. PREREQ: ENGR 264, ENGR 321, CE g332. F

CE 435 Hydraulic Design 3 credits. Hydrology. Hydraulic design of water control and transport structures, pipelines, and distribution systems. Computer methods utilized. PREREQ: ENGR 264, 309. S

CE 436 Roadway Design 3 credits. Fundamentals of earthwork, route location, drainage, and pavement materials with application to geometric and pavement design of highways, streets and rural roads. PREREQ: ENGR 223; CE 301 OR 302. COREQ: CE g332. S

CE 437 Geotechnical Engineering Laboratory 1 credit. Field and laboratory work on site investigation, soil sampling, classification and testing. Evaluation of soil properties. COREQ: CE g332. F

CE 461 Advanced Structural Analysis 3 credits. Analysis of statically indeterminate structures. Continuation of the use of classical methods. Introduction to computer methods in structural analysis including the use of commercially available software, and lateral load effects. PREREQ: CE 361. F.

CE 462 Design of Steel Structures 3 credits. Design of steel members and connections with emphasis on the AISC specifications. PREREQ: CE 461. S

CE 464 Design of Concrete Structures 3 credits. Design of reinforced concrete beams, columns, and slabs. Introduction to pre-stressing. PREREQ: CE 461. S

CE 466 Design of Wood Structures 3 credits. Design of solid and laminated wood members and connections. Includes the design of wooden diaphragms for resisting lateral loads. PREREQ: CE 361. D

CE 467 Structural Engineering Laboratory 1 credit. Measurement of stresses and load distribution through concrete, steel and wood components and structures. COREQ: CE 461. S

Electrical Engineering Courses

EE 325 Electromagnetics 3 credits. Vectors and fields, electrostatics, magnetostatics, electrodynamics, Maxwell's equations, boundary value problems, plane and guided waves, radiation and antennas. PREREQ: ENGR 313, MATH 360. F

EE 329 Introduction to Electronics 3 credits. Introduction to semiconductor theory, operational amplifiers, diode and transistor circuits. PREREQ: ENGR 313. F

EE 344 Instrumentation Systems 3 credits. Introduction to the basics of instrumentation systems analysis and design, including: actuators, final control elements, transducers, sensor systems, signal transmission, data acquisition, and signal conditioning. PREREQ: ENGR 313; MATH 360. F.

EE 345 Signals and Systems 3 credits. Linear time-invariant systems, continuous and discrete; Fourier series, Fourier transforms, discrete Fourier transforms; Laplace transforms, z-transforms; state-space analysis. PREREQ: ENGR 213, 264; MATH 360. S

EE 374 Introduction to Digital Systems 3 credits. Number systems; fundamentals of Boolean algebra; methods of system reduction, combinational and sequential logic. PREREQ: ENGR 264 OR C S 182 OR PERMISSION OF INSTRUCTOR. F

EE g426 Microprocessors 3 credits. Introduction to microprocessor architecture. Programming principles using machine and assembly languages, addressing modes, memory mapping, number representation and processing. PREREQ: EE 374. S

EE g427 Digital Systems Engineering 3 credits. Digital system design using microprocessors and other LSI components. Input/output devices and methods. D/A and A/D conversion. Practical aspects of real-time processing. Includes 1-hour laboratory component. PREREQ: EE g426, g475. D

EE g429 Advanced Electronics 3 credits. Amplifier design and analysis, large-signal amplifiers and nonlinear effects, feedback, oscillators. PREREQ: EE 329. S

EE g430 Analog and Digital Electronic Systems Laboratory 1 credit. Laboratory course emphasizing analog and digital circuits and components. PREREQ: EE 329, 374. COREQ: EE g429. S

EE g472 Electrical Machines and Power 3 credits. Theory and application of electrical machinery and transformers. Power and energy relationships in power systems, transmission lines, network solutions and symmetrical components. PREREQ: ENGR 313, MATH 360. S

EE g473 Automatic Control Systems 3 credits. Study of continuous-time and discrete-time control systems using both frequency-domain and state-space techniques; topics include design methodology, performance specifications, analysis and design techniques. PREREQ: EE 345 or ME 355. F

EE g475 Digital Signal Processing 3 credits. Design of recursive and non-recursive digital filters; frequency-domain analysis, fast Fourier transform techniques, spectral analysis; applications. PREREQ: EE 345. S

EE g492 Advanced Control System Design 3 credits. Design of advanced control algorithms; topics include: observers and state estimation, linear quadratic regulator, frequency-domain techniques for robust control, and an introduction to multivariable and nonlinear control. PREREQ: EE g473. D

EE 494 Control Engineering Laboratory 1 credit. Practical experience in the complete process of control system analysis, design, and implementation, including instrumentation and measurement systems, signal processing, and control algorithms. PREREQ: EE 344, g473. COREQ: EE g475. S

Environmental Engineering Courses

ENVE g408 Water and Waste Water Quality 3 credits. Design and applications of water and wastewater treatment systems for water quality control and reuse. PREREQ: ENGR 309, CHEM 112. D

ENVE g409 Water and Waste Water Lab 1 credit. Fundamental analytical procedures for measurement of water and waste water quality. Introduction to materials and protocols associated with general environmental analytical techniques. COREQ: ENVE g408. D

ENVE g410 Introduction to Environmental Engineering 3 credits. Introduction to physical, chemical, and biological principles of solid and hazardous waste management, water and wastewater treatment, air pollution control, and national environmental regulation. PREREQ: CHEM 112, ENGR 309, OR PERMISSION OF INSTRUCTOR. F

Mechanical Engineering Courses

ME 305 Computer Aided Drafting 2 credits. Advanced use of CAD software to prepare drawings. Planning of drawings and role of drawings in design emphasized. PREREQ: ENGR 105, 264. D

ME 323 Machine Design 3 credits. Mechanical component design including bearings, couplings, shafts, gears, brakes, springs, mechanical fasteners. PREREQ: ENGR 208, 223, 321. D

ME 323 Machine Design 3 credits. Design of mechanical components subject to static and fatigue loads. Design using screws, fasteners, springs, bearings, and welds. Computer-aided design using finite element methods. PREREQ: ENGR 208, 223, 321. S

ME 341 Fluid Mechanics 3 credits. Continuation of transport phenomena emphasizing incompressible fluid flow systems design. Additional topics include open channel flow, compressible fluid flow, pipe flow, flow measurements, pumps, valves, other devices. PREREQ; ENGR 264, 309. COREQ: MATH g360. S

ME 343 Kinematics and Dynamics of Machinery 3 credits. Kinematic analysis and design of cams, gears, and linkages; velocity, acceleration and force analysis; kinematic synthesis; balancing; analysis by complex numbers; computer-aided analysis and synthesis. PREREQ: ENGR 321. D

ME 353 Manufacturing Processes 3 credits. Production techniques and equipment. Casting, molding, pressure forming, metal removal, joining and assembly, automation and materials handling. PREREQ: ENGR 223. D

ME 355 System Dynamics 3 credits. Modeling and representations of dynamic 3-dimensional physical systems emphasizing rigid bodies: transfer functions, block diagrams, state equations. Transient response. PREREQ: ENGR 208, MATH g360. D

ME 405 Measurement Systems Design 3 credits. Introduction to instrumentation systems analysis and design, including: statistical analysis, system modeling, actuators, transducers, sensor systems, signal transmission, data acquisition, and signal conditioning. PREREQ: ENGR 313, MATH 360. COREQ: ME 406. F

ME 406 Measurement Systems Laboratory 1 credit. Principles of measurement, measurement standards and accuracy, detectors and transducers, digital data acquisition principles, signal conditioning systems and readout devices, statistical concepts in measurement, experimental investigation of engineering systems. COREQ: ME 405. F

ME g416 Thermal Power Cycles 3 credits. Application of thermodynamics to design of systems for conversion of thermal energy to power by various power cycles. PREREQ: ENGR 264, 309. F

ME g419 Energy Systems and Resources 3 credits. Fundamentals of conventional (fossil, nuclear fission), and alternative (solar, wind, geothermal) energy systems. Electrical energy supply, building HVAC, resources utilized by transportation sector. PREREQ: ENGR 307, 313; MATH g360. S

ME 440 Mechanical Vibrations 3 credits. Free vibration and forced response of single and multiple degree of freedom systems, normal modes, random vibrations, discrete, lumped mass, and continuous systems. Vibration control techniques. PREREQ: MATH 360, ENGR 208, 321. S

ME 443 Thermal/Fluids Laboratory 1 credit. Measurement of thermal and fluid properties, experiments on fluid flow and heat transfer systems. PREREQ: ME 341. F

ME g451 Compressible Fluid Flow 3 credits. Fundamentals and practical applications of compressible fluid flow and gas dynamics; techniques for isentropic friction, heat addition, isothermal flow, shock wave analysis, propagation, expansion waves, reflection waves. PREREQ: ME 341. D

ME g476 Heat Transfer 3 credits. Continuation of transport phenomena with emphasis on heat transfer. Conduction, convection and radiation will be covered. Numerical solutions and equipment design emphasized. PREREQ: ENGR 264; COREQ: ENGR 309. F

Nuclear Science and Engineering Courses

NS&E 371 Introduction to Nuclear Science and Engineering 3 credits. Basic nuclear and atomic processes; radioactive decay, binding energy, radiation interactions, reaction cross sections. Neutron diffusion, radiation sources. PREREQ: CHEM 111, PHYS 212; COREQ: MATH g360. S

NS&E g444 Nuclear Fuel Cycles 3 credits. Exploration of the processes associated with nuclear fuel cycles including mining, fabrication, reprocessing, and disposal. PREREQ: NS&E 371, CHEM 317. D

NS&E g445 Neutron Reactions and Transport 3 credits. Physical principles underlying neutron interactions. Multi-region and multi-energy diffusion and transport. Beamport and filter concepts and design. PREREQ: ENGR 264, NS&E 371. COREQ: MATH g421. F

NS&E g446 Design of Fuel Cycle Systems 3 credits. Criticality, shielding and thermal design of fuel and waste transportation and storage facilities. Criticality and thermal analysis codes. Regulations, environmental and economic considerations. Introduction to safety criteria. PREREQ: NS&E g445. S

NS&E g447 Nuclear Systems Laboratory 1 credit. Techniques of radiation detection and measurements, flux measurements, neutron activation analysis, approach to criticality, Inhour equation, subcritical experiments. PREREQ: NS&E g445. S

NS&E g448 Design, Control and Use of Radiation Systems 3 credits. Generation, detection and measurement systems design for control and use of radiation in industrial and medical applications. Radiation protection, regulations, environmental and economic considerations. COREQ: NS&E g445. F