Courses in Systems Engineering

SYEN 1207 Introduction to Mechanical Engineering
Prerequisite: none. The mechanical engineering profession; problem solving skills; machine components and tools; forces in structures and fluids, materials and stresses; thermal and energy systems; motion of machinery; mechanical design. Required for SYEN students in the mechanical option, but open to all students on a space available basis. Two hours lecture. Two credit hours.

SYEN 1210 Introduction to Systems Engineering
Prerequisite: MATH 1302 or 1315, or consent of instructor. Introduction to engineering as a profession, engineering problem solving, engineering design process, engineering ethics, engineering communication, history of engineering developments, and case studies involving leading inventions in the engineering field from a variety of disciplines. Students work in teams to build small engineering projects. Course includes industry visits and talks by industry specialists. One hour lecture. Two hours lab. Two credit hours.

SYEN 1301 Introduction to Computer Systems
Prerequisite: consent of instructor. Introduction to the fundamental hardware and software underpinning of computing systems, MOS transistors, logic gates, latches, logic structure, memory, von Neumann model of execution, organization and architecture of a simple computer; machine, assembly, and high-level language programming. Required for systems engineering students in the computer systems option, but open to all students on a space available basis. Four hours lab. Two hours lecture, two hours lab. Three credit hours.

SYEN 1302 C/C++ Programming for Engineers and Scientists

SYEN 1303 Introduction to Telecommunication Systems
Prerequisite: Math 1303 or equivalent. Source coding, Line Coding, Multiplexing and Multiple Access, Analog and digital modulation, fundamentals of Information theory and coding. Required for systems engineering students in the telecommunication systems option, but open to all students on a space-available basis. Two hours lecture, two hours lab. Three credit hours.

SYEN 1304 Introduction to Electrical Engineering
Prerequisite: consent of instructor. Direct current fundamentals; alternating current and components; electrical and electronic component functions; digital logic devices; computer architecture; computer components; semiconductors; the load line; CMOS logic and memory; other semiconductor devices and circuits; fabrication of ICs and MEMS; power generation, transmission, and distribution; wireless communication systems; digital signal processing; electronics terminology. Required for systems engineering students in the computer systems option, but open to all students on a space available basis. Two hours lecture. Two hours lab. Three credit hours.

SYEN 1310 Introduction to Systems Engineering
Prerequisite: MATH 1302 or 1315 or consent of instructor. Introduction to engineering as a profession, engineering problem solving, engineering design process, engineering ethics, engineering communication, history of engineering developments, and case studies involving leading inventions in the engineering field from a variety of disciplines. Students work in teams to build small engineering projects. Course includes industry visits and talks by industry specialists. Two hours lecture. Two hours lab. Three credit hours.

SYEN 2110 Computational Engineering Laboratory
Prerequisite concurrent: SYEN 1302 or consent of instructor. Introduction to engineering problem solving using Matlab, vector and matrix operations, data input and output, program flow control, Matlab functions, graphics in 2D and 3D, symbolic mathematics, engineering examples. Three hours lab. One credit hour.

SYEN 2115 Circuits and Systems Laboratory
Prerequisite or corequisite: SYEN 2315. Structured exercises to illustrate class topics. Both SPICE simulation and bread-boarding/measurement exercises. Use of spectrum analyzer to determine frequency response and system identification. Two hours lab. One credit hour.

SYEN 2117 Manufacturing Processes Laboratory
Prerequisite or corequisite: ETME 2317 or SYEN 1207. Introduction to machine shop equipment and processes; metal fabricating applications, including metal cutting, such as turning, drilling, milling; welding, and measurement and inspection. Course project and the application of Ethics and safety in design and manufacturing. One three-hour lab, One credit hour.

SYEN 2233 Solid Modeling and Design
Prerequisite: SYEN 2117 or equivalent. Modern engineers use computer aided design and engineering (CAD/CAE) programs to improve the design process. This course will introduce the concepts of three-dimensional part modeling and assembly for analysis and manufacturing. The principle method for design communication is through
two-dimensional standard drawing practices which can be easily extracted from three-dimensional models. This course will cover the basic nomenclature to allow engineers to communicate with manufacturers. Some focus will be applied to the intersection of tolerances, as expressed on engineering drawings, with design and manufacturing processes. The course will introduce how to interface solid models with CAE simulations, such as a Finite Element Analysis program. One hour lecture, two hours lab. Two credit hours.

SYEN 2310 Systems Modeling – Discrete
Prerequisite: MATH 1452. Introduction to dynamic modeling, converting real world problems into mathematical models, discrete dynamical system models with examples from natural sciences, social sciences, and engineering, systems with inputs, probabilistic modeling with discrete systems. Three hours lecture. Three credit hours.

SYEN 2315 Circuits and Systems

SYEN 2370 Engineering Statics
Prerequisite: PHYS 2321 or consent of instructor. Prerequisite concurrent: MATH 2453 or consent of instructor. Static equilibrium of particles, equivalent systems of forces, equilibrium of rigid bodies, centroids and centers of gravity, analysis of structures, dry friction, and moments of inertia. Three hours lecture. Three credit hours.

SYEN 3110 Dynamic Systems Modeling and Simulation Laboratory
Prerequisite or corequisite: SYEN 3310. Modeling and simulation of dynamic systems on personal computers. Introduction to computer modeling. Graphical presentation of results. Two hours lab. One credit hour.

SYEN 3130 Digital Systems Laboratory
Prerequisite or corequisite: SYEN 3330. Weekly laboratory providing practical knowledge in designing, assembling, testing, and simulating combinational and sequential digital circuits. Two hours lab. One credit hour.

SYEN 3134 Advanced Microprocessor Systems Laboratory
Prerequisite or corequisite: SYEN 3334. Laboratory course to accompany SYEN 3334 Advanced Microprocessor Systems. Two hours lab. One credit hour.

SYEN 3150 Signals and Systems Laboratory
Prerequisite or corequisite: SYEN 3350. Laboratory course to accompany SYEN 3350 Signals and Systems. Two hours lab. One credit hour.

SYEN 3152 Digital and Analog and Electronics Laboratory
Prerequisite or corequisite: SYEN 3352. Laboratory course to accompany SYEN 3352 Analog and Digital Electronics. Two hours lab. One credit hour.

SYEN 3154 Digital and Analog Communications Laboratory
Prerequisite or corequisite: SYEN 3354. Weekly laboratory experiments to accompany Communication Systems I. Two hours lab. One credit hour.

SYEN 3158 Power Systems Laboratory
Prerequisites: SYEN 2315 and 2115. This lab is designed to accompany SYEN 3358. The lab includes the tests of transformers, DC and AC motors, and power electronic systems. Two hours lecture. One credit hour.

SYEN 3301 Engineering Economy
Prerequisite: MATH 1311, 1342 or 1451, or consent of instructor. Introduction to engineering economic decisions for evaluating the worth of products, services, projects and systems; time value of money, economic equivalence concepts, comparison of investment alternatives, evaluating economic life and replacement analysis, inflation, depreciation and impact of taxes on engineering decisions, and economic risk analysis. Three hours lecture. Three credit hours. Cross listed as CNMG 3302.

SYEN 3310 Dynamic Systems Modeling and Simulation
Prerequisites: MATH 3312 and 3322. Introduction to mathematical modeling of dynamic systems, continuous and discrete system models, system response in time and frequency domains, transfer functions, stability characterization, state-space formulation of modeling problems, fitting models to data, examples from sciences and engineering. Three hours lecture. Three credit hours.

SYEN 3312 Optimization Methods in Systems Engineering
Prerequisites: MATH 2453 and 3312, SYEN 2110. Mathematical foundations, optimality criteria for unconstrained and constrained problems, one-dimensional search methods, gradient and Newtonian methods, linear programming, non-linear programming, discrete optimization, advanced techniques. Three hours lecture. Three credit hours.

SYEN 3314 Probability Theory and Random Variables
Prerequisite or concurrent: MATH 2453. Sample space and events, axioms of probability, conditional probability, independence, Bayes’ rule, discrete and continuous random variables and probability distributions, joint probability distributions, random sampling, limit theorems, confidence intervals, hypothesis testing, introduction to random processes. Three hours lecture. Three credit hours.
SYEN 3316 Discrete Event Systems Modeling and Simulation
Prerequisites: SYEN 3314. The theory and practice of discrete-event simulation modeling and analysis, discrete-event dynamic systems (DEDS), simulation logic and data structures, random number generation, computational issues, experiment design, output analysis, model verification and validation, and modern simulation languages including animation. Three hours lecture. Three credit hours.

SYEN 3318 Decision and Risk Analysis
Prerequisite: SYEN 3312 and 3314. A study in analytic techniques for rational decision-making. Address uncertainty, conflicting objectives, and risk attitudes. Modeling uncertainty; rational decision-making principles; representing decision problems with value trees, decision trees, and influence diagrams; solving value hierarchies, decision trees and influence diagrams; defining and calculating the value of information; incorporating risk attitudes into the analysis; and conducting sensitivity analyses. Three hours lecture. Three credit hours.

SYEN 3320 Systems Engineering Design and Analysis
Prerequisite: SYEN 3312. An integrated introduction to systems design, analysis, and management. The steps of the systems engineering life-cycle process, including identification of system requirements, system concept, engineering design, system testing and integration, and system operation and support. Presentation of basic systems analysis tools, including decision-making, economic evaluation, modeling and simulation, and statistical process control. Elements of systems engineering program management and evaluation. Three hours lecture. Three credit hours.

SYEN 3330 Digital Systems
Prerequisites: SYEN 1302 and 2315. An introduction to digital system design necessary to do modern digital design. Exposure to a balanced treatment of logic design, digital system design, and computer system design basics. New paradigms that cover classical topics and integrate modern technology into the discussion for a real-world viewpoint of modern computer systems. Three hours lecture. Three credit hours.

SYEN 3332 Communication Networks

SYEN 3334 Advanced Microprocessor Systems
Prerequisite: SYEN 3330. The 80°—86 Intel series of microprocessors (from the 8086 to the Pentium members of the series). Principles of microprocessor system design. Architecture of microprocessors, memory interfacing, assembly language programming, I/O programming, I/O peripheral devices, I/O interface design, and data communications. Three hours lecture. Three credit hours.

SYEN 3336 Computer Architecture
Prerequisites: SYEN 3330, or consent of the instructor. The evolution of computers, design methodology, processor basics, data path and control design, memory organization, and system organization. Three hours lecture. Three credit hours.

SYEN 3350 Signals and Systems
Prerequisites: MATH 3322 and corequisites MATH 2453. Linear system theory, convolution, sampling theorem, Fourier series representation, Laplace transform, Fourier transform, digital filtering. Three hours lecture. Three credit hours.

SYEN 3351 Network Analysis
Prerequisites: SYEN 2315 and 2115. Basic circuit laws; circuit analysis methods; capacitive and inductive transients and equivalent circuits; initial, final, and first-order circuits; Laplace transforms; circuit analysis with Laplace transforms; transfer functions; sinusoidal steady-state analysis; frequency response analysis and Bode plots; waveform analysis; Fourier analysis. Three hours lecture. Three credit hours.

SYEN 3352 Analog and Digital Electronics
Prerequisites: SYEN 2315 and 2115. Electronic systems; measurement sensors and actuators; amplification; feedback; semiconductors and diodes; field effect transistors; bipolar junction transistors; analog signal processing; digital systems; sequential logic; digital devices; microcomputers; data acquisition and conversion; system design. Three hours lecture. Three credit hours.

SYEN 3354 Digital and Analog Communication
Prerequisites: SYEN 3350, corequisite 3314. Introduction to communication systems, signals and spectra, signal transmission over communication channels, filtering, linear and exponential CW modulation, sampling, pulse modulation, random signals, noise in communication systems. Three hours lecture. Three credit hours.

SYEN 3356 Electromagnetic Fields and Waves
Prerequisites: SYEN 2315 and MATH 2453. Vector algebra and vector calculus; electrostatics, magnetostatics, Maxwell's equations for time-varying fields, plane-wave propagation; transmission lines; wave reflection and transmission; radiation and antennas. Three hours lecture. Three credit hours.

SYEN 3358 Fundamentals of Power Systems
Prerequisite: SYEN 2315. Electrical machines: generators, motors, and transformers; electrical and electronic drives: motor control and power electronics; electric utility power systems: generation, transmission, distribution, and utilization of electricity. Three hours lecture. Three credit hours.
SYEN 3362 Algorithm Design
Prerequisite: SYEN 1302. Design, analysis, and implementation of algorithms important to computer systems and telecommunication systems; algorithmic design patterns and frameworks; data structures; combinatorial algorithms; graph algorithms; geometric algorithms; numerical algorithms; and Internet algorithms, including text processing, cryptography, and network algorithms. Three hours lecture. Three credit hours.

SYEN 3364 Introduction to Control Systems Engineering
Prerequisite: MATH 3322. Introduction to feedback digital control systems, PID control, continuous modeling of physical systems, application of integral transforms to control system design and analysis, transfer functions, block diagrams, control system characteristics, stability analysis, performance criteria, frequency response methods. Three hours lecture. Three credit hour.

SYEN 3370 Statics and Dynamics
Prerequisite: PHYS 2321 or consent of instructor. Prerequisite concurrent: MATH 2453 or consent of instructor. Statics of particles, equivalent systems of forces, equilibrium of rigid bodies, centroids and centers of gravity, analysis of structures, friction, moments of inertia, kinematics and kinetics of particles, introduction to kinematics and kinetics of rigid bodies, forces and accelerations. Three hours lecture. Three credit hours. Cross listed as CNMG 3370.

SYEN 3371 Engineering Dynamics
Prerequisite: SYEN 2370 or consent of instructor. Kinematics and kinetics of particles, systems of particles, and rigid bodies; energy and momentum methods; mechanical vibrations and resonance; introduction to structural dynamics due to time-varying loads, such as wind and seismic loading. Three hours lecture. Three credit hours.

SYEN 3372 Engineering Materials
Prerequisites: CHEM 1402 and MATH 1451. Atomic structure and bonding, crystal structures, crystal geometry, solidification, crystalline imperfections, and diffusion in solids, mechanical properties of metals, polymeric materials, phase diagrams, engineering alloys, ceramics, composite materials, corrosion, electrical properties of materials, optical properties and superconductive materials, magnetic materials. Cross-listed with CNMG 3372. Three hours lecture. Three credit hours.

SYEN 3378 Engineering Thermodynamics
Prerequisites: CHEM 1402, PHYS 2321, and MATH 1452, or consent of instructor. Properties of pure substances, thermodynamic processes, heat and work, the first law of thermodynamics, closed systems, enthalpy, open systems, the second law of thermodynamics, entropy, exergy, and an introduction to power and refrigeration cycles. Three hours lecture. Three credit hours. Cross listed as CNMG 3378.

SYEN 3379 Elements of Mechanical Design Prerequisites: SYEN 2233 and CNMG 3376 or equivalent with a grade of C or better. Introduction to the design, integration, and best practices for using mechanical elements such as springs, gears, cams and mechanisms, clutches and brakes, and bearings. Methods of joining such as fasteners, welds, press and shrink fits, and shaft coupling will be covered. Performance and failure analysis for components and machines will be covered. Solid modeling of machine assemblies for documentation and basic analysis will be emphasized. A semester-long design project in which a mechanical system is designed, fabricated, and characterized will serve as the practical application of these concepts. Two hours lecture, four hours lab. Three credit hours.

SYEN 3391 Cooperative Education in Systems Engineering I
Prerequisites: declaration of systems engineering major, completion of at least 60 hours total credit hours with an overall GPA of 2.5 or higher, completion of 20 or more credit hours of systems engineering courses with a GPA of 2.5 or higher, and permission of the systems engineering cooperative education faculty coordinator. This course is for qualified students who would like to combine classroom study with at least 200 hours of engineering-related paid employment. The course is a partnership between the student, the employer, the systems engineering faculty, and the UALR Office of Cooperative Education. An individualized Cooperative Education Learning Agreement will specify the detailed work assignment, including employer, supervisor, job title, work schedule, and rate of pay, as well as the academic requirements, including learning objectives, learning activities, documentation of learning, learning assessments, and grading policy. This course will be allowed to satisfy up to six hours of program electives. Three credit hours.

SYEN 4100, 4200, 4300, 4400, 4500 Independent Study
Prerequisite: Senior standing. Individual investigation by an upper level student. Topics determined in consultation with supervising faculty. For each credit hour, the student is expected to work two to four hours per week as determined by the instructor. Agreement must be in writing and filed with the department chairperson. A maximum of six credit hours can be applied toward the SYEN major requirement. One to five credit hours.

SYEN 4174 Fluid Mechanics Laboratory
Prerequisite or corequisite: SYEN 4374. Analysis of experimental data, basic electrical measurements and sensing devices, pressure measurement, flow measurement, temperature measurement, data acquisition and processing, report writing and presentation, design of experiments. Cross-listed with CNMG 4174. Two hours lab. One credit hour.

SYEN 4176 Mechanics of Materials Laboratory
Prerequisite or corequisite: SYEN 4376. Analysis of experimental data, basic electrical measurements and
sensing devices, force measurement, torque measurement, strain measurement, motion measurement, vibration measurement, data acquisition and processing, report writing and presentation, design of experiments. Two hours lab. One credit hour. Cross listed as CNMG 4176.

**SYEN 4182 MEMS and Microsystems Laboratory**

Prerequisites: SYEN 4376 and 4176 or consent of instructor. This laboratory course is an introduction to the principles of microfabrication for microelectronic devices, sensors, and micro-mechanical structures, MEMS, and microsystems with applications in engineering. Course comprised of laboratory work and accompanying lectures that cover silicon oxidation, photolithography, thin film deposition, etching, electrochemical deposition (plating) and packaging. Some selected topics in yield and reliability, as well as process simulation may be covered. Dual-listed in the UALR Graduate Catalog as SYEN 5182. Two hours lab. One credit hour.

**SYEN 4282 MEMS and Microsystems**

Prerequisite: SYEN 3372 or equivalent with a grade of C or higher. Corequisite SYEN 4182. In this introductory MEMS class, we cover the fundamental basis of Microsystems technology. Microelectromechanical devices (MEMS), such as actuators, pressure sensors, and opto-mechanical assemblies, require knowledge of a broad range of disciplines, from microfabrication and mechanics to chemistry and solid state device physics. Dual-listed in the UALR Graduate Catalog as SYEN 5282. Two hours lecture. Two credit hours.

**SYEN 4314 Queuing Theory and Systems**

Prerequisite: SYEN 3314 or equivalent. Theoretical foundations, models and techniques or queuing theory. Topics include classic models of queues including simple and advanced Markovian queuing models, and models with general arrival and service patterns. Applications of queuing theory and queuing systems design considerations. Dual-listed in the UALR Graduate Catalog as SYEN 5314. Three hours lecture. Three credit hours.

**SYEN 4320 Linear State-Space Control Systems**

Prerequisites: SYEN 3364 or consent of instructor. Introduction to modern control systems, state-space models of linear time-invariant systems, solution to state equations, linear transformations and canonical forms, stability analysis, controller synthesis via state feedback, tracking system design, observer-based compensator design, optimal control problems. Dual-listed in the UALR Graduate Catalog as SYEN 5320. Three hours lecture. Three credit hours.

**SYEN 4322 Modeling Transportation Systems**

Prerequisites: SYEN 3312 or equivalent, SYEN 3314 or equivalent, or Consent of Instructor. The objectives of transportation analysis are defined to include mobility provision, consequence identification and selection of courses of action. A set of methodologies has evolved to exclusively address transport modeling, including demand forecasting, technology representation, network-flow, and multi-attribute assessment of performance. This course reviews very powerful tools to analyze such a class of technological and socioeconomic problems, characterized by the explicit recognition of a spatial dimension. Dual-listed in the UALR Graduate Catalog as SYEN 5322. Three lecture hours. Three credit hours.

**SYEN 4350 Digital Signal Processing**

Prerequisites: SYEN 3350. Signals and signal processing; discrete-time signals and systems in the time and frequency domains; digital processing of continuous-time signals; finite-length discrete transforms; discrete-time signals and systems in the z-domain; LTI discrete-time systems in the transform domain; digital filter structures; IIR digital filter design; FIR digital filter design; DSP algorithm implementation; analysis of finite wordlength effects; multi-rate DSP fundamentals; multi-rate filter banks and wavelets; applications of DSP. Three hours lecture. Three credit hours.

**SYEN 4352 Spatial Time Series**

Prerequisites: SYEN 3312, SYEN 3314 or STAT 3353, and consent of instructor. Instead of a single stream of data, multiple streams are gathered over the target can provide better information. Because of the inherent spatial correlation among these data streams, spatial time-series can play an important role in multiplesensor and other data-intensive applications. Image-processing applications include image rectification and restoration, image enhancement, image classification, and data merging. Signal processing applications include Spatial-temporal Autoregressive Moving-Average model and Intervention Analysis. Unifying these diverse analyses and applications is Markov Random Field Theory. Dual-listed in the UALR Graduate Catalog as SYEN 5352. Three hours lecture. Three credit hours.

**SYEN 4353 Advanced Digital Communications**

Prerequisites: SYEN 3154 and 3354. In-depth examination of wireless digital communication design strategies. Topics covered include digital modulation, radiowave propagation characteristics. Signal detection methods, BER performance improvement and simulation techniques RF/hardware architectures, migration path for modulation and demodulation techniques, signal processing building blocks for wireless systems, method for mitigating wireless channel impairments, perform system simulations, BER and channel models, predict system performance and evaluate trade-offs, list TDMA and CDMA techniques, and 3G evolution, describe design issues for wireless systems, particularly those issue in which transmit and receive implementation affect system performance. Dual-listed in the UALR Graduate Catalog as SYEN 5353. Three hours lecture. Three credit hours.

**SYEN 4354 Power Systems Analysis**

Prerequisites: SYEN 3358, or consent of the instructor. Fundamental concepts of power system analysis, transmission line parameters, system models, steady-state performance, network calculations, power flow solutions, fault studies, symmetrical components, operation, and control. Dual-listed in the UALR Graduate Catalog as SYEN 5354. Three hours lecture. Three credit hours.
SYEN 4355 Mobile Multimedia Internet
Prerequisites: SYEN 3314. The course will provide state-of-the-art perspective of the emerging landscape of Mobile Multimedia Internet. Key subject areas covered in advanced mobile Internet technologies include WLAN, GPRS, 3G UMTS, and VoIP. Topics covered will involve architecture of the systems, protocol issues, the design and analysis of solutions for mobility, quality of service, mobile IP, and standardization efforts. Three hours lecture. Three credit hours.

SYEN 4356 Radio Frequency Techniques and Systems

SYEN 4325 Fuzzy Logic in Control and Systems Engineering
Prerequisite: SYEN 3364. Introduction, basic concepts of fuzzy logic, fuzzy sets, fuzzy relations, fuzzy If/Then rules, fuzzy implications and approximate reasoning, fuzzy logic in control theory, hierarchical intelligent control, fuzzy logic applications in information systems, fuzzy model identification, neuro-fuzzy systems and genetic algorithms. Dual-listed in the UALR Graduate Catalog as SYEN 5325. Three hours lecture. Three credit hours.

SYEN 4331 Advanced Computer Architecture
Prerequisites: SYEN 3336, or consent of the instructor. Introduction to Computer Systems, Instruction-Set architecture, Arithmetic/Logic Unit, Data Path and Control, Memory System Design, I/O Interface, and Advanced Architectures. Dual-listed in the UALR Graduate Catalog as SYEN 5331. Three hours lecture. Three hours lecture. Three credit hours.

SYEN 4332 Applied Operating Systems
Prerequisite or corequisite: SYEN 3362. Introduction to operating systems. Buffering, physical input/output, and file management. Multiprogramming and processing, resource scheduling, memory