Systems Engineering and Management

SYSM 6301 (MECH 6337) Systems Engineering, Architecture and Design (3 semester credit hours) Architecture and design of large-scale and decentralized systems from technical and management perspectives. Systems architectures, requirements analysis, design tradeoffs, and reliability through various case studies and multiple types of mathematical techniques. International standardization bodies, including INCOSE, engineering frameworks, processes, and tool support from both theoretical and practical perspectives. (3-0) Y

SYSM 6302 (BMEN 6302 and EECS 6302 and MECH 6317) Dynamics of Complex Networks and Systems (3 semester credit hours) Design and analysis of complex interconnected networks and systems. Basic concepts in graph theory; Eulerian and Hamiltonian graphs; traveling salesman problems; random graphs; power laws; small world networks; clustering; introduction to dynamical systems; stability; chaos and fractals. (3-0) Y

SYSM 6303 (OPRE 6301) Statistics and Data Analysis (3 semester credit hours) Introduction to statistical and probabilistic methods and theory applicable to situations faced by managers. Topics include: data presentation and summarization, regression analysis, fundamental probability theory and random variables, introductory decision analysis, estimation, confidence intervals, hypothesis testing, and One Way ANOVA. (Some sections of this class may require a laptop computer). (3-0) S

SYSM 6304 (OPRE 6335) Risk and Decision Analysis (3 semester credit hours) This course provides an overview of the main concepts and methods of risk assessment, risk management, and decision analysis. The methods used in industry, such as probabilistic risk assessment, six sigma, and reliability, are discussed. Advanced methods from economics and finance (decision optimization and portfolio analysis) are presented. Prerequisite: OPRE 6301 or SYSM 6303. (3-0) T

SYSM 6305 Optimization Theory and Practice (3 semester credit hours) Basics of optimization theory, numerical algorithms, and applications. The course is divided into three main parts: linear programming (simplex method, duality theory), unconstrained methods (optimality conditions, descent algorithms and convergence theorems), and constrained minimization (Lagrange multipliers, Karush-Kuhn-Tucker conditions, active set, penalty and interior point methods). Applications in engineering, operations, finance, statistics, etc. will be emphasized. Students will also use Matlab's optimization toolbox to obtain practical experience with the material. (3-0) Y

SYSM 6306 (BMEN 6372 and MECH 6314) Engineering Systems: Modeling and Simulation (3 semester credit hours) This course will present principles of computational modeling and simulation of systems. General topics covered include: parametric and non-parametric modeling; system simulation; parameter estimation, linear regression and least squares; model structure and model validation through simulation; and, numerical issues in systems theory. Techniques covered include methods from numerical linear algebra, nonlinear programming and Monte Carlo simulation, with applications to general engineering systems. Modeling and simulation software is utilized (MATLAB/SIMULINK). (3-0) Y

SYSM 6307 (EECS 6331 and MECH 6300) Linear Systems (3 semester credit hours) State space methods of analysis and design for linear dynamical systems. Coordinate transformations and tools from advanced
linear algebra. Controllability and observability. Lyapunov stability analysis. Pole assignment, stabilizability, detectability. State estimation for deterministic models, observers. Introduction to the optimal linear quadratic regulator problem. Prerequisites: ENGR 2300 and EE 4310 or MECH 4310 or equivalent. (3-0) Y

**SYSM 6308 (CS 6356 and SE 6356)** Software Maintenance, Evolution, and Re-Engineering (3 semester credit hours) Principles and techniques of software maintenance. Impact of software development process on software justifiability, maintainability, evolvability, and planning of release cycles. Use of very high-level languages and dependencies for forward engineering and reverse engineering. Achievements, pitfalls, and trends in software reuse, reverse engineering, and re-engineering. Prerequisite: SE 5354. (3-0) Y

**SYSM 6309 (CS 6361 and SE 6361)** Advanced Requirements Engineering (3 semester credit hours) System and software requirements engineering. Identification, elicitation, modeling, analysis, specification, management, and evolution of functional and non-functional requirements. Strengths and weaknesses of different techniques, tools, and object-oriented methodologies. Interactions and trade-offs among hardware, software, and organization. System and sub-system integration with software and organization as components of complex, composite systems. Transition from requirements to design. Critical issues in requirements engineering. Prerequisite: SE 5354. (3-0) S

**SYSM 6310 (CS 6367 and SE 6367)** Software Testing, Validation and Verification (3 semester credit hours) Fundamental concepts of software testing. Functional testing. GUI based testing tools. Control flow based test adequacy criteria. Data flow based test adequacy criteria. White box based testing tools. Mutation testing and testing tools. Relationship between test adequacy criteria. Finite state machine based testing. Static and dynamic program slicing for testing and debugging. Software reliability. Formal verification of program correctness. Prerequisite: SE 5354. (3-0) Y

**SYSM 6311 (OPRE 6362)** Systems Project Management in Engineering and Operations (3 semester credit hours) Project management is the discipline of planning, organizing and managing resources to bring about the successful completion of specific project goals and objectives. The course will cover various aspects of managing projects in engineering and operations environments including the critical path methods for planning and controlling projects, time and cost tradeoffs, resource utilization, organizational design, conflict resolution and stochastic considerations. (3-0) S

**SYSM 6312 (FIN 6301)** Systems Financial Management (3 semester credit hours) Develops the basic concepts of finance with particular attention to their application to the financial management of companies. Prerequisites or Corequisites: (ACCT 6301 or ACCT 6305) and OPRE 6301 or program director consent required. (3-0) S

**SYSM 6313 (HMGT 6324 and MECO 6352 and OB 6332)** Systems Negotiation and Dispute Resolution (3 semester credit hours) This course explores the theories, processes, and practical techniques of negotiation so that students can successfully negotiate and resolve disputes in a variety of situations including interpersonal, group, and international settings. Emphasis is placed on understanding influence and conflict resolution strategies; identifying interests, issues, and positions of the parties involved; analyzing co-negotiators, their negotiation styles, and the negotiation situations; and managing the dynamics associated with most negotiations. Practical skills are developed through the use of simulations and exercises. (3-0) Y

**SYSM 6315 (ENTP 6398)** The Entrepreneurial Experience (3 semester credit hours) This course is designed...
to provide student teams with practical experience in the investigation, evaluation and recommendation of technology and/or market entry strategies for a significant new business opportunity. Projects will be defined by the faculty and will generally focus on emerging market opportunities defined by new technologies of interest to a sponsoring corporate partner. Teams will be comprised of management and engineering graduate students, mentored by faculty and representatives of the partnering company. Evaluation will be based on papers, presentations and other deliverables defined on a case-by-case basis. (3-0) R

**SYSM 6316** (ENTP 6388) **Managing Innovation within the Corporation** (3 semester credit hours) Innovators and entrepreneurs within established corporations combine innovation, creativity and leadership to develop and launch new products, new product lines and new business units that grow revenues and profits from within. The course seeks to equip students with the skills and perspectives required to initiate new ventures and create viable businesses in dynamic and uncertain environments in the face of organizational inertia and other sources of resistance to innovation. Course topics include the elements of strategic analysis and positioning for competitive advantage in dynamic markets, and the structuring, utilization and mobilization of the internal resources of existing firms in the pursuit of growth and new market opportunities. (3-0) Y

**SYSM 6318** (MKT 6301) **Marketing Management** (3 semester credit hours) Overview of marketing management methods, principles and concepts including product, pricing, promotion and distribution decisions as well as segmentation, targeting and positioning. (3-0) S

**SYSM 6319** (MECO 6303) **Business Economics** (3 semester credit hours) Foundations of the economic analysis of business problems, with special emphasis on the operation of markets and the macroeconomy. Prerequisite: **OPRE 6303** or equivalent. (3-0) S

**SYSM 6320** (BPS 6332) **Strategic Leadership** (3 semester credit hours) Addresses the challenge of leading organizations in dynamic and challenging environments. Overall goal is to not only question one's assumptions about leadership, but also enhance skills and acquire new content knowledge. Topics include visionary and transformational leadership, post-heroic leadership, empowerment, leveraging and combining resources, designing organizations and ethics. (3-0) Y

**SYSM 6321** **Financial Engineering** (3 semester credit hours) Introduction to finance and investments from an engineering perspective. Focuses on the principles underlying financial decision making which are applicable to all forms of investment: stocks, bonds, real estate, project budgeting, corporate finance, and more. Intended for students with strong technical backgrounds who are comfortable with mathematical arguments. Primary components are deterministic finance (interest rates, bonds, and simple cash flow analysis) and single period uncertainty finance (portfolios of stocks and pricing theory). Prerequisites: Courses in engineering calculus, probability and linear algebra. (3-0) Y

**SYSM 6325** **Requirements Design, Development, and Integration for Complex Systems** (3 semester credit hours) Building on the premise that systems engineering is the glue that holds complex programs together, this course will teach the foundations of effective requirements design and development for complex systems. Students will learn principles and techniques used for effective creation of requirements early within a system's lifecycle; including effective system integration planning. Practical skills are developed through the use of various case studies, and a significant group project (for real, "external" customers, when possible). Prerequisite or Corequisite: **SYSM 6301**. (3-0) Y
**SYSM 6326** Systems Lifecycle Cost Analysis (3 semester credit hours) This course will provide an understanding of system lifecycle cost analysis concepts (also known as systems affordability) and the lifecycle costing process. The course will examine the importance of using these concepts when attempting to make the best possible engineering and business decisions throughout a system's lifecycle. The concepts will include special emphasis on the analysis and evaluation of alternatives by collectively weighing costs, risks and opportunities, performance, weight and other benefit/risk parameters. Topics will include total ownership cost, various estimating methods and techniques (including sensitivity and some risk analysis), cost analysis processes, system trade studies, and system cost effectiveness, to name a few. Practical skills are developed through the use of various case studies, and a significant group project, maturing from "concept" into "operations and support" throughout the semester. Prerequisite: **SYSM 6301**. (3-0) Y

**SYSM 6327** Systems Reliability (3 semester credit hours) This course will provide an advanced understanding of reliability analysis of complex systems, including many of its extended analysis focus areas like availability, maintainability, and supportability (RAMS). Course analysis variables include stress under various conditions, the use of degradation data, relationships between accelerated stresses and normal operating conditions, dependency failures, repairable and non-repairable components, preventive maintenance, replacement and inspection, and accelerated life reliability models, to name a few. The course will also address important reliability metrics, and the impact of reliability in the design, development and management of organizations. Prerequisite: **SYSM 6303** or **OPRE 6301**. (3-0) Y

**SYSM 6328** Computer and networks systems security (3 semester credit hours) This course is a comprehensive study of security principles and practices for computer and network systems. Topics to be covered include fundamental concepts in computer and network security and common attacks and attacking techniques on computer systems and networks. Practical security policies, defense strategies, and mechanisms, as well as fundamentals of cryptographic tools will be discussed. Defense techniques such as secured protocols, authentication, access control, and network intrusion detection will also be covered. Hands-on computer and network security labs using virtual machines will be used to enhance students' learning. Prerequisite: An undergraduate course on operating systems (e.g. **CS 4348** or **SE 4348**) and instructor consent required. (3-0) Y

**SYSM 6332** (ENTP 6375 and MIS 6375 and OPRE 6394) Technology and New Product Development (3 semester credit hours) This course addresses the strategic and organizational issues confronted by firms in technology-intensive environments. The course reflects six broad themes: (1) managing firms in technology-intensive industries; (2) forecasting key industry and technology trends; (3) linking technology and business strategies; (4) using technology as a source of competitive advantage; (5) organizing firms to achieve these goals; and (6) implementing new technologies in organizations. Students analyze actual situations in organizations and summarize their findings and recommendations in an in-depth term paper. The course also introduces concepts related to agile engineering. Case studies and class participation are stressed. (3-0) Y

**SYSM 6333** (OB 6301) Systems Organizational Behavior (3 semester credit hours) The study of human behavior in organizations. Emphasizes theoretical concepts and practical methods for understanding, analyzing, and predicting individual, group, and organizational behavior. Topics include work motivation, group dynamics, decision making, conflict and negotiation, leadership, power, and organizational culture. Ethical and international considerations are also addressed. (3-0) S
**SYSM 6334 (OPRE 6302) Systems Operations Management (3 semester credit hours)**
Operations Management integrates all of the activities and processes that are necessary to provide products and services. This course overviews methods and models that help managers make better operating decisions over time. How these methods will allow firms to operate both manufacturing and service facilities in order to compete in a global environment will also be discussed. Prerequisite or Corequisite: **OPRE 6301. (3-0) S**

**SYSM 6335 (BUAN 6335) Organizing for Business Analytics: A Systems Approach (3 semester credit hours)**
The course develops conceptual understanding of business analytics and key business drivers that lead to business initiatives. The course takes a systems and organizational approach and examines how decision-makers in key functional areas of an enterprise rely on business analytics, how they develop analytical techniques, and how key roles are played by business analytics professionals. The course also emphasizes developing the business case for analytics through defining and executing strategy and addresses how to successfully integrate analytical processes, technologies, and people in all aspects of business operations. (3-0) T

**SYSM 6336** Earned Value Management System (3 semester credit hours) This course introduces the earned value management (EVM) concept as a management tool for effective project administration which allows project teams to have a solid visibility in terms of cost, schedule, and technical progress of a project or program. This course investigates the practical application of EVM for any size project and explains how all project activities are planned, budgeted, and scheduled in time-phased increments and how the project performance is measured. The EVM approach allows managers to develop a project framework to handle the competing requirements of managing limited resources and meeting a fixed duration. Instructor consent required. (3-0) T

**SYSM 6337 (ACCT 6305) Accounting for Managers (3 semester credit hours)** Fundamental concepts in accounting and financial reporting are presented from the perspective of business managers. May not be used to fulfill degree requirements in MS Accounting. Credit cannot be received for both courses, **ACCT 6301 or ACCT 6202** and **ACCT 6305. (3-0) S**

**SYSM 6V70** Research In Systems Engineering and Management (3-9 semester credit hours) Pass/Fail only. May be repeated for credit (15 semester credit hours maximum). Instructor consent required. ([3-9]-0) R

**SYSM 6V80** Special Topics in Systems Engineering and Management (1-6 semester credit hours) May be repeated as topics vary (9 semester credit hours maximum). Instructor consent required. ([1-6]-0) S

**SYSM 6V90** Thesis (3-9 semester credit hours) Pass/Fail only. May be repeated for credit (15 semester credit hours maximum). Instructor consent required. ([3-9]-0) S

**SYSM 6V98** Systems Engineering and Management Internship (1-3 semester credit hours) Student gains experience and improves skills through appropriate developmental work assignments in a real business environment. Student must identify and submit specific business learning objectives at the beginning of the semester. The student must demonstrate exposure to the managerial perspective via involvement or observation. At semester end, student prepares an oral or poster presentation, or a written paper reflecting on the work experience. Student performance is evaluated by the work supervisor. Pass/Fail only. May be repeated for credit as topics vary (3 semester credit hours maximum). SEM Program Director, the School of Engineering Internship Coordinator, and JSOM Internship Coordinator consent required. Prerequisite: **MAS 6102 or MBA major. ([1-3]-0) S**