ENGINEERING, SYSTEMS (ENSY)

ENSY 4010 Systems Engineering Fundamentals (3 Credits)
An overview of systems engineering, including V-diagrams, functional architecture, physical architecture, system assembly and integration, verification and validation, and milestones to monitor the progress of the design.

ENSY 4012 Systems Engineering Requirements Development (3 Credits)
The course covers fundamentals of design and requirements analysis of complex systems to meet overall mission requirements. Spanning the requirements engineering phase, topics include: decomposition, derivation, allocation, verification and validation planning. Prerequisite: ENSY 4010, or permission of instructor.

ENSY 4014 Complex System Architectures (3 Credits)
The course focuses on mission requirements and how an overall mission should function by examining different architecture configurations and tools for modeling purposes. Topics include: allocation of functional and non-functional requirements, Service Oriented Architecture (SOA) and architectural modeling using the System Modeling Language (SysML). Prerequisite: ENSY 4010.

ENSY 4016 Conceptual Design of Systems (3 Credits)
Conceptual design is the part of the design process that yields a basic solution path, which leads to the principle solution. The focus of the course is on two important decision making principles: understanding a problem and devising a plan. Topics include: intellectual property and the development of engineering drawings, schematics and 3D models.

ENSY 4021 Design of Space Systems Part 1 (3 Credits)
This course is part one of a two-part series on spacecraft design by integrated systems and subsystems. Topics include: spacecraft overview, subsystem interfaces, concepts of operation (CONOPS) and the systems engineer's role as a generalist as opposed to specialists.

ENSY 4022 Design of Space Systems Part 2 (3 Credits)
This course is part two of a two-part series on spacecraft design by integrated systems and subsystems. Topics correspond to decomposition of the spacecraft into classical spacecraft subsystems. Practical applications and core functionality of these subsystems are presented, including required testing and integration at the subsystem and spacecraft levels. Prerequisite: ENSY 4021.

ENSY 4024 Applied Electrical, Mechanical and Software Systems (3 Credits)
This is a practice-centered course. Assess case studies of design, implementation and testing, validation and verification of complete complex (e.g. spacecraft) systems to meet mission requirements with performance guarantees. Prerequisites: ENSY 4012, ENSY 4014, and ENSY 4016, or permission by the Instructor.

ENSY 4030 Introduction to Aerospace Missions (3 Credits)
This class is for individuals working in aerospace engineering and related fields. Topics include: design of orbital spacecraft, design for Moon missions (such as landers), design for Mars missions (including rovers), design of an unmanned drone for surveillance (high-altitudes), CubeSats (having large constellations), and rockets and missiles (including hypersonic).

ENSY 4040 Systems Optimization (3 Credits)
The development and application of various optimization techniques will be explored with engineering examples. Topics include: analytical and numerical methods, linear and non-linear programming techniques for unconstrained and constrained problems, and advanced optimization techniques, e.g. global optimization. Assignments are in context of Systems Engineering case studies.

ENSY 4042 Optimization for Advanced Systems (3 Credits)
Advanced optimization algorithms are presented, as a pillar of data science and machine learning. Topics include: linear, nonlinear and integer programming models. Students will learn to understand tractability of models, particularly complex models as are central to the discipline of Systems Engineering. Prerequisite: ENSY 4040.

ENSY 4050 Digital Transformation for Advanced Integration (3 Credits)
Digital engineering technologies address the difficulties of managing complex and evolving technologies over their lifecycles of (i) development and (ii) operations & maintenance. This course will focus on digital technologies to integrate data across the enterprise, break organizational silos, and drive culture to realize risk reduction. Topics include: elements of the digital thread, such as digital twins and simulation, as well as machine learning and data analytics to inform decision-making throughout the lifecycle.

ENSY 4060 Practical Model Based Systems Engineering (3 Credits)
MBSE is part of a long-term trend toward model-centric approaches adopted by other engineering disciplines, including mechanical, electrical and software. In this course, students will be given hands-on access to MBSE tools in order to learn the UML/SysML language of MBSE and to practice systems engineering methods using the digital thread that is enabled by MBSE. Students will also gain an understanding of MBSE being a subset of Model Based Design (MBD). Prerequisite: ENSY 4050, or permission of instructor.

ENSY 4090 Project Management in Relation to Systems Engineering (3 Credits)
An overview of the skills and strategies for managing people, risks, schedules, and information to meet goals and objectives in large, complicated engineering projects. Includes managing project constraints, and best practices for working with project managers. Emphasis is on People, Process and the Business Environment.

ENSY 4112 Practical Validation and Verification Test Planning (3 Credits)
In this course, students gain a practical understanding of V-diagrams, and the path that must be traveled to fully validate and verify any system. Topics include: traceability between requirements and validation and verification test plans, including practical development of detailed test procedures at any level of integration. Prerequisite ENSY 4012, or permission by the instructor.

ENSY 4170 Practical Approaches to Continuous Improvement (3 Credits)
In this course, students learn practical differences between Continuous Improvement (CI) methods, such as Kaizen, Lean, Six Sigma, and Total Quality Management (TQM). Current events will be used as case studies to apply practical understanding of these CI methods. Practical application of the methods will leverage principles taught in ENSY 4010. Case studies and assignments are based on illustrations of value added CI engineering in the Systems Engineering discipline. Prerequisites: ENSY 4010 or instructor approval.

ENSY 4180 Applied Mathematics for Systems Engineering (3 Credits)
The course reviews topics in continuous and discrete mathematics (integral and differential calculus, matrices, vector calculus, discrete math: matrices, graphs, sets) and introductory probability, as they apply to engineering, and introduces students to more advanced concepts aiding the understanding and design of complex engineering systems. Examples are drawn from engineering systems applications. Students apply the techniques using engineering computing platform.

ENSY 4181 Introductory Probability and Statistics for Systems Engineering (3 Credits)
This course introduces fundamentals of probability for Systems Engineers. Students survey data visualization methods and summary statistics, develop models for data, and apply statistical techniques to assess the validity of the models. Techniques include parametric and nonparametric methods for parameter estimation and hypothesis testing for a single sample mean and two sample means, for proportions, and for simple linear regression. Students will apply methods to real-world engineering data, primarily using R.

ENSY 4182 Data Analytics for Systems Engineering (3 Credits)
This course is designed for students to develop skills in data analytics specifically tailored for systems engineering applications. It combines theoretical understanding with practical applications, covering various models for data inference, statistical methodologies, and the use of data analytics tools and software.

ENSY 4200 Applied Machine Learning for Advanced Systems Modeling (3 Credits)
This course covers topics in Machine Learning including Bayesian decision theory, supervised learning, unsupervised learning and clustering, linear discriminant functions, linear classification techniques such as Support Vector Machines, as well as Artificial Neural Networks and Deep Learning methods.

ENSY 4950 Graduate Assessment for Master of Science degree in Systems Engineering (0 Credits)
This class does not meet. All MS in Systems Engineering (MSSY) graduate students will enroll in this class during their last quarter. The purpose is to collect data for the assessment and continuous improvement of the graduate programs. All required assessment materials will be uploaded online in Canvas Assignments to meet the course requirements. Students will receive Canvas course announcements and or emails from the instructor notifying the students of what are required to be uploaded.