ENRE447 Fundamentals of Reliability Engineering (3 Credits)
Topics covered include: fundamental understanding of how things fail, probabilistic models to represent failure phenomena, life-models for non-repairable items, reliability data collection and analysis, software reliability models, and human reliability models.
Credit Only Granted for: ENRE445 or ENRE447.
Formerly: ENRE445.

ENRE489 Special Topics in Reliability Engineering (3 Credits)
Selected topics of current importance in reliability engineering.
Prerequisite: Permission of ENGR-Mechanical Engineering department.
Repeatable to: 6 credits if content differs.

ENRE600 Fundamentals of Failure Mechanisms (3 Credits)
Physical, chemical, and thermal related failures are introduced through a basic understanding of degradation mechanisms such as diffusion, electromigration, defects and defect migration. The failure mechanisms in basic material types will be taught. Failure mechanisms observed in real devices will also be presented. Problems related to manufacturing, and achieving quality and reliability will be analyzed. Mechanical failures are emphasized from the point of view of complex fatigue theory. The mathematical and statistical basis for analysis is presented as well as Failure Mode and Failure Analysis.
Credit Only Granted for: ENMA698M, ENNU648M, or ENRE600.

ENRE601 Fundamentals of Failure Mechanisms (3 Credits)
Introduces students to basic principles of Reliability Engineering and Reliability Physics. The approach is to provide a general tool set by which engineers can understand how to consider reliability in all phases of the design and manufacture of a product. The emphasis is on integrating statistics and probability with understanding the fundamental physics of processes that lead to failures.

ENRE602 Reliability Analysis (3 Credits)
Principal methods of reliability analysis, including fault tree and reliability block diagrams; Failure Mode and Effects Analysis (FMEA); event tree construction and evaluation; reliability data collection and analysis; methods of modeling systems for reliability analysis. Focus on problems related to process industries, fossil-fueled power plant availability, and other systems of concern to engineers.

ENRE620 Mathematical Techniques of Reliability Engineering (3 Credits)
Basic probability and statistics. Application of selected mathematical techniques to the analysis and solution of reliability engineering problems. Applications of matrices, vectors, tensors, differential equations, integral transforms, and probability methods to a wide range of reliability related problems.Also offered as: ENNU620.

ENRE640 Collection and Analysis of Reliability Data (3 Credits)
Basic life model concepts. Probabilistic life models, for components with both time independent and time dependent loads. Data analysis, parametric and nonparametric estimation of basic time-to-failure distributions. Data analysis for systems. Accelerated life models. Repairable systems modeling.
Prerequisite: ENRE602.

ENRE641 Probabilistic Physics of Failure and Accelerated Testing (3 Credits)
Credit Only Granted for: ENRE641 or ENRE650.
Formerly: ENRE650.

ENRE642 Reliability Engineering Management (3 Credits)
Unifying systems perspective of reliability engineering management. Design, development and management of organizations and reliability programs including: management of systems evaluation and test protocols, development of risk management-mitigation processes, and management of functional tasks performed by reliability engineers.

ENRE645 Human Reliability Analysis (3 Credits)
Methods of solving practical human reliability problems, cognitive and behavioral modeling, task analysis, performance shaping factors, error classification, distribution of human performance and uncertainty bounds, sources of human error probability data, human error risk mitigation, examples and case studies.
Credit Only Granted for: ENRE645 or ENRE734.
Formerly: ENRE734.

ENRE648 Special Problems in Reliability Engineering (1-6 Credits)
For students who have definite plans for individual study of approved problems. Credit given according to extent of work.
Repeatable to: 6 credits if content differs.

ENRE655 Advanced Methods in Reliability Modeling (3 Credits)
Bayesian methods and applications, estimation of rare event frequencies, uncertainty analysis and propagation methods, reliability analysis of dynamic systems, analysis of dependent failures, reliability of repairable systems, human reliability analysis methods and theory of logic diagrams and application to systems reliability.
Prerequisite: ENRE602.
Credit Only Granted for: ENRE655 or ENRE665.
Formerly: ENRE665.

ENRE657 Telecommunications Systems Reliability (3 Credits)
Reliability perspectives in telecommunications networks, comparison of networks with respect to operations and reliability, network reliability modeling techniques, applicable procedural/human reliability models, and network metric objectives and data collection.
Prerequisite: ENRE602.

ENRE664 Electronic Packaging Materials (3 Credits)
Energy bands and carrier concentration, carrier transport phenomena, p-n junction, bipolar devices, unipolar devices, crystal growth and epitaxy, oxidation and film deposition, diffusion and ion implantation, lithography and etching, integrated devices, electromigration.
Prerequisite: Permission of ENGR-Mechanical Engineering department.
Credit Only Granted for: ENRE648N or ENRE664.
Formerly: ENRE648N.
ENRE670 Probabilistic Risk Assessment (3 Credits)
Why study risk, sources of risk, overview of Risk Assessment and Risk Management, relation to System Safety and Reliability Engineering; measures, representation, communication, and perception of risk; overview of use of risk assessment results in decision making; overview of Probabilistic Risk Assessment (PRA) process; detailed converge of PRA methods including (1) methods for risk scenario development such as identification of initiators, event sequence diagrams, event trees, causal modeling (fault trees, influence diagrams, and hybrid methods), and simulation approaches; (2) methods of risk scenario likelihood assessment, including quantitative and qualitative approaches, as well as uncertainty modeling and analysis. Also covers methods for risk modeling of system hardware behavior, physical phenomena, human behavior, software behavior, organizational environment, and external physical environment. Additional core topics include risk model integration and quantification (Boolean-based, binary decision diagram, Bayesian belief networks, and hybrid methods), simulation-based Dynamic PRA methods (discrete and continuous) and several examples of large scale PRAs for space missions, nuclear power, aviation and medical systems.
Prerequisite: ENRE602. Also offered as: ENNU651.
Credit Only Granted for: ENNU651 or ENRE670.

ENRE671 Risk Assessment in Engineering (3 Credits)
Introduction to risk management and decision-making, including uncertainty propagation, importance ranking, risk acceptance criteria, decision analysis and other decision-making techniques, risk communication.
Prerequisite: ENRE670.
Credit Only Granted for: ENRE648W or ENRE671.
Formerly: ENRE648W.

ENRE682 Software Reliability and Integrity (3 Credits)
Defining software reliability, initiatives and standards on software reliability, inherent characteristics of software which determine reliability, types of software errors, structured design, overview of software reliability models, software fault tree analysis, software redundancy, automating tools for software reliability prototypes and real time software reliability.
Credit Only Granted for: ENRE682 or ENRE732.
Formerly: ENRE732.

ENRE684 Information Security (3 Credits)
This course is divided into three major components: overview, detailed concepts and implementation techniques. The topics to be covered are: general security concerns and concepts from both a technical and management point of view, principles of security, architectures, access control and multi-level security, trojan horses, covert channels, trap doors, hardware security mechanism, security models, security kernels, formal specifications and verification, networks and distribution systems and risk analysis. Also offered as: ENME442.
Credit Only Granted for: ENME442, ENRE648J, or ENRE684.
Formerly: ENRE648J.

ENRE689 Special Topics in Engineering Materials (3 Credits)

ENRE700 Life Cycle Cost and System Sustainment Analysis (3 Credits)
This course melds elements of traditional engineering economics with manufacturing process and sustainment modeling, and life cycle cost management concepts to form a practical foundation for predicting the cost of products and systems. Various manufacturing cost analysis will be presented including: process-flow, parametric, cost of ownership, and activity based costing. The effects of learning curves, data uncertainty, test and rework processes, and defects will be considered. Aspects of system sustainment including the impact on the life cycle (and life cycle costs) of reliability, maintenance, environment impact, and obsolescence will be treated. Also offered as: ENME770.
Credit Only Granted for: ENME770 or ENRE770.

ENRE798 Pre-Candidacy Research (1-8 Credits)
ENRE799 Doctoral Dissertation Research (1-8 Credits)