List of Recommended Courses for IOE MS/MSE Degrees in

Quality Engineering and Applied Statistics

Please note that only a subset of the courses listed below will be offered in any given year so that these are advisory only and the courses chosen will depend on availability.

Quality Engineering and Applied Statistics Courses

Courses in this group focus on general methods and techniques for the applied statistics, quality control, reliability analysis and decision making of complex systems.

IOE 465. Design and Analysis of Experiments
Prerequisite: IOE 366. (3 credits)
Linear Models, Multicollinearity and Robust Regression, Comparative Experiments, Randomized Blocks and Latin Squares, Factorial Designs, Confounding, Mixed Level Fractional Factorials, Random and Mixed Models, Nesting and Split Plots, Response Surface Methods, Taguchi Contributions to Experimental Design.

IOE 466 (Mfg 466) (Stat 466). Statistical Quality Control
Prerequisite: IOE 265 (Stat 265) and IOE 366 or Stat 401. (3 credits)

IOE 515. Stochastic Processes
Prerequisite: IOE 316. (3 credits)
Introduction to non-measure theoretic stochastic processes. Poisson processes, renewal processes, and discrete time Markov chains. Applications in queuing systems, reliability, and inventory control.

IOE 551. Benchmarking, Productivity Analysis and Performance Measurement
Prerequisite: IOE 510. I (3 credits)
Introduction to quality engineering techniques commonly used for performance measurement, productivity analysis, and identification of best practice. Topics include balanced scorecard, activity-based costing/management, benchmarking, quality function deployment and data envelopment analysis (DEA). Significant focus of the course is on the application of DEA for identification of best practice.
IOE 560 (Stat 550) (SMS 603). Bayesian Decision Analysis  
Prerequisite: IOE 366 or Stat 426. (3 credits)  
Axiomatic foundations for, and assessment of, probability and utility; formulation of decision problems; risk functions, admissibility; likelihood functions and the likelihood principle; natural conjugate a priori distributions; Bayesinan regression analysis and hypothesis testing; hierarchical models; credible intervals; numerical analysis; applications to decision-making.

IOE 562 (Stat 535). Reliability  
Prerequisite: IOE 316 and IOE 366 or Stat 425 and Stat 426. (3 credits)  
Reliability concepts and methodology for modeling, assessing and improving product reliability: common models for component and system reliability; analysis of field and warranty data; component reliability inference; repairable systems; accelerated stress testing for reliability assessment; reliability improvement through experimental design.

IOE 565 (ME 563) (Mfg 561). Time Series Modeling, Analysis, Forecasting  
Prerequisite: IOE 366 or ME 401. I (3 credits)  
Time series modeling, analysis, forecasting, and control, identifying parametric time series, autovariance, spectra, Green's function, trend and seasonality. Examples from manufacturing, quality control, ergonomics, inventory, and management.

IOE 566 (Mfg 569). Advanced Quality Control  
Prerequisite: IOE 466. (3 credits)  

IOE 568  
PREREQUISITES: IOE 265, IOE 366, IOE 466, Stats 500 or equiv  
Overview of advanced quality control topics on profile data monitoring and variation diagnosis; Maximum likelihood estimation, Bayes estimation, mixed model, change point detection methods; Selected supervised, unsupervised, and reinforcement learning methods for variation pattern interference and diagnosis; Feature extraction via data transformation and feature selection method.

IOE 570 (Stat 570). Experimental Design  
Prerequisite: Stat 500 or background in regression. Graduate Standing. (3 credits)  
Basic design principles, review of analysis of variance, block designs, two-level and three-level factorial and fractional factorial experiments, designs with complex aliasing, data analysis techniques and case studies, basic response
surface methodology, variation reduction and introductory robust parameter designs.

**Engineering Breadth**

Courses in this group include engineering application arenas that illustrate use of the models and analysis methods in Quality Engineering and Applied Statistics.

**IOE 441 (Mfg 441). Production and Inventory Control**  
*Prerequisite: IOE 310, IOE 316. (3 credits)*  
Basic models and techniques for managing inventory systems and for planning production. Topics include deterministic and probabilistic inventory models; production planning and scheduling; and introduction to factory physics.

**IOE 447 (Mfg 447). Facility Planning**  
*Prerequisite: IOE 310, IOE 316. (3 credits)*  

**IOE 449 (Mfg 449). Material Handling Systems**  
*Prerequisite: IOE 310, IOE 316. (2 credits)*  
Review of material handling equipment used in warehousing and manufacturing. Algorithms to design and analyze discrete parts material storage and flow systems such as Automated Storage/Retrieval Systems, order picking, conveyors, automated guided vehicle systems, and carousels.

**IOE 541 (Mfg 541). Inventory Analysis and Control**  
*Prerequisite: IOE 310, IOE 316. (3 credits)*  
Models and techniques for managing inventory systems and for planning production. Topics include single item and multi-item inventory models, production planning and control, and performance evaluation of manufacturing systems.

**IOE 543 (Mfg 543). Scheduling**  
*Prerequisite: IOE 316, IOE 310. (3 credits)*  
The problem of scheduling several tasks over time, including the topics of measures of performance, single-machine sequencing, flow shop scheduling, the job shop problem, and priority dispatching. Integer programming, dynamic programming, and heuristic approaches to various problems are presented.

**IOE 545 (Mfg 545). Queueing Networks**  
*Prerequisite: IOE 515 or EECS 501. (3 credits)*  
Introduction to queuing networks. Topics include product and non-product form networks, exact results and approximations, queuing networks with blocking, and
polling systems. Applications from manufacturing and service industries are
given as examples.

IOE 549 (Mfg 549). Plant Flow Systems
Prerequisite: IOE 310, IOE 416. (3 credits)
Analytical models for the design and throughput performance evaluation of
material handling systems used in discrete parts flow production facilities.
Analysis of design and control issues for manual and automated handling
systems including lift trucks, micro-load automatic storage/retrieval systems and
automated guided vehicle systems.

IOE 574. Simulation Analysis
Prerequisite: IOE 515. (3 credits)
Underlying probabilistic aspects of simulation experiments, statistical
methodology for designing simulation experiments and interpreting output.
Random number generators, variate and process generation, output analysis,
efficiency improvement techniques, simulation and optimization, how commercial
simulation software works. Applications from telecommunications, manufacturing
statistical analysis.

IOE 583 (ME 583) (Mfg 583) (EECS 566). Scientific Basis for
Reconfigurable Manufacturing
Prerequisite: Graduate Standing or permission of instructor. (3 credits)
Principles of reconfigurable manufacturing systems (RMS). Students will be
introduced to fundamental theories applicable to RMS synthesis and analysis.
Concepts of customization, integrability, modularity, diagnosability, and
convertibility. Reconfiguration design theory, life-cycle economics, open-
architecture principles, controller configuration, system reliability, multi-sensor
monitoring, and stream of variations. Term projects.

IOE 588 (ME 588) (Mfg 588). Assembly Modeling for Design and
Manufacturing
Prerequisites: ME 381 and ME 401 or equivalent. (3 credits)
Assembly on product and process. Assembly representation. Assembly
sequence. Datum flow chain. Geometric Dimensioning & Tolerancing. Tolerance
analysis. Tolerance synthesis. Robust design. Fixturing. Joint design and joining

Additional Recommended Statistical Courses

Stat500 -- Applied Statistics
Stat503 -- Applied Multivariate Analysis
Stat406 -- Introduction to Statistical Computing

Projects, Research, and Seminars

IOE 590. Masters Directed Study, Research, and Special Problems
Prerequisite: graduate standing or permission of instructor. (2-4 credits)

Updated 7/24/2013