



*University of Missouri-Rolla*

*Course Descriptions*

*UMR-USC Graduate Program in  
Systems Engineering*

*The Boeing Company*

## University of Missouri-Rolla (UMR) Course Descriptions

### Core

#### **Emgt 368 Systems Engineering Analysis I**

The concepts of Systems Engineering, provides the basic knowledge and tools of transforming an operational need into a defined system configuration through the interactive process of analysis, system integration, synthesis, optimization and design. These tools and concepts are reinforced with projects and case studies. Prerequisite: Graduate or senior standing

#### **Emgt 468 Systems Engineering Analysis II**

Advanced concepts of Systems Engineering, provides the advanced knowledge and tools of transforming an operational need into a defined system configuration through the interactive process of analysis, system integration, synthesis, optimization and design. These tools and concepts are reinforced with projects and case studies. Prerequisite: Graduate standing and Emgt 368.

#### **Emgt 469 Systems Architecting**

The objective of the course is to provide the basic tools and concepts of systems architecting for complex systems design and operations. The following topics are covered; The need for the architect and architecting teams, The process of architecting, Architecting methods, Design of architects, The Architect's Role during System Life Cycle. Prerequisite: Graduate standing

#### **Emgt 408 Advanced Engineering Economy**

The analyses of capital expenditures, multi-outcome considerations: risk and uncertainty, and cost of risk. The study of utility theory, dispersed service lives, expansion and economic package concepts, implementation, control, and follow-up of capital expenditures, mathematical programming uncertainty, game theory, model building and simulation, queuing evaluations for capital planning. Prerequisite: Emgt 209 or 308

#### **Emgt 314 Management for Engineers**

The transition of the engineer to manager; planning and organizing technical activities; selecting and managing projects; team building and motivation; techniques of control and communication; time management. Prerequisite: Senior or Graduate standing; students who have taken Emgt 211 cannot enroll in this course.

#### **Emgt 361 Project Management**

Organization structure and staffing; motivation, authority and influence; conflict management; project planning; network systems; pricing, estimating, and cost control; proposal preparation; project information systems; international project management. Prerequisite: Emgt 211.

## UMR Specialty Courses by Track

### Artificial/Computational Intelligence/Robotics

#### Computational Intelligence

#### **Emgt 378 Introduction to Neural Networks & Applications**

Introduction to artificial neural network architectures, adaline, madaline, back propagation, BAM, and Hopfield memory, counter-propagation networks, self organizing maps, adaptive resonance theory, are the topics covered. Students experiment with the use of artificial neural networks in engineering through semester projects. Prerequisite: Math 204 or 229. (co-listed with CS 378, El Eng 368)

#### **Emgt 476 Advanced Engineering Management Science**

Solving of managerial problems utilizing management science techniques. Problems are analyzed, modeled and solved using such techniques as linear, goal, dynamic, programming, simulation, statistical analysis or other non-linear methods. Prerequisite: Graduate standing or Emgt 382.

#### **Emgt 478 Advanced Neural Networks**

Intelligent system architectures, advanced neural networks paradigms; ARTMAP, CMAC, fuzzy logic, associative memory, hierarchical networks, radial basis functions, adaptive heuristic critic for solving product design, process planning and control, scheduling, feature identification and assembly problems in building autonomous manufacturing systems. Prerequisite: Emgt 378 or equivalent neural network course.

#### **Emgt 479 Smart Engineering System Design**

The course covers the emerging technologies for the design of Smart Engineering Systems, namely; evolutionary programming, fuzzy logic, wavelets, chaos and fractals are introduced. Integration of these techniques for designing Smart Engineering Systems are stressed through a design project. Prerequisite: Emgt 378 or equivalent neural network course.

#### **CS 345 Introduction to Robotic Systems**

Analysis of methods of the design and operation of robotic systems. Identification of three-dimensional objects using digitized images. Arm control: coordinate transformations, feedback control systems, and hardware components. Applications of distributed micro-computers to robotic control. Command languages and job assignments. Prerequisite: Math 22, Physics 24, (CS 158 or CS 228).

#### **CS 347 Introduction to Artificial Intelligence Programming**

A study of LISP, PROLOG and other special object oriented computer languages for developing intelligent software. In addition knowledge abstraction and representation, searching, backtracking, recursion, and pruning will be presented. A substantial project in expert systems is required. Prerequisite: CS 253

## **Computational Intelligence (Continued)**

### **CS/ Emgt 404 Data Mining and Knowledge Discovery**

Data mining and knowledge discovery utilizes both classical and new algorithms, such as machine learning and neural networks, to discover previously unknown relationships in data. Key data mining issues to be addressed include knowledge representation and knowledge acquisition (automated learning). Prerequisite: CS 304 or 347, Stat 215.

### **CS 447 Advanced Topics in Artificial Intelligence**

Objectives of work in artificial intelligence simulation of cognitive behavior and self-organizing systems. Heuristic programming techniques including the use of list processing languages. Survey of examples from representative application areas. The mind-brain problem and the nature of intelligence. Class and individual projects to illustrate basic concepts. Prerequisite: CS 347

### **Data Mining**

### **CS 303 Multi Media Systems**

This course introduces the concepts and components of Multimedia information systems. Topics include: Introduction to Multimedia Data, Multimedia Data Compression, Techniques and Standards, Indexing and Retrieval, Data Storage Organization, Communication and Synchronization, Applications-Media-OnDemand Systems, Video Conferencing, Digital Libraries. Prerequisite: CS 153

### **CS 304 Data Base Systems**

Fundamental concepts of data base including a history of development, definition of terms, functional requirements of complex data structures, data base administrator functions, privacy-confidentiality issues, and future directions. Case studies are coordinated with a detailed examination of several commercially available systems. Prerequisite: CS 238 or 274 and CS 158.

### **CS 347 Introduction to Artificial Intelligence Programming**

A study of LISP, PROLOG and other special object oriented computer languages for developing intelligent software. In addition knowledge abstraction and representation, searching, backtracking, recursion, and pruning will be presented. A substantial project in expert systems is required. Prerequisite: CS 253

### **CS/ Emgt 404 Data Mining and Knowledge Discovery**

Data mining and knowledge discovery utilizes both classical and new algorithms, such as machine learning and neural networks, to discover previously unknown relationships in data. Key data mining issues to be addressed include knowledge representation and knowledge acquisition (automated learning). Prerequisite: CS 304 or 347, Stat 215.

### **CS 408 Object-Oriented Database Systems**

This course will include a study of the origins of object oriented database manipulation languages, their evolution, currently available systems, application to the management of data, problem solving using the technology, and future directions. Prerequisite: CS 308 and Database Systems.

### **CS 447 Advanced Topics in Artificial Intelligence**

Objectives of work in artificial intelligence simulation of cognitive behavior and self-organizing systems. Heuristic programming techniques including the use of list processing languages. Survey of examples from representative application areas. The mind-brain problem and the nature of intelligence. Class and individual projects to illustrate basic concepts. Prerequisite: CS 347.

## **Communication Systems**

### **Communication and Signal Processing**

#### **EE 243 Communication Systems**

Signals and their spectra; signal filtering; amplitude, angle and pulse modulation; multiplexing; noise in communications systems.

Prerequisite: El Eng 265.

#### **EE 341 Digital Signal Processing**

Spectral representations, sampling, quantization,  $z$  - transforms, digital filters and discrete transforms including the Fast Fourier transform. Prerequisite: EE 267.

#### **EE 343 Communications Systems II**

Random signals and their characterization; noise performance of amplitude, angle and pulse modulation systems; digital data transmission; use of coding for error control. Prerequisite: EE 243.

#### **EE 345 Digital Image Processing**

Fundamentals of human perception, sampling and quantization, image transforms, enhancement, restoration, channel and source coding. Prerequisite: EE 267.

#### **EE 347 Machine Vision**

Image formation, image filtering, template matching, histogram transformations, edge detection, boundary detection, region growing and pattern recognition. Complementary laboratory exercises are required. Prerequisite: CPE 111 and preceded or accompanied by EE 267.

#### **EE 441 Digital Signal Processing II**

Effects of discrete noise sources in digital signal processing; discrete spectral analysis of random signals; discrete time signal detection, estimation, and filtering algorithms. Prerequisite: EE 341 and 343 or 443 or Stat 343.

#### **EE 443 Statistical Signal Analysis**

Probability and random processes, correlation functions, power spectral density, orthogonal series expansions of random processes, linear systems with random inputs, weiner and matched filters, nonlinear systems with random inputs. Prerequisite: EE 243.

#### **Stat 414 Statistical Time Series Analysis**

A formal introduction to the fundamentals of statistical modeling and analysis of discrete time series. Topics include autoregressive and moving average processes, ARMA models, second order stationarity, vector processes, autocorrelation function, Fourier representation, estimation and prediction of time series. Prerequisite: Stat 343 and Math 203 or 208.

## **Control Systems**

### **Control Systems**

#### **EE 231 Control Systems**

Formulation of the control problem, system equations and models, frequency, time, and state space analysis and design of linear control systems. Prerequisite: El Eng 267.

#### **EE 331 Digital Control**

Analysis and design of digital control systems. Review of  $z$  transforms; root locus and frequency response methods; state space analysis and design techniques; controllability, observability and estimation. Examination of digital control algorithms. Prerequisite: EE 231, 267.

#### **EE 333 System Simulation and Identification**

Computationally efficient methods of digital simulation of linear systems. Non-parametric identification. Parametric identification with least squares and recursive least squares algorithms. Algorithms programmed using MATLAB. Prerequisite: EE 231, 267.

#### **EE 337 Neural Networks for Control**

Introduction to artificial neural networks and various supervised and unsupervised learning techniques. Types of neural nets architecture used in control. Identification and adaptive control using neural networks. Case studies and laboratory projects. Prerequisite: EE 231.

#### **EE 432 Optimal Control and Estimation**

Review of linear quadratic regulators (LQR), LQR extensions; constraint optimization (Pontragin's minimum principle); review of probability theory and random processes; optimal prediction and filters; frequency domain properties of LQR and Kalman filters; linear quadratic Gaussian (LQG) control; model uncertainties, frequency shaping, LQR/LTR design methodology. Prerequisite: EE 431.

#### **EE 438 Robust Control Systems**

Performance and robustness of multivariable systems, linear fractional transformations, LQG/LTR advanced loop shaping, Youla parameterization,  $H_\infty$  optimal control, mixed  $H_2$  and  $H_\infty$  control, controller synthesis for multiple objective optimal control, linear matrix inequalities theory and case studies. Prerequisite: EE 435.

## **Economic Decision Analysis**

### **Economic Decision Analysis**

#### **Emgt 322 Accounting for Engineering Management**

Study of accounting principles, procedures, and the application of accounting principles to management planning, control and decision making. Includes financial statement analysis and cost and budgetary procedures.

#### **Emgt 332 Engineering Cost Accounting**

Analysis and design of job, process and standard cost accounting methods in manufacturing environment, interrelationship of cost accounting methods, and justification of automation in a technological setting. Prerequisite: Senior or Graduate standing.

#### **Emgt 352 Activity Based Accounting and Financial Decision**

This course reviews the fundamentals of activity based accounting and financial decision making.

#### **Emgt 452 Advanced Financial Management**

Principles of financial organization and management in the technological enterprise; demands for funds; internal and external supply of funds; budgetary control; reserve and dividends policy. Emphasizes systems approach and problems of engineering design and automation as they influence financial decisions. Prerequisite: Emgt 322.

#### **Stat 346 Regression Analysis**

Simple linear regression, multiple regression, regression diagnostics, multicollinearity, measures of influence and leverage, model selection techniques, polynomial models, regression with autocorrelated errors, introduction to non-linear regression. Prerequisite: Math 22 and one of Stat 211, 213, 215, 217, or 343. (Co-listed with CS 366).

## **Engineering Management**

### **Integrated Enterprise**

#### **Emgt 333 Management Information Systems**

Study of the operational and managerial information needs of an organization. Emphasis is on the information needed throughout an organization and on information systems to meet those needs.

Prerequisite: Senior or Graduate standing.

#### **Emgt 352 Activity Based Accounting and Financial Decision**

This course reviews the fundamentals of activity based accounting and financial decision making.

#### **Emgt 354 Integrated Process Development**

Emphasize design policies of concurrent engineering and teamwork, and documenting of design process knowledge. Integration of various product realization activities covering important aspects of a product life cycle such as "customer" needs analysis, concept generation, concept selection, product modeling, process development, DFX strategies, and end-of product life options. Prerequisite: Senior or Graduate standing.

#### **Emgt 366 Business Logistics Systems Analysis**

An analysis of logistics function as a total system including inventory, transportation, order processing, warehousing, material handling, location of facilities, customer service, and packaging with trade-off and interaction. Prerequisite: Stat 213 or 215.

#### **Emgt 433 Advanced Management Information System**

Advanced topics in management information systems such as information resource management, group decision support systems, knowledge based systems, and communication systems. Prerequisite: Emgt 333

#### **Emgt 451 Advanced Marketing Management**

Study of marketing decision areas in the technically based firm, including product selection and development, marketing research, market development, distribution, advertising, and promotion. Pricing policies including legal aspects and problems in selecting, training and controlling field sales force. Examination of interaction within consumer and industrial marketing environments. Prerequisite: Emgt 314, Econ 122.

#### **Emgt 454 Advanced Production Management**

Examination of responsibilities of production manager in the technological enterprise for providing finished goods to meet the quality, price, quantity and specification needs of the market place. Study of functions of production manager. Quantitative approach to decision making in production management. Prerequisites: Senior or graduate standing and advanced mathematical modeling competence. Prerequisite: Senior or Graduate standing and advanced mathematical modeling competence.

## Technology Management

### **Emgt 320 Technical Entrepreneurship**

Student teams develop a complete business plan for a company to develop, manufacture and distribute real technical/product service. Lectures & business fundamentals, patents, market/ technical forecasting, legal and tax aspects, venture capital, etc., by instructor and successful technical entrepreneurs. Prerequisite: Senior or graduate standing. Prerequisite: Senior or Graduate standing.

### **Emgt 327 Legal Environment**

Study of the effect of the legal environment on the decisions which the engineering manager must make. The course investigates the social forces that produced this environment and the responsibilities incumbent upon the engineer.

### **Emgt 354 Integrated Process Development**

Emphasize design policies of concurrent engineering and teamwork, and documenting of design process knowledge. Integration of various product realization activities covering important aspects of a product life cycle such as "customer" needs analysis, concept generation, concept selection, product modeling, process development, DFX strategies, and end-of product life options. Prerequisite: Senior or Graduate standing.

### **Emgt 420 Technological Innovation Management**

Technological innovation is new technology creating new products and services. This course studies the issues of managing technological innovation under four topics: 1) Innovation; 2) New Ventures; 3) Corporate Research and 4) R&D Infrastructure.

### **Emgt 441 Case Studies in General Management**

A quantitative study of engineering management problems related to the functioning of the industrial enterprise through case studies. Prerequisite: Preceded or accompanied by Emgt 400 level course.

## Flight Systems

## Integrated Flight and Control Systems

### **EE 331 Digital Control**

Analysis and design of digital control systems. Review of z transforms; root locus and frequency response methods; state space analysis and design techniques; controllability, observability and estimation. Examination of digital control algorithms. Prerequisite: EE 231, 267.

### **AE 353 Aeroelasticity**

Study of phenomena involving interactions among inertial, aerodynamic, and elastic forces and the influence of these interactions on aircraft and space vehicle design. Some aeroelastic phenomena are: divergence, control effectiveness, control reversal, flutter, buffeting, dynamic response to rapidly applied loads, aeroelastic effects on load distribution, and static and dynamic stability. Prerequisite: AE 251 and 271.

### **AE 361 Flight Dynamics - Stability and Control**

Review of static stability, dynamic equations of motion, linearized solutions, classical control design and analysis techniques, introduction to modern control. Prerequisite: AE 261.

### **AE 381 Mechanical and Aerospace Control Systems**

Synthesis of mechanical and aerospace systems to perform specific control functions. Response and stability are studied. Singular value analysis for stability margins is introduced. Prerequisite: AE 361 or ME 279(Co-listed with ME 381).

### **AE 479 Analysis and Synthesis of Mechanical and Aerospace Systems**

A unified treatment of modern system theory for the Mechanical and Aerospace Engineering Controls Analyst, including analysis and synthesis of linear and nonlinear systems, compensation and optimization of continuous and discrete systems, and theory of adaptivity. Prerequisite: AE 381 or ME 381(co-listed with ME 479)

## Structures

### **AE 311 Introduction to Composite Materials & Structures**

Introduction to fiber-reinforced composite materials and structures with emphasis on analysis and design. Composite micromechanics, lamination theory and failure criteria. Design procedures for structures made of composite materials. An overview of fabrication and experimental characterization. Prerequisite: BE 110.

### **AE 334 Theory of Stability I**

Formulation of stability concepts associated with columns, beams, and frames. Applications to some engineering problems utilizing numerical methods. Prerequisite: BE 110;Math 204 and either BE 150 or ME 160.

### **AE 336 Fracture Mechanics**

Linear elastic and plastic mathematical models for stresses around cracks; concept of stress intensity; strain energy release rates; correlation of models with experiment; determination of plane stress and plane strain parameters; application to design. Prerequisite: BE 110.

### **AE 344 Fatigue Analysis**

The mechanism of fatigue, fatigue strength of metals, fracture mechanics, influence of stress conditions on fatigue strength, stress concentrations, surface treatment effects, corrosion fatigue and fretting corrosion, fatigue of joints components and structures, design to prevent fatigue. Prerequisite: BE 110.

### **AE 352 Finite Element Approximation I -An Introduction**

Variational statement of a problem. Galerkin Approximation, finite element basis functions and calculations, element assembly, solution of equations boundary conditions, interpretation of the approximation solution, development of a finite element program, two-dimensional problems. Prerequisite: Math 204.

### **AE 408 Finite Element Approximation II - Second Course**

Continuation of Finite Element Approximation I - An Introduction: element selection and interpolation estimates, Lagrange, Hermite, and Isoparametric elements; mixed, hybrid, penalty and boundary elements; eigenvalue and time-dependent problems; three-dimensional and nonlinear problems). Prerequisite: EM 307 or ME 312 or AE 352.

## Structures Continued

### **AE 484 Analysis of Laminated Composite Structures**

An overview of isotropic beams, plates, and shells. Bending, vibration, and buckling of laminated composite beams and plates: exact and approximate solutions. Development of composite shell theory and simplified solutions. Analysis of composite structures including transverse shear deformation and thermal effects. Prerequisite: EM 381 or ME 382 or AE 311.

### **AE 485 Mechanics of Composite Materials**

Effective moduli of spherical, cylindrical and lamellar systems. Micromechanics of fiber-matrix interfaces and unidirectional composites. Application of shear lag and other approximate theories to interfaces and composites including fiber pull-out, debonding and matrix cracking. Prerequisite: EM 381 or ME 382 or AE 311.

### **AE 487 Finite Element Approximation III - Nonlinear Problems**

Formulation of nonlinear problems, iterative methods, solution of nonlinear problems, cover topics of interest to the class. Prerequisite: EM 408 or ME 408 or AE 408.

### **EM 436 Advanced Fracture Mechanics**

Mathematical theories of equilibrium cracks and brittle fracture; mathematical analysis of elastic-plastic fracture mechanics, COD, R-curve and J-integral analysis. Prerequisite: AE 336 or EM 336 or ME 336.

## Human Factors

### Human Factors

### **Emgt 380 Work Design**

The design process, work measurement, methods study and methods design. Prerequisite: Senior or Graduate standing.

### **Emgt 386 Safety Engineering Management**

Principles of safety engineering applied to industrial situations; job safety analysis and specifications of solutions; reduction of accident rates, frequency and costs; protective equipment, jugs, fixtures and standards; rules, regulations and law. Prerequisite: Junior standing in engineering or engineering management. Prerequisite: Senior or Graduate standing.

### **Psych/ Emgt 311 Human Factors**

An examination of human-machine systems and the characteristics of people that affect system performance. Topics include applied research methods, systems analysis, and the perceptual, cognitive, physical and social strength and limitations of human beings. The focus is on user-centered design of technology. Prerequisite: Psych 50.

## Information Systems and Computer Architecture

### Computer Systems

### **CS 384 Array Formalisms for Massively Parallel High Performance Computing I**

Uniprocessors and networks of homogeneous workstations will be platforms studied. The purpose of this course is to teach techniques needed to analyze algorithms that are ideal for High Performance Computing and Communications. Prerequisite: CS 284 and 253.

### **CS 385 Computer Communications and Networks**

Network architecture model including physical protocols for data transmission and error detection/correction, data link concepts, LAN protocols, internetworking, reliable end to end service, security, and application services. Students will implement course concepts on an actual computer network. Prerequisite: CS 284 and 158.

### **CS 387 Parallel Processing: Architectures, Languages and Algorithms**

Introduction to parallel (concurrent) processing. Topics will include parallel computer architectures, programming languages, which support parallel processing and parallel algorithms. Special emphasis will be placed on the design, analysis and implementation of parallel algorithms. Prerequisite: CS 284 and 355.

### **CS 485 Distributed Systems Theory and Analysis**

Analysis of the problems of state maintenance and correctness in concurrent systems using formal methods such as Hoare Logic and Temporal Logic applied to agreement problems, serializability theory, and consistency for database systems, file systems, and responsive computing systems. Prerequisite: CS 385 or CS 387 or CS 158.

### **CS 487 New Trends in Massively Parallel Computing**

The study of exploiting the potential parallelism of massively parallel computers, state-of-the-art multiprocessor architectures and languages. Topics from current research include design and analysis of efficient parallel algorithms, task partitioning and load balancing, topological embeddings, and reconfigurable mesh algorithms. Prerequisite: CS 387.

## **Information Systems**

### **CS 303 Multi Media Systems**

This course introduces the concepts and components of Multimedia information systems. Topics include: Introduction to Multimedia Data, Multimedia Data Compression, Techniques and Standards, Indexing and Retrieval, Data Storage Organization, Communication and Synchronization, Applications-Media-On Demand Systems, Video Conferencing, Digital Libraries. Prerequisite: CS 153.

### **CS 304 Data Base Systems**

Fundamental concepts of data base including a history of development, definition of terms, functional requirements of complex data structures, data base administrator functions, privacy-confidentiality issues, and future directions. Case studies are coordinated with a detailed examination of several commercially available systems. Prerequisite: CS 238 or 274 and CS 158.

### **CS/ Emgt 404 Data Mining and Knowledge Discovery**

Data mining and knowledge discovery utilizes both classical and new algorithms, such as machine learning and neural networks, to discover previously unknown relationships in data. Key data mining issues to be addressed include knowledge representation and knowledge acquisition (automated learning). Prerequisite: CS 304 or 347 or Stat 215.

### **CS 408 Object-Oriented Database Systems**

This course will include a study of the origins of object oriented database manipulation languages, their evolution, currently available systems, application to the management of data, problem solving using the technology, and future directions. Prerequisite: CS 308 and Database systems.

## **Software Engineering**

### **CS 304 Data Base Systems**

Fundamental concepts of data base including a history of development, definition of terms, functional requirements of complex data structures, data base administrator functions, privacy-confidentiality issues, and future directions. Case studies are coordinated with a detailed examination of several commercially available systems. Prerequisite: CS 238 or 274 and CS 158.

### **CS 306 Software Engineering I**

Development of methodologies useful in the software engineering classical life cycle. This includes: requirements, design, implementation, and testing phases. These methodologies are reinforced through utilization of a CASE tool and a group project. Prerequisite: CS 253.

### **CS 307 Software Testing and Quality Assurance**

It covers unit testing, subsystem testing, system testing, object-oriented testing, testing specification, test case management, software quality factors and criteria, software quality requirement analysis and specification, software process improvement, and software total quality management. Prerequisite: CS 253.

### **CS 308 Object Oriented Analysis and Design**

This course will explore principles, mechanisms, and methodologies in object-oriented analysis and design. An object-oriented programming language will be used as the vehicle for the

exploration. Prerequisite: CS 253.

### **CS 401 B Computer Security**

The course deals with various kinds of intrusions and threats for computers in a network and ways of combating them. Topics include: Intruders, worms, viruses, cryptography, firewalls, authentication and access control.

### **CS 406 Software Engineering II**

A quantitative approach to measuring costs/productivity in software projects. The material covered will be software metrics used in the life cycle and the student will present topical material. Prerequisite: CS 306

## **Manufacturing Systems**

### **Manufacturing Systems**

### **Emgt 334 Computer Integrated Manufacturing Systems**

Study of the design and use of computer-based integrated manufacturing management systems in the allocation and control of plant, equipment, manpower, and materials. Prerequisite: Emgt 282

### **Emgt 354 Integrated Process Development**

Emphasize design policies of concurrent engineering and teamwork, and documenting of design process knowledge. Integration of various product realization activities covering important aspects of a product life cycle such as "customer" needs analysis, concept generation, concept selection, product modeling, process development, DFX strategies, and end-of-product life options. Prerequisite: Senior Or Graduate Standing.

### **Emgt 364 Value Analysis**

An organized effort directed at analyzing the hardware and processes used in manufacturing a product to achieve the required product function at the lowest overall cost. Covers the basic philosophy, methodology and procedures which draw together and utilize techniques from various fields. It is a logical method used in solving value problems. Prerequisite: Senior Or Graduate Standing.

### **Emgt 372 Production Planning and Scheduling**

Introduction to basic techniques of scheduling, manufacturing planning and control, just-in-time systems, capacity management, master production scheduling, single machine processing, constructive Algorithms for flow-shops, scheduling heuristics, intelligent scheduling systems are the topics covered. Prerequisite: Emgt 282.

### **Emgt 385 Statistical Process Control**

The theoretical basis of statistical process control procedures is studied. Quantitative aspects of SPC implementation are introduced in context along with a review of Deming's principles of quality



improvement and a brief introduction to sampling inspection. Prerequisite: Stat 213 or 215.

### **Manufacturing Systems Cont.**

#### **ME 308 Rapid Product Design and Optimization**

Product Life cycle design; Finding design solutions using optimization technique; Rapid product realization using rapid prototyping and virtual prototyping techniques. Prerequisite: ME 208.

#### **ME 355 Automation in Manufacturing**

Current topics in manufacturing automation. Areas covered include: fixed automation, flexible automation, CNC devices, process planning and part programming, group technology, factory networks, and computer integrated manufacturing. Prerequisite: ME 253.

#### **Met Eng 377 Principles of Engineering Materials**

Examination of engineering materials with emphasis on selection and application of materials in industry. Particular attention is given to properties and applications of materials in extreme temperature and chemical environments. A discipline specific design project is required.

#### **Emgt 454 Advanced Production Management**

Examination of responsibilities of production manager in the technological enterprise for providing finished goods to meet the quality, price, quantity and specification needs of the market place. Study of functions of production manager. Quantitative approach to decision making in production management. Prerequisites: Senior or graduate standing and advanced mathematical modeling competence. Prerequisite: Senior Or Graduate Standing and advanced mathematical modeling competence.

#### **ME 459 Advanced Topics in Design and Manufacturing**

Various topics in the area of design and manufacturing will be covered in this course: development of flexible manufacturing systems, CAD/CAM integration, rapid prototyping, etc. Prerequisite: ME 355.

### **Multimedia**

#### **CS 303 Multi Media Systems**

This course introduces the concepts and components of Multimedia information systems. Topics include: Introduction to Multimedia Data, Multimedia Data Compression, Techniques and Standards, Indexing and Retrieval, Data Storage Organization, Communication and Synchronization, Applications-Media-OnDemand Systems, Video Conferencing, Digital Libraries. Prerequisite: CS 153.

#### **CS 304 Data Base Systems**

Fundamental concepts of data base including a history of development, definition of terms, functional requirements of complex data structures, data base administrator functions, privacy-confidentiality issues, and future directions. Case studies are coordinated with a detailed examination of several commercially available systems. Prerequisite: CS 238 or 274 and CS 158.

#### **CS 342 JAVA GUI and Visualization**

Fundamentals of Java Swing Foundation Classes, Java System Language Specifics, Graphical User Interfaces, Images, Audio, Animation, Networking, and Threading. Visualization of Algorithms. GUI Elements include Event Driven Programming, Interaction with Mouse and KeyBoard, Window Managers, Frames, Panels, Dialog Boxes, Borders. Prerequisite: CS 253 or equivalent.

#### **CS 343 Interactive Computer Graphics**

Applications and functional capabilities of current computer graphics systems. Interactive graphics programming including windowing, clipping, segmentation, mathematical modeling, two and three dimensional transformations, data structures, perspective views, antialiasing and software design. Prerequisite: Cs 228 and 253.

#### **CS 412 Web Data Management and XML**

Introduction to semi-structured data, XML, DTD, XML schema, DOM, XSLT, XML indexing and other web data management techniques.

#### **CS 401 A Mobile and Distributed Data Access (Winter 2003)**

Mobile computing architectures, location management, transaction processing and replication control in mobile computing, security and fault-tolerance issues, mobile caching and broadcasting.

#### **CS 408 Object-Oriented Database Systems**

This course will include a study of the origins of object oriented database manipulation languages, their evolution, currently available systems, application to the management of data, problem solving using the technology, and future directions. Prerequisite: CS 308 and Database Systems.

#### **CS 443 Computer Graphics and Realistic Modeling**

Algorithms, data structures, software design and strategies used to achieve realism in computer graphics of three-dimensional objects. Application of color, shading, texturing, antialiasing, solid modeling, hidden surface removal and image processing techniques. Prerequisite: CS 343.

## **Quality & Reliability Engineering**

### **Quality Engineering**

#### **Emgt 364 Value Analysis**

An organized effort directed at analyzing the hardware and processes used in manufacturing a product to achieve the required product function at the lowest overall cost. Covers the basic philosophy, methodology and procedures which draw together and utilize techniques from various fields. It is a logical method used in solving value problems. Prerequisite: Senior Or Graduate Standing.

#### **Emgt 375 Total Quality Management**

Examination of various quality assurance concepts and their integration into a comprehensive quality management system: statistical techniques, FMEA's, design reviews, reliability, vendor qualification, quality audits, customer relations, information systems, organizational relationships, motivation. Prerequisite: Senior Or Graduate Standing.

#### **Emgt 381 Management and Methods in Reliability**

Study of basic concepts in reliability as they apply to the efficient operation of industrial systems. Prerequisite: Stat 213 or 215 or 343.

#### **Emgt 385 Statistical Process Control**

The theoretical basis of statistical process control procedures is studied. Quantitative aspects of SPC implementation are introduced in context along with a review of Deming's principles of quality improvement and a brief introduction to sampling inspection. Prerequisite: Stat 213 or 215.

#### **Emgt 387 Experimentation in Engineering Management**

The techniques for planning and analyzing industrial experiments are introduced with emphasis on their application to the design, development, and production of quality goods and services. Prerequisite: Stat 213 or 215.

#### **Emgt 475 Quality Engineering**

This course is an examination of the theory and practice of quality engineering with particular emphasis on the work of Genichi Taguchi. The application of the quality loss function, signal to noise ratio and orthogonal arrays is considered in-depth for generic technology development; system, product and tolerance design; and manufacturing process design. The emphasis of the course is off-line quality control. Prerequisite: Emgt 375 and Math 229 or equivalent.

#### **Stat 444 Design and Analysis of Experiments**

Experimental designs and their statistical analysis. Includes completely randomized designs, complete and incomplete blocking designs, factorial and fractional factorial experiments, multiple comparisons, response surface analysis. Prerequisite: One of Stat 343, 353 or Emgt 387 and one Stat 211,213,215,217.

## **Reliability**

#### **EE 317 Fault-Tolerant Digital Systems**

Design and analysis of fault-tolerant digital systems. Fault models, hardware redundancy, information redundancy, evaluation techniques, system design procedures.

#### **EE 403 Power System Reliability**

Reliability definition and measures. Probability concepts and Markov chains. Failure models and availability models. Generator system reliability. Loss of load probability method. Evaluation of transmission network reliability. Analysis of the electric power system reliability. Prerequisite: Stat 343 or EE 343.

#### **Emgt 381 Management and Methods in Reliability**

Study of basic concepts in reliability as they apply to the efficient operation of industrial systems. Prerequisite: Stat 213 or 215 or 343.

#### **Stat 470 Theory of Reliability**

Statistical analyses of life-testing distributions such as the Weibull, gamma, exponential, logistic, and normal. Reliability estimation, tolerance limits, censored sampling, and applications of Monte-Carlo simulation. Prerequisite: Stat 344.

## **Software Systems**

### **Computational Software Systems**

#### **CS 328 Object Oriented Numerical Modeling I**

A study of object-oriented modeling of the scientific domain. Techniques and methodologies will be developed enabling the student to build a class library of reusable software appropriate for scientific application. Applications will be drawn from mechanics, finance, and engineering. Prerequisite: CS 228 and CS 153.

#### **CS 329 Numerical Linear Algebra**

A survey of the state-of-the-art problem-solving numerical techniques. Topics will include: direct and iterative methods for linear and non-linear equations, optimization, eigenvalue problem finite element methods, Multigrid method, parallel numerical algorithms. Prerequisite: CS 228 or Advanced calculus.

#### **CS 355 Analysis of Algorithms**

The purpose of this course is to teach the techniques needed to analyze algorithms. The focus of the presentation is on the practical application of these techniques to such as sorting, backtracking, and graph algorithms. Prerequisite: Cs 253.

#### **CS 422 Numerical Differential Equations**

The numerical solution of ordinary and partial differential equations, boundary value problems, eigenvalue problems, stability and convergence of current numerical methods solution of applied problems on digital computers. Prerequisite: CS 328 or CS 329.

#### **CS 428 Parallel Numeric Algebra**

A survey of the state-of-the-art computational methods of linear algebra and their parallel implementations; theory of matrices in numerical analysis, direct and iterative methods of solving systems of linear equations, eigenvalue problems, gradient methods, parallel algorithms. Prerequisite: CS 328 or CS 329.

### **Software Engineering**

#### **CS 304 Data Base Systems**

Fundamental concepts of data base including a history of development, definition of terms, functional requirements of complex data structures, data base administrator functions, privacy-confidentiality issues, and future directions. Case studies are coordinated with a detailed examination of several commercially available systems. Prerequisite: CS 238 or 274 and CS 158.

#### **CS 306 Software Engineering I**

Development of methodologies useful in the software engineering classical life cycle. This includes: requirements, design, implementation, and testing phases. These methodologies are reinforced through utilization of a CASE tool and a group project. Prerequisite: CS 253.

#### **CS 307 Software Testing and Quality Assurance**

It covers unit testing, subsystem testing, system testing, object-oriented testing, testing specification, test case management, software quality factors and criteria, software quality requirement analysis and

specification, software process improvement, and software total quality management. Prerequisite: CS 253.

#### **CS 308 Object Oriented Analysis and Design**

This course will explore principles, mechanisms, and methodologies in object-oriented analysis and design. An object-oriented programming language will be used as the vehicle for the exploration. Prerequisite: CS 253.

#### **CS 401 B Computer Security**

The course deals with various kinds of intrusions and threats for computers in a network and ways of combating them. Topics include: Intruders, worms, viruses, cryptography, firewalls, authentication and access control.

#### **CS 406 Software Engineering II**

A quantitative approach to measuring costs/productivity in software projects. The material covered will be software metrics used in the life cycle and the student will present topical material. Prerequisite: CS 306

## **Systems & Design Optimization**

### **Engineering Design and Optimization**

#### **Math 303 Mathematical Modeling**

Model construction and the modeling process, model fitting, models requiring optimization, empirical model construction, modeling dynamic behavior. Individual and team projects. Prerequisite: Math 204 or 229, Programming competency.

#### **Emgt 356 Industrial Systems Simulation**

Simulation modeling of manufacturing and service operations through the use of computer software for operational analysis and decision making. Prerequisite: Stat 213 or 215.

#### **Emgt 374 Engineering Design Optimization**

This course is an introduction to the theory and practice of optimal design as an element of the engineering design process. The use of optimization as a tool in the various stages of product realization and management of engineering and manufacturing activities is stressed. The course stresses the application of nonlinear programming methods. Prerequisite: Math 204 or 229.

#### **Emgt 465 Mathematical Programming**

Techniques for modeling decision-making problems using appropriate mathematical models of linear, integer, combinatorial, or nonlinear programming. Modeling techniques will be illustrated with examples. A comprehensive treatment of applicable algorithms to solve wide varieties of mathematical programming models will be provided. Prerequisite: Stat 213 or equivalent and Emgt 382 or Math 203 or 208.

#### **Emgt 476 Advanced Engineering Management Science**

Solving of managerial problems utilizing management science techniques. Problems are analyzed, modeled and solved using such techniques as linear, goal, dynamic, programming, simulation, statistical analysis or other non-linear methods. Solutions will involve the use of personal or mainframe computers. A study of the current

literature in management science will also be conducted. Prerequisite:  
Emgt 382 or Graduate Standing.

## **For More Information, please contact:**

### **Dr. Cihan Dagli,**

Professor Systems Engineering Program Director  
Engineering Management Coordinator of Graduate  
Academic Affairs  
University of Missouri-Rolla  
229 Engineering Management Department  
Rolla, MO 65409-0370

Phone: 573-341-4374

Fax: 573-341-6268

Email: [dagli@umr.edu](mailto:dagli@umr.edu)

## **Admission and Degree Programs**

### **Dr. Mariesa Crow**

Associate Dean, Graduate Affairs and Research  
School Of Engineering  
University Of Missouri-Rolla.  
Phone: 573-341-4149  
Fax: 573-341-4979  
E-mail: [crow@ece.umr.edu](mailto:crow@ece.umr.edu)

### **Systems Engineering Graduate Program Office**

Department of Engineering Management

University of Missouri-Rolla

Phone: 573-341-7211

Fax: 573-341-7238

Email: [syseng@umr.edu](mailto:syseng@umr.edu)

### **Video Communication Center**

Video Communication Center

University of Missouri-Rolla

Phone: 573-341-6490

Fax: 573-341-6993

Email: [vcchelp@umr.edu](mailto:vcchelp@umr.edu)