

ENGINEERING DESIGN (EDSGN)

EDSGN 507: Systems Thinking

3 Credits

The theory and practice of systems thinking. General systems theory; system dynamics, emergent properties, structure, feedback and leverage.

Cross-listed with: SYSEN 507

EDSGN 547: Designing for Human Variability

3 Credits

Statistics, optimization, and robust design methodologies to design products and environments that are robust to variability in users.

Cross-listed with: ME 547

EDSGN 548: Interaction Design

3 Credits

Strategies in user-centered design, ergonomic product analysis, statistical data analysis, low and high fidelity prototyping, and innovative design techniques. EDSGN 548 Interaction Design (3) Interaction Design provides an integrative perspective on the types of human-centered design techniques that can be used to analyze existing consumer products and develop innovative solutions. In this class, students will learn qualitative (e.g., observations and surveys) and quantitative methods (e.g., eye tracking and eye tracking) to measure user interactions. This knowledge will be used to develop design recommendations for future products. The material will be presented through a variety of hands-on activities including a semester long interaction design project which requires students to evaluate an existing product using human-centered design techniques, develop solutions based on interaction design principles, prototype solutions, and evaluate their designs in a formal user study. Upon completion of this course, students will be able to identify appropriate research methods (quantitative and qualitative) for guiding interaction design decisions, conduct a user study, and develop design recommendations based on interaction design principles.

Prerequisite: EDSGN 547 or IE 479 or IST 501 or equivalent

Cross-listed with: IE 548

EDSGN 549: Design Decision Making

3 Credits

Complexity of design-making; state-of-the-art methods and tools. EDSGN (IE) 549 Design Decision Making (3) Students in this course will internalize the importance of information and decision-making in design; understand the complexities due to uncertain information, multi-person decision making, technology obsolescence, competitive priorities; become familiar with state-of-the-art methods and tools for design decision-making; and, demonstrate the application of this knowledge in the context of a collaborative design project. Learning in this course will be facilitated in an "apply what you have learned" fashion with ample opportunities for students to demonstrate their learning through in-class participation, discussion of solved problems, hands-on design projects. Strategies, methods, and means of the design process will be discussed

and practiced to include such things as understanding client needs, generating design concepts, and evaluating design ideas.

Cross-listed with: IE 549

EDSGN 558: Systems Design

3 Credits

Systems engineering, principles, practices, and applications of systems engineering in analysis, design, development, integration, verification and validation of complex systems. EDSGN 558 Systems Design (3) The course is intended for engineering students who aspire to careers in systems design and those who wish to broaden their knowledge so as to address systems problems. The principal objectives of this course are: (1) to bring systems theory, systems thinking, systems engineering, and systems management together into a single framework and to integrate them such that successful system design is possible; and (2) to immerse the student in the principles, practices, and application of systems engineering through selected readings, textbook study, lectures, and homework assignments and as members of a multidisciplinary systems development team on a systems design project. The course is designed to immerse students in the principles, practices and application of systems engineering within the design, development, integration and deployment of complex systems. Students will learn the special functions and responsibilities of systems engineers in comparison to analysts, design specialists, test engineers, project managers and other members of the systems development teams. They will acquire the knowledge, skills and mindset necessary to be successful as part of a major system development project and will acquire the leadership, problem-solving and innovation skills necessary for success. The objective of this course is to immerse traditional engineering students in the principles, practices, and application of systems engineering and design through selected readings, textbook studies, lectures, homework assignments, and a team design project. This course begins with an overview of systems engineering as a discipline, which prepares the student for the course topics/modules that follow. The course addresses the "hows" and "whys" of systems analysis, design, and development. Students will: 1) learn how to bridge the gap between capturing user needs and the development of systems by honing skills in the technical activities of systems analysis, systems design, and systems development; 2) learn how to translate abstract visions of the stakeholders and users into a language of specifications, architectures, and designs to direct the system hardware and software development activities resulting in a system that satisfies user needs without latent defects, delivered on schedule, within budget, and profitable for the developing entity; 3) acquire an understanding of systems engineering as a problem-solving solution development discipline that requires a comprehensive understanding of how to analyze systems and how systems are organized, structured, defined, and employed by the user; and, 4) apply the knowledge gained from these lessons toward the analysis, design, and development of a system as members of a multi-disciplinary team.

EDSGN 561: Data Mining Driven Design

3 Credits

The study and application of data mining/machine learning (DM/ML) techniques in multidisciplinary design. CSE 561 / EDSGN 561 / IE 561 / IST 561 Data Mining Driven Design (3) This course examines how theoretical data mining/machine learning (DM/ML) algorithms can be employed to solve large-scale, complex design problems. Knowledge Discovery in Databases (KDD) is the umbrella term used to describe the sequential steps involved in capturing and discovering hidden,

previously unknown knowledge in large databases. The course begins with foundational information regarding engineering design and provides an overview of KDD and the emergence of the digital age. Students will investigate data acquisition and storage techniques where they will learn the difference between stated and revealed data as related to design. Students will construct their own databases and learn essential techniques in data base queries (SQL) and management. Data transformation techniques, such as binning and dimensionality reduction, will be examined in the data transformation section of the course. This course has a design-driven focus, which will enable students to solve real-life design challenges spanning diverse domains. Students will work on project-based exercises aimed at proposing novel data mining algorithms, or employing existing algorithms to solve design problems in fields relating to engineering, healthcare, financial markets, military systems, to name a few. Data visualization techniques will also be studied to help communicate complex data mining models in a timely and efficient manner.

Cross-listed with: CSE 561, IE 561, IST 561

EDSGN 562: Design for Additive Manufacturing

4 Credits

Additive manufacturing (AM, colloquially 3D printing) is rapidly changing the face of modern manufacturing. This layer-by-layer manufacturing approach allows for parts to be created with significant levels of complexity and in cost-effective small batches, with reduced raw material waste when compared with traditional manufacturing processes. This technology has given rise to the need for Design for Additive Manufacturing (DfAM) techniques capable of accounting for both the possibilities and restrictions offered by AM in product design. However, due to the relative youth of the technology, understanding of how to properly establish and evaluate these design considerations is still evolving. In this course, students will be exposed to research in the field of DfAM that aims to establish an understanding of both opportunistic possibilities (e.g., lattice structures, topology optimization, and mass customization) and quantify restrictive limitations (e.g., minimum feature size and support material removal) when designing products for creation with additive manufacturing. The material will be presented through a combination of literature investigations and design exercises viewed through the lens of research in the DfAM field. The objectives of the course include describing the role that DfAM plays in the greater field of additive manufacturing, identifying similarities and differences between existing DfAM approaches and frameworks, synthesizing opportunistic DfAM approaches and how they improve product quality and novelty, identifying and quantifying restrictive DfAM considerations through experimentation, and identifying and discussing key areas of future research to advance the field of DfAM.

CONCURRENT: IE 527

Cross-listed with: AMD 562

EDSGN 571: Compliant Mechanism Design

3 Credits

Compliant mechanisms are devices that exploit mechanical compliance to obtain motion. These devices are frequently seen in organisms and natural systems. In this course, students will gain compliant mechanism design skills transferable to virtually all mechanical design applications. Students will develop the ability to assess design challenges and their compatibility with compliant mechanisms and will improve their mechanical design intuition by understanding the relationships

between flexibility, strength, displacement, and force. Students draw on these principles as they study current research literature, theoretical frameworks, and methodologies, predominantly the pseudo-rigid-body model, to synthesize new knowledge in the field of compliant mechanisms. Students grow their abilities to expand the frontiers of compliant mechanism research as they create new design methods. Students will gain experience in the emerging field of origami-based design. Students' capacity to produce creative scholarly products will be reinforced in compliant mechanism design projects, where students will conceptualize, model, prototype, test, and convey compliant mechanism theories and designs.

EDSGN 581: Engineering Design Studio I

3 Credits

Cross-disciplinary teams learn in a studio environment to consider broad aspects and context of engineering design activities. EDSGN 581 Engineering Design Studio I (3) Students examine engineering design from a broad perspective, including design thinking, systems design, and societal contexts. Students bring together many disparate aspects of their previous engineering and non-engineering experiences and investigate new aspects. The material will be presented through a variety of hands-on activities including design projects. Current and best industry practices will also be examined. This course provides a unique opportunity to explore material from many engineering fields and other disciplines within the context of design. This course is a precursor to Engineering Design Studio II (i.e., EDSGN 582). The course will be taught using a studio model.

EDSGN 582: Engineering Design Studio II

3 Credits

Cross-disciplinary teams in an engineering design studio environment with project emphasis on technical and analytical depth. EDSGN 582 Engineering Design Studio II (3) The course is a continuation of Engineering Design Studio I (i.e., EDSGN 581) and will be conducted using a studio model. The course requires students to bring together the many disparate aspects of their previous engineering and non-engineering experiences. The course material will be presented through a variety of hands-on activities including design projects. Current and best industry practices will also be studied. Students will integrate the depth and breadth of their engineering and personal experiences and focus on analysis and performance prediction throughout the life cycle of the design.

Prerequisite: EDSGN581

EDSGN 585: Engineering Design Portfolio

1 Credits

Preparation of a portfolio summarizing the student's experience with engineering design research and practice. EDSGN 585 Engineering Design Portfolio (1) Industries seeking to fill positions in engineering design frequently ask for a portfolio representing the applicant's work. In this course, students will work with a faculty mentor (i.e., course instructor) to create a design portfolio that reflects the depth of their research and design experience. The portfolio consists of two parts: a detailed white paper or report and a short graphical summary. The graphical summary represents the breadth of the student's experience. Students will reflect on their experiences, identify critical milestones, opportunities for growth, and successes and present these experiences

as vignettes in their portfolio. Those examining this element of the portfolio will gain insight into the growth and talent of the engineering designer it represents. The portfolio is mutually beneficial - for the students and the prospective employer.

Prerequisite: EDSGN582

EDSGN 590: Colloquium

1-3 Credits/Maximum of 3

Continuing seminars that consist of a series of individual lectures by faculty, students, or outside speakers.

EDSGN 594: Research Topics

1-12 Credits/Maximum of 12

Supervised student activities on research projects identified on an individual or small-group basis.

EDSGN 595: Internship

1-9 Credits/Maximum of 9

Supervised off-campus, nongroup instruction, including field experiences, practicums, or internships. Written and oral critique of activity required.

EDSGN 596: Individual Studies

1-9 Credits/Maximum of 9

Creative projects, including nonthesis research, that are supervised on an individual basis and which fall outside the scope of formal courses.

EDSGN 597: Special Topics

1-9 Credits/Maximum of 9

Formal courses given on a topical or special interest subject which may be offered infrequently; several different topics may be taught in one year or semester.

EDSGN 599: Foreign Studies

1-2 Credits/Maximum of 4

Courses offered in foreign countries by individual or group instruction.

International Cultures (IL)

EDSGN 600: Thesis Research

1-15 Credits/Maximum of 999

No description

EDSGN 610: Thesis Research Off Campus

1-15 Credits/Maximum of 999

No description.

EDSGN 890: Colloquium

1-3 Credits/Maximum of 3

Continuing, professionally oriented seminars that consist of a series of individual lectures by faculty, students, or outside speakers.

EDSGN 896: Individual Studies

1-9 Credits/Maximum of 9

Creative projects with a professional orientation, including nonthesis research, that are supervised on an individual basis and which fall outside the scope of formal courses.

EDSGN 897: Special Topics

1-9 Credits/Maximum of 9

Formal courses given on a topical or special interest subject with a professional orientation that may be offered infrequently.