ADVANCED MANUFACTURING (AMFG)

AMFG401. ADDITIVE MANUFACTURING. 3.0 Semester Hrs.
(II) Additive Manufacturing (AM), also known as 3D Printing in the popular press, is an emerging manufacturing technology that will see widespread adoption across a wide range of industries during your career. Subtractive Manufacturing (SM) technologies (CNCs, drill presses, lathes, etc.) have been an industry mainstay for over 100 years. The transition from SM to AM technologies, the blending of SM and AM technologies, and other developments in the manufacturing world has direct impact on how we design and manufacture products. This course will prepare students for the new design and manufacturing environment that AM is unlocking. Prerequisites: MEGN200 and MEGN201 or equivalent project classes. 3 hours lecture; 3 semester hours.

AMFG421. DESIGN FOR ADDITIVE MANUFACTURING. 3.0 Semester Hrs.
(II) Design for Additive Manufacturing (DAM) introduces common considerations that must be addressed to successfully design or re-design parts for additive manufacturing methods. Industry-leading hardware and FEA software will be used to explore all phases of the DAM workflow, including topology optimization, additive process simulation, distortion compensation, and in-service performance. 3 hours lecture; 3 semester hours.

AMFG422. LEAN MANUFACTURING. 3.0 Semester Hrs.
Throughout the course, students will learn to apply skillsets to real world problems, focusing on lean and six-sigma principles and methodologies. The course is taught with a focus on the DMAIC structure of implementation (Define, Measure, Analyze, Improve and Control) for improving and implementing process efficiencies in industry. The course is split into three general subject areas; 1) Lean manufacturing principles, 2) six-sigma and statistical process control (SPC) methodologies and 3) Implementation techniques focusing on graphical and numerical representation of processes using R. Students will receive an in-depth overview of Lean manufacturing principles and will perform case studies at local industries to implement learned skill-sets. Next, students will step-through several hands-on activities using real products to investigate six-sigma and perform SPC analysis, identifying shifts in process data and learning how to shift processes into capable processes. Lastly, students will learn about various implementation techniques for industry and will perform an in-depth analysis of the course topics based on the industry tours performed. Prerequisite: MEGN381.

AMFG423. DESIGN AND ANALYSIS OF EXPERIMENTS. 3.0 Semester Hrs.
This course introduces effective experimental design and analysis methodologies relevant to all engineering and scientific disciplines to maximize the information learned from every experiment (test case) while minimizing the total number of tests. We will be using state-of-art methods steeped in statistics to effectively set up your experiments, understand what the results are telling you, and clearly communicate the results to peers and leadership. We apply a disciplined systems engineering approach across the four major experimental phases: plan, design, execute, and analyze. This hands-on class will focus on understanding concepts and practical applications while relying less on the statistical theoretical development. Prerequisite: MATH 201 is recommended, not required.

AMFG498. SPECIAL TOPICS IN ADVANCED MANUFACTURING. 1-6 Semester Hr.
(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Prerequisite: none. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.

AMFG501. ADDITIVE MANUFACTURING. 3.0 Semester Hrs.
This course gives students a broad understanding of additive manufacturing (AM) techniques (popularly known as 3d printing) and how these techniques are applied to make engineered products. The course covers the seven standard classifications of AM processes and compares and contrasts each technique alongside legacy fabrication methods such as milling. Students will also get a high-level view of design, material, and pre/post-processing requirements for AM produced parts along with a fundamental understanding of the cost drivers that make AM competitive over legacy fabrication methods. Prerequisites: MEGN200 and MEGN201 or equivalent project classes.

AMFG511. DATA DRIVEN ADVANCED MANUFACTURING. 3.0 Semester Hrs.
(I) Although focused on materials manufacturing, this course is intended for all students interested in experimental design and data informatics. It will include both directed assignments to reinforce the concepts and algorithms discussed in class and a term project that will encourage students to apply these concepts to a problem of their choosing. Some programming background would be beneficial but is not necessary; the basics of python and the sklearn machine learning toolkit will be covered in the first weeks of the course. 3 hours lecture; 3 semester hours.

AMFG521. DESIGN FOR ADDITIVE MANUFACTURING. 3.0 Semester Hrs.
(II) Design for Additive Manufacturing (DAM) introduces common considerations that must be addressed to successfully design or re-design parts for additive manufacturing methods. Industry-leading hardware and FEA software will be used to explore all phases of the DAM workflow, including topology optimization, additive process simulation, distortion compensation, and in-service performance. 3 hours lecture; 3 semester hours.

AMFG522. LEAN MANUFACTURING. 3.0 Semester Hrs.
Throughout the course, students will learn to apply skillsets to real world problems, focusing on lean and six-sigma principles and methodologies. The course is taught with a focus on the DMAIC structure of implementation (define, measure, analyze, improve and control) for improving and implementing process efficiencies in industry. The course is split into three general subject areas; 1) lean manufacturing principles, 2) six-sigma and statistical process control (SPC) methodologies and 3) implementation techniques focusing on graphical and numerical representation of processes using R. Students will receive an in-depth overview of lean manufacturing principles and will perform case studies at local industries to implement learned skill-sets. Next, students will step-through several hands-on activities using real products to investigate six-sigma and perform SPC analysis, identifying shifts in process data and learning how to shift processes into capable processes. Lastly, students will learn about various implementation techniques for industry and will perform an in-depth analysis of the course topics based on the industry tours performed.

AMFG523. DESIGN AND ANALYSIS OF EXPERIMENTS. 3.0 Semester Hrs.

This course introduces effective experimental design and analysis methodologies relevant to all engineering and scientific disciplines to maximize the information learned from every experiment (test case) while minimizing the total number of tests. We will be using state-of-art methods steeped in statistics to effectively set up your experiments, understand what the results are telling you, and clearly communicate the results to peers and leadership. We apply a disciplined systems engineering approach across the four major experimental phases: plan, design, execute, and analyze. This hands-on class will focus on understanding concepts and practical applications while relying less on the statistical theoretical development. Completion of MATH201 is recommended, not required.

AMFG531. MATERIALS FOR ADDITIVE MANUFACTURING. 3.0 Semester Hrs.

(II) This course will cover various structural materials used in additive manufacturing (AM) processes. Focus will be on polymer, ceramic, and metallic compositions. General chemistry of each material will be covered with additional focus on the behavior of these materials when processed using AM. The course will span the entire AM lifecycle from feedstock fabrication to fabrication by AM to post processing and inspection of as-fabricated material. Students will have hands-on exposure to AM processes and will conduct laboratory studies of AM material properties. Additionally, students will conduct a semester-long research project exploring some aspect of AM materials. 3 hours lecture; 3 semester hours.

AMFG581. OPTIMIZATION MODELS IN MANUFACTURING. 3.0 Semester Hrs.

This course explores the process of taking known inputs such as costs, supplies and demands, and determining values for unknown quantities (variables) so as to maximize or minimize some goal (objective function) while satisfying a variety of restrictions (constraints). Such problems arise in manufacturing operations as personnel planning, product sequencing, and plant scheduling. We examine a variety of manufacturing settings, e.g., flow shops, job shops, flexible manufacturing shops, and the corresponding appropriate models to optimize operations. The course explores a mix of mathematical modeling, software use and case studies. Prerequisite: Junior standing in an engineering major, or instructor consent.

AMFG592. ADDITIVE MANUFACTURING BUILD PREPARATION. 1.0 Semester Hr.

This course covers practical aspects of additive manufacturing build preparation, which include designing a part, part build orientation, and support structures. It distinguishes these concepts from those of traditional manufacturing methods and addresses how they influence final part outcome in regard to mechanical performance, dimensional accuracy, surface finish, and post processing requirements. Similarities and differences in these concepts are covered as they apply to various additive manufacturing technologies. These concepts are integrated to ultimately provide students with the ability to holistically approach design for additive manufacturing. Prerequisite: AMFG401 or AMFG501.

AMFG598. SPECIAL TOPICS IN ADVANCED MANUFACTURING. 1-6 Semester Hr.

(I, II) Pilot course or special topics course. Topics chosen from special interests of instructor(s) and student(s). Usually the course is offered only once. Prerequisite: none. Variable credit; 1 to 6 credit hours. Repeatable for credit under different titles.