Syllabus

MLDR 8823: Future Manufacturing Technologies

Course Information

Instructor: **Kyle Saleeby**
Fall 2026

Course Description:
This course introduces students to foundational concepts underpinning implementation of next generation manufacturing methods, including concepts such as Industry 4.0, machine learning and extended reality. We will discuss frameworks for assessing these technologies and evaluating them for implementers and practitioners.

Pre- and/or Co-Requisites:

- None

Office Hours:

- Mondays, 5:00 – 6:00 pm via Zoom (Link posted weekly on Canvas)
- All sessions recorded, posted by Wednesday morning

Weekly Agenda

- 5-minute review of schedule, deadlines
- 15-minutes review of critical topics
- 40-minute Q&A

Course Goals

- Select and implement conceptual process and product design tools for facilitating process improvement
- Define and apply measurement systems analysis methods for supporting process benchmarking and quantifying process improvement
- Assess technology and manufacturing readiness levels for various manufacturing technologies
- Examine Industry 4.0, additive manufacturing, collaborative robotics and extended reality issues as they pertain to future manufacturing systems
- Identify and select Industry 4.0, additive manufacturing, collaborative robotics and extended reality solutions for specific application cases

Grading Policies

- Grading breakdown:

Grading Type	Description of Graded Assignments	% Grade	Length of Time
Midterm Exam	Assessment covering modules 1-3	30	1 hour
Final Exam	Assessment covering modules 4-7	30	1 hour
Project	Capstone project integrating concepts in each of the modules	30	18 hours
Homework	2 homeworks	10	3 hours
Total:		100	

Attendance Policy

- This is a fully online course.
- Login on a regular basis to complete your work, so that you do not have to spend a lot of time reviewing and refreshing yourself regarding the content.

Plagiarism Policy

Plagiarism is considered a serious offense. You are not allowed to copy and paste or submit materials created or published by others, as if you created the materials. All materials submitted and posted must be your own.

Student Honor Code:

Students are reminded of the Georgia Tech Honor Code. Please see http://www.honor.gatech.edu. Any act of dishonesty will result in a Fail Grade.

Students with Disabilities:

Georgia Tech offers accommodations to students with disabilities. If you need a classroom accommodation, please make an appointment with the *ADAPTS* office (see http://www.adapts.gatech.edu).

Communication

- Email communication with instructor is recommended for any questions or concerns.
- Please communicate clearly with your teammates

Netiquette

- Netiquette refers to etiquette that is used when communicating on the Internet. When you are communicating via email, discussion forums or synchronously (in real-time), please use correct spelling, punctuation, and grammar consistent with the academic environment and scholarship.
- We expect all participants to interact respectfully. Learners who do not adhere to this guideline may be removed from the course.

Class Text:

- Borror, C. M., Certified Quality Engineer Handbook. ASQ Quality Press, 2008 (Available as an electronic book on GT library website)
- Veneri, G., and Capasso, A., Hands-on industrial Internet of Things: create a powerful industrial IoT infrastructure using industry 4.0. Packt Publishing Ltd, 2018 (Available as an electronic book on GT library website)
- Tao, F., Zhang, M., & Nee, A. Y. C. (2019). Digital twin driven smart manufacturing. Academic Press (Available as an electronic book on GT library website)

Technology/Software Requirements

- Internet connection (DSL, LAN, or cable connection desirable)

Topics:

Weeks	Information	
Week 1 Module 1: Foundational tools for manufacturing process improvement		
Week 1 Description	This module will be focused on developing an understanding of fundamental mathematics needed for data-driven manufacturing processes. This module covers introductory calculus, matrix operations, and statistics for manufacturing process analysis. This fundamental knowledge is critical to data-driven future manufacturing systems.	
Week 1 Learning Objectives	1. Define, select and apply fundamental mathematics for numerical analysis. 2. Define, select and apply statistical metrics for data analysis. 3. Define, select and apply fundamental probability and distribution analysis tools for data analysis.	
Week 1 Video Lessons	Lesson 1	Intro to Digital Manufacturing Technologies
	Lesson 2	Mathematics for Engineers I: Matrix Operations and Summation
	Lesson 3	Mathematics for Engineers II: Differentiation and Integration
	Lesson 4	Statistics Fundamentals for Manufacturing
	Lesson 5	Probability and Distributions
	Lesson 6	Introduction to AI/ML for Manufacturing
Week 1 Assessments	Homework 1	
Week 2 Module 2: Measurement systems analysis for manufacturing		
Week 2 Description	This module will be focused on developing an understanding of measurement systems analysis tools needed to carry out benchmarking and process improvement with new future manufacturing systems technologies.	
Week 2 Learning Objectives	1. Examine underpinning statistical models for measurement systems analysis.	

Weeks	Information	
	2. Define principles of measurement and measurement systems. 3. Evaluate and identify uncertainty sources in measurement. 4. Conduct gage repeatability and reliability analyses on measurement systems. 5. Examine principles of signal analysis. 6. Evaluate process capability and conduct process control for mixed environmental situations.	
Week 2 Video Lessons	Lesson 1	Failure Modes & Effects Analysis
	Lesson 2	Measurement Fundamentals for Manufacturing
	Lesson 3	Measurement Systems Analysis
	Lesson 4	Gage Repeatability and Reproducibility
	Lesson 5	Process Capability Analysis
	Lesson 6	Statistical Process Control
	Lesson 7	Statistical Process Control Rules
Week 3 Module 3: Manufacturing technology adoption and assessment		
Week 3 Description	This module will be focused on developing an understanding of assessment methods used for quantifying readiness of technology and manufacturing systems.	
Week 3 Learning Objectives	1. Define the timeline for technology development in manufacturing 2. Interpret technology readiness and manufacturing readiness levels as they pertain to new methods for manufacturing 3. Apply appropriate assessment methods for evaluating technology and manufacturing readiness levels 4. Examine historical cases for evaluation of TRL and MRL	
Week 3 Video Lessons	Lesson 1	Technology Development Fundamentals
	Lesson 2	Voice of the Customer and House of Quality
	Lesson 3	Technology Readiness Introduction
	Lesson 4	Technology and Manufacturing Readiness Assessment Tools
	Lesson 5	Risk Assessment Matrix
	Lesson 6	Supplier Readiness Assessment Tools
Week 3 Assessments	Homework 2	
Midterm Exam	Midterm Exam	
Week 4 Module 4 : Industry 4.0 technologies		
Week 4 Description	This module will be focused on developing an understanding of various Industry 4.0 technologies used for manufacturing systems, including edge, fog and cloud based resources.	

Weeks	Information	
Week 4 Learning Objectives	1. Inspect range of manufacturing data available on the factory floor 2. Identify and select sensors and controllers for machine sensing 3. Analyze options for edge and fog compute and select appropriate technologies for system development 4. Evaluate digital communication standards in selection of optimal system configurations	
Week 4 Video Lessons	Lesson 1	Fundamentals of Manufacturing Data
	Lesson 2	Industrial Data Flow: Sensors and Actuators
	Lesson 3	Industrial Data Flow: Controllers and More
	Lesson 4	OPC UA Communication Protocol
	Lesson 5	MTConnect Protocol
	Lesson 6	Message Queue Telemetry Transport (MQTT)
	Lesson 7	Digital Twins
Final Project Release	Final Project Release	
Week 5 Module 5 : Convergent manufacturing technologies		
Week 5 Description	This module will be focused on developing an understanding of various convergent manufacturing technologies used for manufacturing systems, including various additive manufacturing and hybrid based methods.	
Week 5 Learning Objectives	1. Compare difference in production approach between conventional frameworks and those leveraging convergent manufacturing methods 2. Examine the different additive manufacturing processes available 3. Define and identify issues pertaining to feedstock and product/process qualification 4. Identify technology standards of importance to convergent manufacturing	
Week 5 Video Lessons	Lesson 1	Conventional manufacturing
	Lesson 2	Additive manufacturing
	Lesson 3	Hybrid manufacturing
	Lesson 4	Feedstock materials
	Lesson 5	Process qualification
	Lesson 6	Product qualification
	Lesson 7	Technology standards
Week 6 Module 6 : Collaborative robotics for manufacturing		
Week 6 Description	This module will be focused on developing an understanding of various collaborative robotics manufacturing technologies, including design and implementation of such systems in theory and practice.	

Weeks	Information	
Week 6 Learning Objectives	1. Identify key robot types in collaborative robotics 2. Analyze basic principles for collaborative robotics 3. Apply principles of collaboration for design of collaborative work cells 4. Identify key safety issues with generalized robotic platforms	
Week 6 Video Lessons	Lesson 1	Collaborative robotics overview
	Lesson 2	Robot types
	Lesson 3	Principles of collaboration
	Lesson 4	Sensing and triggering
	Lesson 5	Collaborative work cells
	Lesson 6	Force limited robots
	Lesson 7	Robot safety
Week 7 Module 7 : Extended Reality for Manufacturing		
Week 7 Description	This module will be focused on developing an understanding of various extended reality manufacturing technologies, including design and implementation of such systems in theory and practice.	
Week 7 Learning Objectives	1. Define use cases for extended reality in manufacturing 2. Identify various hardware and software solutions for extended reality 3. Design new solutions based on principles of effective extended reality design 4. Identify ethical issues and dilemmas in use of extended reality in manufacturing	
Week 7 Video Lessons	Lesson 1	Introduction to extended reality (XR)
	Lesson 2	Hardware and sensing schemes
	Lesson 3	Virtual reality
	Lesson 4	Augmented reality
	Lesson 5	Principles of XR design
	Lesson 6	Ethical issues for XR
	Lesson 7	Case studies for XR
Final Exam	Final Exam	