Course 6: Digital Factory

Course Objective: As information and communication technologies connect the world into one, today's companies are challenged by increasingly aggressive competition to satisfy dynamic customer demands. Digital transformation will be indispensable, and having an ability to mimic a physical world into a virtual world will become necessary to companies for assessing scenarios before they even occur, resulting in effective operations, better failure prevention, and attractive offerings. This course aims to build student competence in digital transformation, digital factory modeling, and digital factory analysis. The students will also practice the knowledge gained in a case study factory.

Learning Outcomes:
The students on the completion of this course would be able to
CLO1. Understand the strategic differences between *traditional factory* and *digital factory*)Understand, Module I(
CLO2. Understand the capacities and limitations of digital technologies available nowadays)Understand, Module I(
CLO3. Formulate a data model representing data streamlining in a production line of an existing traditional factory using a data flow diagram)Develop, Module II(
CLO4. Simulate the dynamic behavior of a production line and identify locations which must be closely monitored to keep productivity in control, as well as to prevent work defects and machine breakdowns)Analysis, Module II(
CLO5. Propose a digital factory platform of a case study factory in a virtual environment upon what have been learned)Design, Module III(

Prerequisite: None

Course Outline:

Module 1: Introduction to digital factory: Road to digital transformation

1. Lean product lifecycle management towards digital factory
2. Technologies for digital transformation
3. Integration of technologies for digital factory

Module 2: Digital Factory Modeling: How to formulate a virtual world

1. Cyber-physical systems and data security
2. Data flow model concept and construction
3. Simulation of a production line

Module 3: Digital factory analysis: From analysis to factory solutions

1. Factory digitalization
2. Factory critical points identification and suggestions for improvement
3. Future trends of digital factory

Laboratory Sessions: Laboratory on establishment of a digital twin

Learning Resources:

Textbook: No designated textbook, but class notes and handouts will be provided

Reference books:

1. Barrenechea, Mark J .Jenkins, Tom Digital Manufacturing, First Published, Published in Canada 2018.
2. Milan Gregor and Stefan Medvecky)2010 .(Digital Factory – Theory and Practice, Engineering the Future, Laszlo Dudas)Ed(., InTech, Available from : http//:www.intechopen.com/books/engineering-the-future/digital-factory-theory-and-practice
3. Stephan Richter Dr .Steffen Wischmann, Additive manufacturing methods – state of development, market prospects for industrial use and ICT-specific challenges in research and development, Available from :www.autonomik40.de
4. Zude Zhou, Shane)Shengquan (Xie, and Dejun Chen, Fundamentals of Digital Manufacturing Science, Springer London Dordrecht Heidelberg New York, 2012.
5. Zongwei Luo, Robotics, Automation, and Control in Industrial and Service Settings, Published in the United States of America by Engineering Science Reference)an imprint of IGI Global(, Available from :http//:www.igi-global.com
6. 2016 Global Industry 4.0 Survey, Industry 4.0 :Building the digital enterprise, Available from :https//:www.pwc.com/gx/en/industries/industry-4.0.html

Teaching and Learning Method:

1. Every week students will participate in in-class activities along with practical training in a PLM software laboratory.
2. Visiting case study factories will be scheduled every month for students to observe digital technologies being implemented in reality and for data collection.
3. Student presentation will be regularly scheduled for students to practice presentation skills.
4. Students design a virtual digital factory out of a real traditional one as a class final project .

Time Distribution and Study Load:

In-class activities: 30 hours
Practical training: 45 hours (including visiting a factory at a minimum of 12 hours)

STUDY SCHEDULE:

Week/Topic	Learning Material	Workshop/Tutorial Material	Learning mode	Remark
MODULE 1: Introduction to digital factory: Road to digital transformation (hybrid online/offline mode)				
Lean product lifecycle management towards digital factory	MSIE-06-L-M1S1-S3.pptx (slides 1-39)	Discussion (MSIE-06-M1S1-S3-W01.pptx) (Slides 2-6)	online	
Technologies for digital transformation	MSIE-06-L-M1S1-S3.pptx (slides 40-100)		online	
Integration of technologies for digital factory	MSIE-06-L-M1S1-S3.pptx (slides 101-116)	Self-study (MSIE-06-M1S1-S3-W01.pptx) (Slides 7-10)	online	Article-1 for slide7-8 Article-2 for slide 10
1st Factory Visit		Observation of tradition factory	Offline & Self-study	
MODULE 2: Digital Factory Modeling: How to formulate a virtual world (hybrid online/offline mode)				
Cyber-physical systems and data security	MSIE-06-L-M2S1.pptx	Design and development for CNC turning system by writing architecture (MSIE-06-M2S1-W01.docx) (MSIE-06-M2S1-W01.pptx)	online	Assignment for checking understanding
Data flow model concept and construction	MSIE-06-L-M2S2.pptx	Data Flow Diagram Constructing, the case study of the Estate Agency (MSIE-06-M2S2-W01.docx) (MSIE-06-M2S2-W01.pptx)	online	Assignment for checking understanding
2nd Factory Visit		Data Flow Diagram Constructing for tradition factory	Offline & Self-study	
Simulation of a production line	MSIE-06-L-M2S3.pptx	Simulation of Fuel pipe production by using Technomatix program (MSIE-06-M2S3-W01.docx)	Offline & Self-study	Assignment for checking understanding

		(MSIE-06-M2S3-W01.pptx)		
MODULE 3: Digital factory analysis: From analysis to factory solutions (hybrid online/offline mode)				
Factory digitalization	MSIE-06-L-M3S1.pptx (slides 1-22)			
Factory digitalization	MSIE-06-L-M3S1.pptx (slides 23-49)	Digital twin in cyber physical system, the case study of Gear Factory (MSIE-06-M3S1-W01.docx) (MSIE-06-M3S1-W01.pptx)		
3rd Factory Visit		Making the plan of digital factory transforming	Offline & Self-study	
Factory critical points identification and suggestions for improvement	MSIE-06-L-M3S2.pptx (slides 1-42)			Assignment for checking understanding
Factory critical points identification and suggestions for improvement	MSIE-06-L-M3S2.pptx (slides 43-76)	The analysis of case study production line bottlenecks and management by using Technomatix program (MSIE-06-M3S2-W01.docx) (MSIE-06-M3S2-W01.pptx)		
Future trends of digital factory	MSIE-06-L-M3S3.pptx			
4th Factory Visit		Present the plan of digital factory transforming	Offline & Self-study	