Digital Technologies Applied to Chemical Engineering

1. **Course number and name:** 020DTECS5 Digital Technologies Applied to Chemical Engineering

2. **Credits and contact hours:** 4 ECTS credits, 2x1:15 contact hours

3. **Name of instructor:** -

4. **Instructional materials:**
   - PowerPoint slides

5. **Specific course information**

   a. **Catalog description:**
   This course delves into the application of digital technologies in chemical engineering, focusing on the integration of computational tools and data-driven approaches to enhance process design, optimization, and control. Students will explore the use of machine learning, artificial intelligence, and smart sensors in modeling complex chemical processes, predictive maintenance, and real-time process monitoring. The curriculum emphasizes the development and application of digital twins, process simulation, and automation technologies to improve efficiency and sustainability in chemical engineering practices. Through case studies and practical applications, students will gain hands-on experience in leveraging digital solutions to address contemporary challenges in the chemical industry.

   b. **Prerequisites:** None

   c. **Required/ Selected Elective/Open Elective:** Selected Elective

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**

   By the end of this course, students will be able to:

   - Explain the role of digital technologies (AI, ML, sensors) in modern chemical engineering practices.
   - Apply process simulation tools to model, analyze, and optimize chemical processes.
   - Use data-driven methods (including machine learning) to build predictive models and digital twins for chemical systems.
   - Integrate smart sensors and automation technologies for real-time process monitoring and control.
   - Design and evaluate digital strategies for predictive maintenance and operational sustainability.
   - Interpret and present case study results, showcasing the implementation of digital tools in real-world chemical engineering challenges.

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b. PIs addressed by the course:

PI	7.1	7.2
Covered	x	x
Assessed	x	x

7. Brief list of topics to be covered

- Introduction to digitalization in chemical engineering
- Basics of machine learning and artificial intelligence for engineers
- Process simulation tools (e.g., Aspen Plus, MATLAB/Simulink, Python-based models)
- Concept and implementation of digital twins
- Smart sensors and IoT applications in process industries
- Predictive maintenance and fault detection using AI
- Real-time monitoring and control using automation and digital feedback systems
- Data management, preprocessing, and analytics in chemical processes
- Case studies: Industry 4.0 in chemical manufacturing
- Sustainability assessment through digital optimization