Design of Mechatronic Systems

1. **Course number and name:** 020CSMES4 Design of Mechatronic Systems

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

3. **Name(s) of instructor(s) or course coordinator(s):** TBD (To Be Determined)

4. **Instructional Materials:** PowerPoint slides.

   Textbooks/References:
   - Mechatronics System Design, 2nd edition, D. Shetty and R. A. Kolk, Cengage Learning, 2011.
   - Mechatronic Systems: Analysis, Design and Implementation, K. Boukas and F.M. Al-Sunni, Springer, 2011.
   - Mechatronics with Experiments, 2nd edition, Sabri Cetinkunt, Wiley, 2015.

5. **Specific course information**
   a. **Catalog description:**
   This course offers a comprehensive understanding of mechatronics and microcontroller systems, emphasizing the integration of mechanical components, electronics, and data-driven control. Students will explore topics such as numbering systems, microcontroller architecture, assembly language programming, A/D and D/A conversion, parallel I/O, programmable timer operation, and the interfacing of sensors and actuators. Through theoretical knowledge, students will develop the skills required to design and implement mechatronic systems for various applications. Furthermore, they will collaboratively engage in a team project focused on applying these skills to real-world scenarios.

   b. **Prerequisite:** Sensors and Instrumentation (020CEIES3).

   c. **Selected Elective** for ME students.

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
   - Articulate a comprehensive understanding of mechatronics, encompassing its definition, historical development, and interdisciplinary nature.
   - Design mechanical systems, incorporating principles of kinematics, dynamics, sensors, actuators, and informed material selection.
   - Apply basic electronics concepts, analyze both analog and digital signals, and utilize numbering systems such as binary and hexadecimal in practical applications.
   - Program microcontrollers using assembly language, understanding memory organization, and addressing modes.

- Implement analog-to-digital and digital-to-analog conversion techniques, effectively interfacing microcontrollers with ADCs and DACs for precise signal conversion.
- Interface sensors and actuators with microcontrollers, demonstrating proficiency in calibration, signal processing, and the implementation of control strategies for seamless actuator integration.

b. PI addressed by the course:

PI	1.1	1.2	1.3	2.1	2.2	2.3
Covered	x	x	x	x	x	x
Assessed						

7. Brief list of topics to be covered

- **Chapter 1: Introduction to Mechatronics:** Definition and scope of mechatronics – Interdisciplinary nature of mechatronics – Historical development and key milestones – Importance of mechatronics in modern engineering. (3 Lectures).
- **Chapter 2: Mechanical Systems and Components:** Mechanical design principles – Kinematics and dynamics of mechanical systems – Sensors and actuators in mechatronics – Material selection and manufacturing considerations. (3 Lectures).
- **Chapter 3: Electronics and Numbering Systems:** Basic electronics concepts – Analog and digital signals – Introduction to numbering systems (binary, hexadecimal) – Data representation and conversion. (3 Lectures).
- **Chapter 4: Microcontroller Architecture and Assembly Language Programming:** Overview of microcontroller architecture – Memory organization and addressing modes – Introduction to assembly language programming – Instruction set and programming techniques (3 Lectures).
- **Chapter 5: A/D and D/A Conversion:** Principles of analog-to-digital conversion – Digital-to-analog conversion techniques – ADC and DAC interfacing with microcontrollers – Signal conditioning for accurate conversion. (4 Lectures).
- **Chapter 6: Parallel I/O and Programmable Timer Operation:** Parallel I/O interfacing with microcontrollers – Overview of programmable timers – Timer programming for precise timing control – Pulse-width modulation (PWM) techniques. (4 Lectures).
- **Chapter 7: Interfacing Sensors and Actuators:** Sensor types and characteristics – Interface design for sensors and actuators – Calibration and signal processing – Control strategies for actuator integration. (4 Lectures).