Digital Systems Design

1. **Course number and name:** 020TEDCI4 Digital Systems Design

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

3. **Name(s) of instructor(s) or course coordinator(s):** Alain Ajami

4. **Instructional materials:** course handouts; lab experiments; slides; in-class problems

5. **Specific course information**
   a. **Catalog description:**
      This course provides students with the opportunity to familiarize themselves with various methods of designing simple digital systems. They will learn how to decompose a function into combinational and sequential blocks, and discover techniques for automating industrial processes based on specifications. The course content covers essential concepts such as number systems and codes, combinational and sequential logic, logical functions, and integrated logic circuits. Students will also explore topics including the Morgan's theorem, Karnaugh maps, flip-flops, synchronous and asynchronous binary counters/decoders, and shift registers. Practical work will be conducted to apply these concepts.

   b. **Prerequisites:** None

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

6. **Specific Educational objectives for the course**
   a. **Specific outcomes of instruction:**
      - Understand number systems and codes, binary arithmetic, and Boolean variables.
      - Explore the concepts of combinational and sequential logic, logical functions, and Boolean algebra.
      - Familiarize oneself with different logic gates and integrated logic circuits.
      - Apply Morgan's theorem and utilize Karnaugh maps.
      - Understand the operation of flip-flops, registers, and synchronous/asynchronous binary counters/decoders.
      - Apply Huffman's method for the synthesis of sequential systems.
      - Participate in practical work involving the use of the Quartus tool for schematic description and VHDL implementation of logic circuits, with the aim of testing the results on an FPGA board.
      - Carry out practical projects such as designing a 4-bit adder in VHDL, a 7-segment display, arithmetic operations using logic circuits, sequential circuits, and temporal signal analysis.

- Design counters, shift registers, and perform wiring of logic gates using integrated circuits on a breadboard.

b. PI addressed by the course:

PI	1.2	1.3	6.1	6.2	6.3	6.4
Covered	x	x	x	x	x	x
Assessed	x	x	x	x	x	x

7. Brief list of topics to be covered

- Number Systems and Codes (2 lectures)
- Boolean Algebra and Logic Gates (2 lectures)
- Arithmetic Operations and Circuits (2 lectures)
- Combinational Logic (3 lectures)
- Synchronous and asynchronous Sequential Logic (3 lectures)
- Registers and Counters (4 lectures)
- Huffman's Method for Synthesizing Sequential Circuits (2 lectures)
- Lab sessions (6 lectures)