Space and Micro/Nano satellite technologies

1. **Course number and name:** 020SSTES4 Space and Micro/Nano satellite technologies

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

3. **Name(s) of instructor(s) or course coordinator(s):** Elias Rachid

4. **Instructional materials:** Professor handouts, Lab and applied work exercises

   References:
   - Space Mission Engineering: The New SMAD (Space Technology Library, Vol. 28) Paperback – July 29, 2011, by65 Authors from the Astronautics Community,James R.Wertz,David F. Everett,Jeffery J. Puschell(Editors)
   - Space Microsystems and Micro/nano Satellites Zheng You 2017

5. **Specific course information**
   a. **Catalog description:**
   micro/nano satellite mission, orbits design and analysis, subsystem scheme, micro/nano satellite configuration design, system performance determination and analysis, reliability and safety analysis technical processes of the satellite development, attitude system determination and control, design of the micro/nano satellite integrated electronic system, architecture of micro/nano satellite integrated electronic and relevant technical specifications, concept of micro/nano satellite testing description,, ground station types and related software's, STK tracker software,design and implement (tabletop) a nanosatellite type Cubesat 1U using commercial components and boards.

   b. **Prerequisites: (**020MC1NI1 Mechanics 1 or 020MC1CI1 Mechanics 1) and (020ELAES1 Analog Electronics)

   c. **Selected Elective** for CCE and EE students

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
      - Analyze Micro/nano satellite mission and design orbits.
      - Design micro/nano satellite configuration.
      - Develop the technical processes of the satellite.
      - Introduce basic conception and modeling technologies for nano-satellite design (CubeSat).
      - Determine and controls the attitude system (environmental disturbance, kinematics, dynamics, attitude sensors, actuators, etc.).
      - Knowledge of the orbit and orbital motion of a space operations.
      - Introduce the architecture of micro/nano satellite integrated electronic and relevant technical specifications of differents subsystems.

- Design a micro/nano satellite integrated electronic system, including the on-board computer (OBC) design.
- Describe the concept of micro/nano satellite testing.
- Describes the ground station types (VHF-UHF transceivers, S, X band etc.).
- Become familiar with some software tracker such HRD, STK, innoslate …
- Design and implement a nanosat (CubeSat 1U) using commercial components and boards.

b. PI addressed by the course:

PI	2.1	2.2	2.4	3.2	5.1	7.1
Covered	x	x	x			x
Assessed	x	x	x	x	x	x

7. Brief list of topics to be covered

- Micro/Nano Satellite System Technology
- Orbital Considerations
- System Engineering and spacecraft Design
- Payload Architectures Sample
- Platform Subsystems Sample
- Fire RS project Lune1 Sample
- Multidisciplinary Design Optimization of a Micro/Nano Satellite System
- Lab sessions covering the following topics:
  - Hands-on STM32 board: basic peripherals and components
  - Write your own ground station.
  - STK coverage analysis, life time analysis, power generation analysis
  - EOS, ADCS simulation.
  - Antenna deployment application using your STM32
  - Defining pc104 pinout for an example Cubesat.
  - Sizing a CubeSat
  - Mass and Power and data budgets
  - Link Budget.
  - Blink led application with actual OBC
  - Innoslate software
  - STK sofware