Mechanics 1

1. **Course number and name:** 020MC1CI1 Mechanics 1

2. **Credits and contact hours:** 6 ECTS credits, 3x1:15 contact hours

3. **Name(s) of instructor(s) or course coordinator(s):** Sami Youssef

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

5. **Specific course information**
   a. **Catalog description:**
      The main objective of this course is to master the principles and fundamental concepts of classical physics (inertia principle, fundamental principle of dynamics, principle of reciprocal actions, work-energy theorem), and to enhance the understanding of these principles through a wide range of concrete applications or real-life situations with all their richness, particularly in the field of engineering.

   b. **Prerequisites:** None

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

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
      - Demonstrate rigor: define a system, conduct a comprehensive assessment of applied forces.
      - Demonstrate autonomy: choose a reference frame, choose a coordinate system, identify unknowns, select an equation-solving method when multiple methods are possible.
      - Model a situation: choose an appropriate level of modeling; be aware of the limitations of a model; understand the importance of increasingly complex models (considering friction, nonlinear effects).
      - Utilize various tools (graphical discussions, analytical solutions, numerical solutions) to analyze the solutions of one or more differential equations that model the temporal evolution of a system.
      - Identify and use conservative quantities.
      - Seek significant parameters of a problem.
      - Reveal and exploit analogies.
      - Be aware of the limitations of a theory (e.g., relativistic limits).

b. PI addressed by the course:

PI	1.2	1.3
Covered	x	x
Assessed	x	x

7. Brief list of topics to be covered

- Course introduction (1 lecture)
- Cartesian, cylindrical and spherical coordinate systems, polar coordinate system, cinematics of single particles, Frenet–Serret formulas, circular and non-uniform acceleration motions (6 lectures)
- Newton's Laws of Motion, free fall, dry and fluid friction, Archimedes' principle, simple gravity pendulum and small angle approximation (8 lectures)
- Power and work, work-energy theorem, potential energy, equilibrium and stability, conservative and non-conservative fields, mechanical energy, bound and free sates, phase space (8 lectures)
- Electrical and magnetism phenomena, Lorentz force, electric potential energy, motion of charged particles in electric and magnetic fields (7 lectures)

  Torque, angular momentum, central forces and effective potential energy, conservation of angular momentum, polar equation of conic section, eccentricity vector, planetary and satellite motions, Kepler's three laws, escape velocity (12 lectures)