Mechanics 1

1. **Course number and name:** 020MC1NI1 Mechanics 1

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

3. **Name(s) of instructor(s) or course coordinator(s):** Joseph Kesserwani, Abbas Mgharbel, Adnan Naja, Elie Moussaed.

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

5. **Specific course information**
   a. **Catalog description:**
   Particle mechanics is a branch of physics that studies the motion of objects by considering them as dimensionless mass points. It simplifies the study of physical systems by neglecting the dimensions and internal structure of objects, focusing solely on their overall motion. In this case, the object under study is assumed to be point-like, meaning it has no significant spatial dimensions, which simplifies calculations by considering only the object's mass and its position in space. The fundamental principles of particle mechanics are based on Newton's laws, which describe the relationship between the applied force on an object, its mass, and its motion. By using these principles, one can analyze the motion of a particle by studying the applied forces, the object's mass, and the initial conditions. Particle mechanics provides an essential foundation for understanding more advanced concepts in classical mechanics, such as kinematics, dynamics, laws of motion, energy, etc.

   b. **Prerequisites:** None

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

6. **Educational objectives for the course**
   a. **Specific outcomes of instruction:**
   - Define Cartesian, cylindrical, and spherical coordinate systems.
   - Identify reference frames and the relationships between different coordinate systems.
   - Locate a material point in space.
   - Determine the velocity and acceleration vectors of a material point in different coordinate systems.
   - Determine kinetic quantities for different types of motion.
   - Understand the fundamental concepts of mechanics.
   - Apply the laws of motion.
   - Study different types of external forces and contact forces.
   - Determine the work and power of external forces.
   - Apply the work-energy theorem and kinetic energy theorem.
   - Determine the potential energy of a force field.

- Study equilibrium positions and their stability.
- Calculate the mechanical energy of a material point and determine its states of motion.
- Study the phase portrait.
- Solve problems using the concepts and principles of particle mechanics.

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

- Concept of material point, spatial location (2 lectures)
- Coordinate systems (3 lectures)
- Velocity and acceleration vectors, Frenet frame (3 lectures)
- Examples of motion (2 lectures)
- Applications on particle kinematics (3 lectures)
- Inertial mass and Newton's laws (2 lectures)
- Friction forces and interaction forces (2 lectures)
- Applications on particle dynamics (4 lectures)
- Work and power of a force (3 lectures)
- Kinetic energy theorem (1 lecture)
- Potential energy (2 lectures)
- Equilibrium of a material point (3 lectures)
- Mechanical energy and states of motion (2 lectures)
- Phase portrait (1 lectures)
- Applications on work and energy (3 lectures)