Information about the course

1. TIMETABLE

Classes will be given during the month of July in hybrid format, i.e. both on-site at the University and online through Google Meets. 3 additional classes will be given at the beginning of September to answer doubts on the subject before the final exam. A detailed schedule is provided below. Any modification of it will be promptly communicated to the students.

July: Mechanics (7), Fluid dynamics (4), Structures (3), Quiz (1)

Day	Room	Topic
01/07*	Online:	Mechanics
02/07*	Online:	Fluid dynamics
03/07*	Online:	Mechanics
04/07*	Online:	Structures
05/07*	Online:	Mechanics
08/07*	Online:	Mechanics
09/07*	Online:	Fluid dynamics
10/07*	Online:	Mechanics
11/07*	Online:	Structures
14/07*	Online:	Mechanics
15/07*	Online:	Mechanics
16/07*	Online:	Fluid dynamics
17/07*	Online:	Fluid dynamics
18/07*	Online:	Structures

*Class will be held from 11:00 to 13:00 CET

September:

Day	Room	Topic
28/08 (11:00 - 13:00 CET)	On-site:	Mechanics
29/08 (09:00 - 11:00 CET)	On-site:	Fluid dynamics
30/08 (13:00 - 15:00 CET)	On-site:	Structures

2. TEACHING MATERIAL

The teaching materials will be made available through Google Drive:
https://drive.google.com/drive/folders/1QyCsddY2iByt1tZEAiLYyX0FfFJyKOCG?usp=sharing

3. EVALUATION

The final mark will weight for a 40% the midterm quiz mark to be hold in July (in hybrid format) and for a 60% the final exam to be hold on-site in September.

Midterm Quiz (40% final mark)

Day	Room
19/07 (11:00 - 13:00 CET)	Online:

Final Exam (60% final mark)

Day (time)	Room
06/09 (11:00 - 13:00 CET)	On-site:

4. COURSE TOPICS

Point particle and rigid body mechanics, and basic orbital dynamics
(Teacher: Jiewei Zhou, email: jzhou@pa.uc3m.es)

- Point particle kinematics: reference frames, position velocity and acceleration; coordinates systems; working with multiple vector bases; time derivative of a vector; omega definition; Coriolis theorem; velocity and acceleration in a moving reference frame.
- Point particle dynamics: force, linear momentum and kinetic energy; Newton's laws; equations of motion (EOM); power, work and potential energy; conservation of mechanical energy; angular momentum and torque; central force motion.
- Orbital mechanics: Kepler's problem; conservation of specific mechanical energy; conservation of specific angular momentum; perifocal reference frame; trajectory equation; Conic sections; Trajectory types; velocity components and flight path angle; vis-viva equation and fundamental velocities; classical orbital elements.
- Rigid body kinematics: body-fixed reference frame; velocity and acceleration fields; instantaneous axis of rotation and slip; general rigid body motion; points of a rigid body; Euler angles, omega, alpha; degrees of freedom (DOF) of a rigid body.
- Geometry of masses.
- Rigid body dynamics: linear momentum; angular momentum; kinetic energy; EOM of rigid body; Euler’s equations in the principal axes of inertia; equilibrium; conservation of mechanical energy.

Fluid mechanics and thermal engineering

(Teacher: Marco Raiola, email: mraiola@ing.uc3m.es)

- Fundamental concepts: control mass and volume. Thermodynamic state, properties, processes.
- Conservation of mass and momentum.
- First Law: heat and work, stored energy, internal energy, the energy equation for a control volume, enthalpy, specific heats.
- Second law: entropy and irreversibility. Thermodynamics cycles.
- 1D flow model.
- Nozzles.
- Heat transfer mechanisms: conduction, convection, radiation.

Solid mechanics and structural engineering

(Teacher: Rauno Cavallaro, email: rauno.cavallaro@uc3m.es)

- Introduction to solid mechanics and linear structures.
- Deformation and stress in a material. Elasticity. Constitutive relations.
- Loads and stress types: compression/tension, shear, torsion, bending...
- Resistance: ultimate stresses. Safety factors in a structure.