Università degli Studi di L'Aquila - Dipartimento di Ingegneria e Scienze dell'Informazione e Matematica

Course catalogue

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Programme of Course "Fisica Generale I"

- Code: I0199
- Type of course unit: Compulsory (Laurea in Ingegneria dell'Informazione curriculum Automatica), Compulsory (Laurea in Ingegneria dell'Informazione curriculum Telecomunicazioni), Compulsory (Laurea in Ingegneria dell'Informazione curriculum Elettronica), Compulsory (Laurea in Ingegneria dell'Informazione curriculum Comune), Compulsory (Laurea in Ingegneria dell'Informazione curriculum Informatica)
- Level of course unit: Undergraduate Degrees
- Semester: 2

Number of ects credits: (Laurea in Ingegneria dell'Informazione) 9 (workload 225 hours)

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1	**Course objectives**	Learning of the fundamentals of mechanics and thermodynamics, and acquiring the tools for solving basic problems of mechanics and thermodynamics.
2	**Course content and learning outcomes (dublin descriptors)**	Topics of the module include: • 1. Motion in two dimensions. Velocity ??tangent to the trajectory. Tangential and centripetal acceleration. 2. Circular Motion. Angular velocity as an axial vector. 3. Newton's three principles of dynamics. • 4. Centripetal force: its definition. Calculation of the tension that keeps a particle on a circular motion with constant speed. 5. Elastic force and harmonic motion. 6. The simple pendulum. • 7. Definition of work and kinetic energy. 8. Conservative and non-conservative forces: definitions and examples. 9. Conservation of mechanical energy for conservative forces, and energy balance for both conservative and non-conservative forces acting on particle. • 10. The simple pendulum: conservation laws of its motion. 11. Definition of angular momentum and torque. 12. Systems of particles and center of mass. Dynamical equations for the center of mass. Internal and external forces. • 13. Momentum. Dynamical equations for the momentum. Internal and external forces. Conservation of momentum. 14. Law of the angular momentum. Conservation law for the angular momentum. 15. Decomposition of the angular momentum and for the kinetic energy in an intrinsic component and a center of mass components (König theorems). Demonstration. • 16. Circular motion of two material points between their bound by the vertical rod of negligible mass in the case in which this rod is perpendicular and non-perpendicular to the rotation axis. Conservation of the axial angular momentum. Parallel and perpendicular components of the angular momentum with respect to axis of rotation and their physical meaning. 17. Circular motion of a generic rigid body. Moment of inertia, definition. Equation of motion. 18. Proof of the Huygens-Steiner theorem and its implications on the calculation of the kinetic energy of rotating systems. • Plan roto-translatory motion. Equations for the center of mass acceleration and for the angular velocity. 20. Rolling of a body in the case of a force applied to its center of mass. Conditions for pure rolling. 21. The Yo-Yo: calculation of the acceleration of fall. • 22. Rolling of a body when a torque is applied to the center of mass. Conditions of pure rolling motion. 23. Oscillatory motion of a physical pendulum. 24. Wheel suspended by a wire to its axis of rotation. • 24. The spinning and precessing of a spinning top. 26. Collision between two particles: classification of elastic and inelastic collisions. 27. Impulsive force applied to and unconstrained rigid body. "Sweet spot" of tennis rackets and baseball bats. 28. Constrained and unconstrained inelastic collisions of a particle that sticks to a rigid body. • 1. The first law of thermodynamics and its physical meaning. 2. Thermodynamic transformations: definition and relationship between the thermodynamic variables p, V, T. 3. Work of a perfect gas: expression in the case of quasi-static transformations. Examples 4. Internal energy of an ideal gas: dependence on thermodynamic and

		expression of its variations. 5. Derivation of the Mayer relationship between specific heats at constant pressure and volume. • 6. Thermodynamic cycles: definition and properties. The Carnot cycle of a thermal machine. 7. Thermodynamic cycles: definition and properties. The Carnot cycle of a refrigerating machine. 8. The second law of thermodynamics in the modern formulation based on the existence of the entropy. Proof that the entropy is a function of the state of a perfect gases. 9. The second law of thermodynamics in the statements of Clausius and Kelvin-Planck. • 10. Carnot's theorem: Demonstration from the second law of thermodynamics in the formulation of Clausius that all reversible heat engines working between two temperatures have the same return, and those who have irreversible yield or less. 11. The Clausius theorem and its implications. 12. The Carnot cycle in the plane T-S. Calculation of entropy for ideal gases. 13. The definition of universe and its thermodynamic entropy change. The principle of increasing entropy. Physical examples of non-reversible thermodynamic process. On successful completion of this module, the student should : • have learned the fundamentals of mechanics and thermodynamics, and acquired the necessary tools to solve basic problems of mechanics and thermodynamics.
3	**Course prerequisites**	Knowledge of basic mathematics notions (algebra, analytic geometry and elementary trigonometry). Notions of mathematical analysis (limits, derivatives and integrals)
4	**Teaching methodsand language**	Lectures and recitations **Language**: Italian **Reference textbooks** • P. Mazzoldi, M. Nigro e C. Voci, ***Elementi di Fisica Meccanica e Termodinamica***. EdiSES. 2008. *http://www.edises.it*
5	**Assessment methods**	Written and oral exam, with two mid-terms examinations