UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2022/2023
BACHELOR'S DEGREE (BSC)	BIOMEDICAL ENGINEERING
SUBJECT	PHYSICS 1
TYPE OF EDUCATIONAL ACTIVITY	A
AMBIT	50293-Fisica e chimica
CODE	03295
SCIENTIFIC SECTOR(S)	FIS/03
HEAD PROFESSOR(S)	BASILE SALVATORE Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	
YEAR	1
TERM (SEMESTER)	2° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**BASILE SALVATORE** Tuesday 15:00 17:00 Viale delle Scienze, Edificio 6 (ex DIN), stanza 213. Nel periodo di non svolgimento di attivita didattica in presenza si svolge su piattaforma Teams, previa prenotazione via email. Thursday 15:00 17:00 Viale delle Scienze, Edificio 6 (ex DIN), stanza 213. Nel periodo di non svolgimento di attivita didattica in presenza si svolge su piattaforma Teams, previa prenotazione via email.

DOCENTE: Prof. SALVATORE BASILE

PREREQUISITES	High school mathematics. Algebra. 2- and 3-dimensional geometry. Coordinate (Cartesian) geometry. Goniometry and trigonometry. Good knowledge of calculus (derivatives, integrals and their geometric meaning) from the first semester courses.
LEARNING OUTCOMES	Knowledge and understanding Theoretical understanding: have a good understanding of the principles of classical mechanics and thermodynamics (logical and mathematical structure, experimental support, and described physical phenomena) and their applications to engineering. Mathematical skills: be able to understand and master the use of the most commonly used mathematical methods. This will be verified during the written and oral test. Applying knowledge and understanding Problem solving skills: be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems. Be able to solve mechanics problems using the dynamics laws and the conservation laws (energy, momentum, angular momentum) and thermodynamics problems using its principles. Modelling: be able to identify the essentials of a process / situation and to set up a working model of the same; be able to perform the required approximations. This will be verified during the written and oral test. Making judgements Be able to identify the more effective way to the solution of mechanics problems using either a dynamics (Newton's laws) and/or a conservation laws approach and thermodynamics problems using its principles. Acquire an understanding of how mechanics and thermodynamics laws are applicable to many fields, namely engineering. This will be verified during the oral test. Communications skills Be able to describe, analyse and solve mechanics and thermodynamics problems using appropriate technical language and be able of written and oral communication on related subjects. Be able to describe the logical flowchart of problem solving. Be able to improve the group working skills. This will be verified during the oral test. Learning skills The student will learn the basic laws of mechanics and thermodynamics and the typical methodology of the physical sciences, to be applied to engineering problems, critically and in an autonomous way. He will also improve the ability of autonomous learning. This will be verified during the oral test.
ASSESSMENT METHODS	The exam consists of both a written and oral test, evaluated on a 30 points scale. The final mark will take into account the outcome of both tests. Purpose of the tests: test knowledge of the principles of classical mechanics and thermodynamics and their application to solve mechanics and thermodynamics problems using the dynamic laws and the conservation laws (energy, momentum, angular momentum) and the thermodynamics laws. Check the ability of modelling and identifying the essential elements of a problem. Type of tests: written test (problems and exercises with symbolic or numerical answer, open- or closed-ended); passing the written test (at least 18/30) gives access to the oral exam (discussion of the written test and questions on general topics and / or exercises with reference to the recommended texts). The oral examination must be undertaken in the same exam session ("appello") of the written test. The written test is a closed book one. Only a calculator and a formula sheet are allowed. Duration of the written exam: no more than 3 hours. A mid-term test will be scheduled. EVALUATION CRITERIA Indicator - Knowledge and competence of contents Descriptor and score range: Excellent 10 Autonomous and effective 8-9 Acceptable 6-7 Fragmentary or partly superficial 4-5 Inadequate 0-3 Indicator - Applicative skill, precision, logical-thematic coherence Descriptor and score range: Excellent 10 Adequate 8-9 Acceptable also if partly driven 6-7 Limited 4-5 Inadequate 0-3 Indicator - Expression and terminology, reprocessing skills and multi-disciplinary connections Descriptor and score range:

	Excellent 10 Effective and well-structured 8-9 Generally satisfactory 6-7 Hesitant and rough 4-5 Inadequate 0-3
EDUCATIONAL OBJECTIVES	Have a good understanding of the principles of classical mechanics and thermodynamics. Be able to solve simple problems on mechanics of particles, rigid bodies, fluids, using the dynamics laws and the conservation laws. Be able to solve simple thermodynamics problems using its principles.
TEACHING METHODS	Lectures. Instructor-assisted resolution of exercises and problems. Classwork, for single students or groups. Teaching tools: blackboard, chalk sticks, blackboard eraser; computer and video projector.
SUGGESTED BIBLIOGRAPHY	Appunti delle lezioni e materiale didattico fornito dal docente. Si può utilizzare qualunque testo universitario di Fisica Generale (Meccanica e Termodinamica) per i corsi di Ingegneria. Di seguito una lista, non esaustiva, di possibili scelte. P. Mazzoldi, M. Nigro, C. Voci, "Elementi di Fisica, Meccanica e Termodinamica", III / 2021, EdiSES, ISBN 9788836230365. L. Duò, P. Taroni, "Fisica, Meccanica e Termodinamica", 2021, EdiSES, ISBN 9788836230280. U. Gasparini, M. Margoni, F. Simonetto, "Fisica, Meccanica e Termodinamica", 2019, Piccin, ISBN 9788829929726. P. Mazzoldi, M. Nigro, C. Voci, "Fisica Vol. I, Meccanica e termodinamica", II / 2000, EdiSES, ISBN 9788879591379. S. Focardi, I. Massa, A. Uguzzoni, M. Villa, “Fisica Generale, Meccanica e Termodinamica”, II / 2014, CEA, ISBN 9788808182159. C. Mencuccini, V. Silvestrini, "Fisica, Meccanica e termodinamica", 2016, CEA, ISBN 9788808186492. R.A. Serway, J.W. Jewett, “Fisica per Scienze ed Ingegneria”, Volume 1, V / 2015, EdiSES, ISBN 9788879598347. Ultima edizione in inglese; R.A. Serway, J.W. Jewett, “Physics for Scientists and Engineers, Volume 1, 10th Edition”, 2019, Cengage, ISBN 9781337553575. H.D. Young, R.A. Freedman, "Principi di Fisica. Vol. 1. Meccanica, Onde e Termodinamica", 2022, Pearson Italia, ISBN 9788891906038. D. Kleppner, R. Kolenkow, “An Introduction to Mechanics”, II / 2013, Cambridge University Press, ISBN 9780521198110. D. Morin, "Introduction to Classical Mechanics with Problems and Solutions", 2008, Cambridge University Press, ISBN 9780521876223. Libri di consultazione per applicazioni specifiche. D. Scannicchio, "Fisica Biomedica", IV / 2020, Edises, ISBN 9788836230198. Libri di testo e manuali accessibili da Unipa (in dipendenza dell'anno accademico). Textbooks and reference books freely accessible from Unipa (depending on the year). W. Demtröder, "Mechanics and Thermodynamics", 2017, Springer, ISBN 9783319278759. https://link.springer.com/book/10.1007/978-3-319-27877-3 A. Bettini, "A Course in Classical Physics 1-Mechanics", 2016, Springer, ISBN 9783319292564. https://link.springer.com/book/10.1007/978-3-319-29257-1 V. Ilisie, "Lectures in Classical Mechanics", 2020, Springer, ISBN 9783030385842. https://link.springer.com/book/10.1007/978-3-030-38585-9 I.P. Herman, "Physics of the Human Body", II / 2016, Springer, ISBN 9783319239309. https://link.springer.com/book/10.1007/978-3-319-23932-3 Libri di esercizi e problemi. C. Del Papa, M. P. Giordani, G. Giugliarelli, "Problemi di Fisica con soluzione. Meccanica - Termodinamica - Gravitazione", 2014, CEA. ISBN 9788808187383. C. Daghero, R.C. Iotti, P. Mandracci, M.L. Ruggiero, Problemi di Fisica - Meccanica e termodinamica", 2019, Pearson Italia. ISBN 9788891904959. M. Zani, L. Duò, P. Taroni, "Esercizi di Fisica, Meccanica e Termodinamica", 2021, Edises, ISBN 9788836230297. P. Zotto, S. Lo Russo, "Problemi di Fisica Generale, Meccanica e Termodinamica", 2015, Edizioni La Dotta, ISBN 9788898648214. S. Longhi, M. Nisoli, R. Osellame, S. Stagira, "Fisica Generale: Problemi di Meccanica, Termodinamica, Elettricità e Magnetismo", 2017, Esculapio. ISBN 9788893850452. F. Falciglia, "Problemi di Fisica I, Meccanica e Termodinamica", 2013, Edises, ISBN 9788879597647. M. Villa, A. Uguzzoni, "Esercizi di Fisica 1, Meccanica", 2016, CEA, ISBN 9788808180438.

	C. Mencuccini, V. Silvestrini, "Esercizi di Fisica, Meccanica e Termodinamica", 2017, CEA, ISBN 9788808287021. R. Cerbino, "Problemi di Fisica Biomedica", 2019, Edises, ISBN 9788833190396. D.J. Morin, "Problems and Solutions in Introductory Mechanics", 1st ed 2014, CreateSpace Independent Publishing Platform. ISBN 9781482086928. Siti consigliati: http://www.compadre.org/osp/search/browse.cfm?browse=gsss http://www.sc.ehu.es/sbweb/fisica3/# https://www.compadre.org/physlets/

SYLLABUS

Hrs	Frontal teaching
2	Measurement and physical quantities. Physics and the scientific method. Measurement of a physical quantity. Fundamental quantities and units. Systems of measurement and dimensional equations. The International System.Vectors and vector algebra. Scalars and vectors. Addition of vectors: geometric and analytical method. Scalar and vector product. Derivative of a vector. Position vector and coordinate systems. Cross product of position vector and a generic vector.
6	Kinematics of a particle. Reference system. Position vector as a function of time. Trajectory. Speed and velocity. Rectilinear motion. Velocity and acceleration in rectilinear motion. Motion under constant velocity and constant acceleration. Free fall of bodies. Motion under variable acceleration. Simple harmonic motion. Motion in a plane. Velocity and acceleration in plane. Polar coordinates. Tangential and normal basis. Projectile Motion. uniform circular motion and varied. angular sizes. Relations between the linear and angular sizes. Motion in 3d space. Composition of motions. Kinematics of relative motions. Velocity and acceleration in different reference systems. Coriolis acceleration.
6	Dynamics of a particle. Interactions and forces. Inertial reference systems. Newton's laws. Mass and weight. Applications of Newton's laws. Friction forces. Elastic forces and Hooke's law. Velocity-dependent forces. Classification of forces. Normal and contact forces. Pivot forces. Impulse and momentum. Dynamics of circular motion. Central forces. The simple harmonic oscillator. Simple pendulum. Torque and angular momentum. Dynamics laws of in a non-inertial reference frame.
6	Work and energy. Work of a force. Kinetic energy and its relation with work of a force. Conservative forces fields. Potential energy. Non-conservative forces. Mechanical energy and its conservation. The law of energy conservation. Relationship between force and potential energy. The power. Energy considerations for the simple harmonic motion.
4	Dynamics of a system of particles. Center of mass and its Newton’s equation. Momentum conservation. Angular momentum and its conservation. Internal forces. Kinetic energy of a system of particles. König’s theorems. Parallel forces and the center of gravity. Momentum and angular momentum equations. Collisions. Variable mass systems.
6	Dynamics of a rigid body. Degrees of freedom. Kinematics of rigid bodies: translational motion, rotational motion with fixed or variable axis. Moment of inertia. Parallel axis theorem. Equation of motion for rotation of a rigid body. Kinetic energy of rotation. Rolling without slipping motion. Free motion of a rigid body. Compound pendulum. Conservation laws in the motion of a free rigid body. Collisions between particles and rigid bodies and between rigid bodies. Static equilibrium of rigid body.
3	Oscillazioni. Richiami sul moto armonico semplice. Oscillazioni smorzate. Oscillazioni forzate. Risonanza. Analisi di Fourier.
3	Fluids. General information on fluids. Density. Pressure. Fluid statics. Stevin's law and Pascal’s law. Barometric equation. Buoyant forces and Archimedes' principle. Ideal and real fluids. Fluid dynamics. Equation of continuity. Volume flux. Bernoulli's theorem and its applications. Laminar flow. Viscosity. Motion in a viscous medium.
3	Thermodynamic systems. Thermodinamic equilibrium. Temperature and the zeroth principle. Thermometers.
3	The first law of thermodynamics. Heat and Internal Energy. Specific Heat and Calorimetry. Latent Heat. Work in Thermodynamic Processes. Thermodynamics processes in gases.
3	The Kinetic Theory of Gases. Molecular Model of an Ideal Gas. Molar Specific Heat of an Ideal Gas. The Equipartition of Energy. Adiabatic Processes for an Ideal Gas. Distribution of Molecular Speeds.
3	Heat Engines and the Second Law of Thermodynamics. Reversible and Irreversible Processes. The Carnot Engine. Entropy in Thermodynamic Systems.

Hrs	Practice
2	Algebra vettoriale
3	Kinematics of a particle
6	Dynamics of a particle
6	Work and energy
6	Dynamics of a system of particles
6	Dynamics of a rigid body
4	Thermodynamics