UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2018/2019
BACHELOR'S DEGREE (BSC)	CIVIL AND BUIDING ENGINEERING
SUBJECT	RATIONAL MECHANICS
TYPE OF EDUCATIONAL ACTIVITY	A
AMBIT	50106-Formazione scientifica di base
CODE	04954
SCIENTIFIC SECTOR(S)	MAT/07
HEAD PROFESSOR(S)	GARGANO FRANCESCO Professore Associato Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	144
COURSE ACTIVITY (Hrs)	81
PROPAEDEUTICAL SUBJECTS	13711 - MATHEMATICAL ANALYSIS I
MUTUALIZATION	
YEAR	2
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**GARGANO FRANCESCO** Tuesday 10:00 11:00 Ex dipartimento di Metodi e modelli Matematici, primo piano

DOCENTE: Prof. FRANCESCO GARGANO

PREREQUISITES	Classical knowledge of the concepts of mathematical analysis of function of one real variable, geometry of Euclidean spaces and linear algebra.
LEARNING OUTCOMES	Knowledge and understanding The student at the end of the course will have gained knowledge of the basic laws of a mechanical system. The student will be able to determine the condition ensuring the equilibrium of a system. The student will know how to use the laws of physics and the mathematical equations that describe them, to solve simple problems of mechanics. Applying knowledge and understanding The student will be able to use the laws of physics and the mathematical tools for solving complex mechanical problems; the student will know the validity and the limits of the laws of the models used, and which model to apply in certain contexts. The student will gain the ability to solve problems correctly. The ability acquired is verified through active participation of the student during the lessons to solve problems and issues. Communication skills The student, after developing a mathematical model that describes the static or the dynamics of a mechanical system, will be able to describe the techniques used to contruct the model. The student will acquire the ability to clearly expose the results obtained from the analysis of the problem. The assessment of communication skills will be judged during the oral examination. Learning ability The student will have learned the basic laws to deduce a mathematical model that correctly describe a physical system. The student acquires the ability to contextualize their knowledge in wide multidisciplinary areas by adjusting their knowledge on the contextualized problem.
ASSESSMENT METHODS	The overall assessment will be made on the basis of the following criteria. The final test will be judged: - Inadequate: if the candidate does not have an acceptable knowledge of the topics covered in the teaching; - Sufficient (rating 18-21): If you have a basic understanding of the object of teaching subjects but an insufficient ability to use independently the acquired knowledge; - Satisfactory (rating 22-25): if it has not fully mastered the topics covered but has sufficient capacity 'of independent use of the knowledge gained; - Good (score 26-28): if you have a good command of the object of teaching topics, has a discrete property of language and demonstrates a sufficient ability 'to independently apply the knowledge acquired; - Excellent (score 29- 30 cum laude): if it demonstrates excellent knowledge and mastery of the laws of analytical mechanics and relativistic, excellent property 'language and if it is able to apply autonomously the acquired knowledge to solve problems.
EDUCATIONAL OBJECTIVES	The aim of the course is to provide to the student the knowledge of the mathematical tools to describe the the physical laws of a material system, the reduction of applied vectors, and the general methodologies to address the study of mechanical systems.
TEACHING METHODS	The course is semi-annual (first semester). The teaching consists in lectures and classroom exercises . The aim of the course is to provide to the students the main tools to deal with a rigorous approach to mathematical problems typically encountered in quantitative description of physical processes. Students will acquire the following knowledge: -Reduction of systems of applied forces. -Cinematics and dynamics in absolute and relative systems. -Geometry of the masses. Inertia ellipsoid and the principal inertial axes. -static of a material system, determination of the equilibrium of the system by using the virtual work principle and cardinal equations. -The Lagrange equation of motion, and approximation of the motion of small oscillations around a stable equilibrium position These topics will be presented and analyzed rigorously in lectures, while greater understanding will be gained from the exercises. . Part of the exercises is dedicated to the resolution of the exam problems. The exercises are designed to test the skills attained by students in the application of acquired knowledge

	and are a useful training to the ultimate test exam. It is also planned a mid-cours test on the following topics: - Reduction of system of applied forces. -Geometry of the masses, determination of the centre of gravity of complex systems, and determination of the inertial axes .
SUGGESTED BIBLIOGRAPHY	Fabio Bagarello, Meccanica razionale per l'ingegneria , Mc Graw Hill. Biscari, Ruggeri, Saccomandi, Vianello, Meccanica Razionale per l'Ingegneria, Monduzzi Editoriale Muracchini, Ruggeri, Seccia, Esercizi e tempi d'esame di meccanica razionale, Societa' Editrice Esculapio

SYLLABUS

Hrs	Frontal teaching
4	Definition of applied vectors system. Resultant and momentum of a system. Law of the variation of the momentum. couple of applied vectors. Torsor. Reducibility and equivalence of a system. Basic operation on a system. Poisson's theorem on the reducibility. Trinomial invariant and reduction to torsor.
2	Cinematics of a material point. Euation of the motion. Scalar and vectorial Velocity and acceleration.
2	Curve on the space. Curvilinear abscissa. Frenet's Trihedron. Curvature and osculating circle. Central motion and Binet law, areolar velocity.
4	Cinematic of rigid bodies. Absolute and solidal axes. Foundamental law of a rigid motion and Poisson formulas. Planar motion. instantaneous center of zero velocity and acceleration. Mozzi theorem a local motion in time. Base and rulletta of a rigid body and Chasles theorem
3	Cinematics of relative motion for a point. Velocity and acceleration in absolute and relative system. Galileo principle and Coriolis theorem. Relative motion of rigid bodies, composition of angular velocity
2	Rigid Contact motion over curve and surfaces. Conditions for a pure rolling and slipping
2	Dynamics for a material point. Mass and foundamental laws of the dynamics. Inertial system. Examples of direct problem of the dynamics and solution of differential equation. Dynamics in non inertial systems.
3	Constraint and friction, classification of the constraints and their reaction. Coulomb- Morin Laws. Motion of a material point constrained on a curve and surface
5	Material system. Centre of gravity and its properties. Moment of inertia. Operator and tensor of inertia. Inertia ellipsoid.
3	Quantity of motion and constraints. Momentum of the quantity of motion. Kinetic energy. Koenig's theorem. Orbital angular momentum.
3	Work and conservative forces. Potential and Potential energy. Work of a rigid body. Definition of infinitesiaml work, possible work, virtual work, elementary work. Power. Work of a solicitation acting over a rigid body. Lagrangian solicitations.
5	Dynamics of a system. Cardinal equations. Theorem of live forces. Central forces and associated potential. Rigid body with fixed axes.
6	Static of a material system. Virtual displacements and constraints. Principle of virtual work. Work of the virtual reaction. Equilibrium of material system.
5	Lagrangian dynamcis and equation of motion. Symmetries and constant of the motion. Equation of motion for conservative system. Basic laws of the Hamiltonian mechanics. Small oscillation around an equilibrium

Hrs	Practice
6	Systems of applied vectors
4	Rigid bodies, slipping and pure roll motion
2	Base and rulletta
6	Centre of gravity. Inertia ellipsoid.
4	Quantity of motion and constraints. Momentum of the quantity of motion. Kinetic energy.
4	Static of a system. Constraint reactions
6	Lagrangian mechanics. Small oscillations around equilibrium