<table>
<tr><td colspan="5">Academic subject: Mathematical Physics 1</td></tr>
<tr><td colspan="2">Degree Class:
L–35 – Scienze Matematiche</td><td colspan="1">Degree Course:
Mathematics</td><td colspan="2">Academic Year:
2018/2019</td></tr>
<tr><td colspan="2"></td><td>Kind of class:
mandatory</td><td>Year:
2</td><td>Period:
2</td></tr>
<tr><td></td><td></td><td></td><td colspan="2">ECTS:8
divided into
ECTS lessons: 5
ECTS exe/lab/tutor: 3</td></tr>
<tr><td colspan="5">Time management, hours, in–class study hours, out–of–class study hours
lesson: 40 exe/lab/tutor: 30 in–class study: 70 out–of–class study: 130</td></tr>
<tr><td>Language:
Italian</td><td>Compulsory Attendance:
no</td><td colspan="3"></td></tr>
<tr><td>Subject Teacher:
Lidia R. R. Palese</td><td>Tel:
e–mail:
lidiarosaria.palese@uniba.it</td><td>Office:
Department of Mathematics
Room 29, II Floor</td><td colspan="2">Office days and hours:
Wednesday 11-13.
Other days and times by appointment.</td></tr>
<tr><td colspan="5">Prerequisites:
Mathematical knowledge which usually is acquired during the first year of a degree of L–35 class, especially classical mathematical analysis of one and several variables, linear algebra.</td></tr>
<tr><td colspan="5">Educational objectives:
Mathematical formulation, understanding and resolution of physical problems concerning the equilibrium of olonomic systems</td></tr>
<tr><td>Expected learning outcomes (according to Dublin Descriptors)</td><td colspan="4">Knowledge and understanding:
Acquiring fundamental concepts of the classical mechanics, , understanding physical, mathematical and geometrical aspects of a given problem

Applying knowledge and understanding:
Ability to use theoretical knowledge in various statics problems.
Making judgements:
Ability to identify mathematical tools and techniques to study physical problems written as mathematical models.
Communication:
Students should acquire the mathematical language and formalism necessary to read and comprehend textbooks, to explain the acquired knowledge .
Lifelong learning skills:
Acquiring suitable learning methods, supported by text consultation and by solving the questions periodically suggested during the course.</td></tr>
<tr><td colspan="5">Course program
Elements of vector and matrix algebra: Vectors. Linear operators and their representations. Tensor product. Symmetric and antisymmetric operators. Unit operators, orthogonal and rotation operators. Projection operators. Eigenvalue problems. Positive definite operators.
Differential properties of the curves: the Frenet frame.
Applied vectors: Moment vectors with respect to a point or axis. Vector systems. Variation of the moment vector. Couple of applied vectors. Central axis of a vector system. Reduction of systems of applied vectors at a given point. Moments Transport Theorem. Systems whose parallel moment is null. Systems of parallel applied vectors.
Kinematics of a rigid body: The mathematical model of a rigid body. Body-fixed frames of reference. Angular velocity and Poisson formulas. The velocity field in a rigid body. Rigid motions and their classification. Euler angles. Lagrangian and Eulerian approach.. Eulerian velocity. Mozzi theorem.
Relative kinematics: Rate of change of a vector in a rotating frame. Velocity and acceleration addition theorems. Rolling of two surfaces.
Planar rigid motions: Center instantaneous of rotation. Analytical detection of the center.
Kinematics of holonomic systems: Constraints. Lagrangian coordinates and configuration space. Virtual and possible displacements. .Reversible and irreversible displacements.</td></tr>
</table>

Mass point geometry: The concepts of mass and density. Center of mass and its location. Inertia tensor. Eigenvalues and eigenvectors of the inertia tensor and their detection.. Huygens-Steiner theorem. Ellipsoid of inertia. Moment of inertia. The planar case.
Linear and angular moments. Kinetic energy. Center of mass frame of reference. Konig theorems. Application to a rigid body and to a holonomic system.
Work and potential: The concept of force. The work of a force. Conservative force. Work of a system of forces. Systems of conservative forces. Application to a rigid body and to an holonomic system
Classical mechanics principles: Friction. Constraints without friction. Principle of the constraint reactions. Pure rolling constraint.
Statics of a point:static equilibrium and rest. Point constrained on a surface without friction. Point constrained on a curve without friction.

Principle of virtual works: a necessary and sufficient equilibrium condition. Application to a rigid free body, to a rigid

body with a fixed point, with a fixed axis or with a sliding axis on a fixed line., to an holonomic system.
Statics equations: a necessary condition for the equilibrium. The case of a rigid body: the statics equations are necessary and sufficient for equilibrium. Applications of the statics equations to a rigid free body, to a rigid body with a fixed point, to a rigid body with a fixed axis, or with an axis sliding on a fixed line, to an holonomic system.
Dynamics of a material point: First integral, general and particular integrals. Kinetic energy theorem. The first integrals of the kinetic energy, ot total mechanical energy.
Relative dynamics: Kinetic energy theorem. The two-body problem .
Equations of the motion: Dynamics of a system. General and particolar integrals . Kinetic energy theorem. The first energy integral. Equation of mass center motion..
Lagrange equations: D'Alembert principle. Lagrange equations . Lagrange equations for potential forces. Generalized potentials. General and particular integrals of the motion of an holonomic system. First integrals. Cyclic coordinates**.**

Teaching methods:
Lectures and exercise sessions.

Auxiliary teaching:
Didactic material proided by the teacher

Assessment methods:
Oral exam.

Bibliography:

A. Strumia: MECCANICA RAZIONALE I, II. Edizioni Nautilus Bologna.
M. Fabrizio: Introduzione alla Meccanica Razionale e ai suoi metodi matematici. Zanichelli, 1997.