UNIVERSITÀ DI PAVIA

Anno Accademico 2021/2022

APPLIED MECHANICS

Enrollment year	2019/2020
Academic year	2021/2022
Regulations	DM270
Academic discipline	ING-IND/13 (APPLIED MECHANICS FOR MACHINERY)
Department	DEPARTMENT OF CIVIL ENGINEERING AND ARCHITECTURE
Course	CIVIL AND ENVIRONMENTAL ENGINEERING
Curriculum	Ingegneria civile
Year of study	3°
Period	2nd semester (07/03/2022 - 17/06/2022)
ECTS	6
Lesson hours	53 lesson hours
Language	Italian
Activity type	WRITTEN AND ORAL TEST
Teacher	CARNEVALE MARCO (titolare) - 9 ECTS
Prerequisites	This course is part of the basic mechanical education for the students of Industrial Engineering. To better attend the classes, the student should have attended the courses of Analisi matematica 1, Geometria e Algebra, Fisica 1 and got their basic knowledge. Among them we recall: Vector calculus, function limits, functions of one and two variables; scalar and vector products; moment of a force; potential energy and gravitational field; kinetic energy; work and power of a force.
Learning outcomes	The aim of the course is to provide the student with the basic skills necessary for the modeling and analysis of mechanical systems. At the end of the course the students will be able to write and solve the equations governing the kinematics and dynamics of mechanical systems (in the plane), also in the presence of mechanical transmissions and endothermic, electric and hydraulic propulsion

	systems. Students will be also able to analyse and understand the behaviour of a linear vibrating system, and they will know the main components of machines.
Course contents	a) Kinematics of the point, of the rigid body and of systems of rigid bodies in the plane. Constraint classification and pure rolling constraint. Relative motion theorem. Analysis of open and closed kinematic chains with the use of complex numbers: Scara manipulator, ordinary crank mechanism, four bar linkage, oscillating glyph. b) Statics of the rigid body and of rigid body systems. Static equilibrium equations. Virtual work principle for a system of rigid bodies, in the presence of conservative and non-conservative forces. c) Mass geometry: centre of gravity and mass moment of inertia. Parallel axis theorem for the moment of inertia. d) Dynamics of the rigid body and of rigid body systems. Equations of dynamic equilibrium according to D'Alembert. Contact forces: static and sliding friction, rolling resistance. Kinetic energy theorem and power balance. e) Dynamics of the one-degree-of-freedom machine. Transmission ratio and efficiency, direct and inverse motion, steady state and transient motion. Characteristic diagrams of engines, electric motors and users (resistance forces). Study of the starting transient in the case of linear drive torque. Study of the longitudinal dynamics of the motor vehicle. Rotor balancing. f) Vibrations of mechanical systems. Equation of motion of one-degree-of-freedom linear systems. Free motion and forced motion. Role played by damping. g) Machine components. Rolling bearings. Drive belts. Friction brakes. Friction wheels. Friction clutch.
Teaching methods	Lectures through which the student learns the main theoretical aspects of the subject. Exercises aimed at acquiring the skills and methodology necessary for the kinematic and dynamic analysis of mechanical systems. Computer lab (Matlab) through which the student learns to implement the kinematic solution of a mechanism by computer.
Reccomended or required readings	[1] FONDAMENTI DI MECCANICA TEORICA E APPLICATA 3/ED Mc Graw Hill Education Authors: Nicolò Bachschmid, Stefano Bruni, Andrea Collina, Bruno Pizzigoni, Ferruccio Resta e Alberto Zasso [2] Supplementary notes and exercises are available at https://elearning.unipv.it/course/view.php?id=1197
Assessment methods	The exam consists of a written test (2 hours and 30 minutes) and an oral test. The written test, aimed at verifying the skills acquired in modelling and solving kinematics and dynamics of mechanical systems, consists of two exercises related to the topics addressed in class during the exercises. Only the students who get a positive mark to the written test are admitted to the oral exam, the latter focusing on the entire course program. The final evaluation is based on the degree of depth and understanding

	of the topics presented. Both the written and oral test weights 50% of the final mark, the latter providing an assessment of thirty. During the written test it will be necessary to use a calculator. The result of the written test will be communicated via email, as a rule within 7 days from the written test date.
Further information	Supplementary material: https://elearning.unipv.it/course/view.php?id=1197
Sustainable development goals - Agenda 2030	$lbl_legenda_sviluppo_sostenibile