UNIVERSITÀ DEGLI STUDI DI PALERMO

DEPARTMENT	Ingegneria
ACADEMIC YEAR	2023/2024
MASTER'S DEGREE (MSC)	CIVIL ENGINEERING
SUBJECT	VIBRATIONS
TYPE OF EDUCATIONAL ACTIVITY	B
AMBIT	50353-Ingegneria civile
CODE	21621
SCIENTIFIC SECTOR(S)	ICAR/08
HEAD PROFESSOR(S)	PIRROTTA ANTONINA Professore Ordinario Univ. di PALERMO
OTHER PROFESSOR(S)	
CREDITS	9
INDIVIDUAL STUDY (Hrs)	129
COURSE ACTIVITY (Hrs)	96
PROPAEDEUTICAL SUBJECTS	
MUTUALIZATION	VIBRATIONS - Corso: INGEGNERIA DEI SISTEMI EDILIZI VIBRATIONS - Corso: BUILDING ENGINEERING
YEAR	1
TERM (SEMESTER)	1° semester
ATTENDANCE	Not mandatory
EVALUATION	Out of 30
TEACHER OFFICE HOURS	**PIRROTTA ANTONINA** Tuesday 15:00 16:30 F180

DOCENTE: Prof.ssa ANTONINA PIRROTTA

PREREQUISITES	Mechanism of continuous elasticity Geometry and linear algebra Structural Analysis Methods
LEARNING OUTCOMES	Knowledge and ability to understand Students will acquire a comprehensive understanding of vibrations and their far-reaching implications, developing skills for addressing complex challenges in their future careers. They will gain awareness of the pivotal that vibrations play in different engineering fields with insights into the impact of vibrations on structural design and urban infrastructure, enabling them to consider vibration-related challenges in urban planning and design. At the end of the course, the student will acquire knowledge and methodologies for originally solving vibration issues in both deterministic and random domains. These skills will be attained through active participation in lessons, through reading of the recommended texts, and participation in interdisciplinary seminars with Urban Planning and BIM teachers. Ability to apply knowledge and understanding At the end of the course, the student will be able to acquire interdisciplinary skills and develop independent Vibration mitigation projects along with methodologies for the study Vibration- induced effects. These skills will be developed through the presentation of case studies from the disciplines covered in the interdisciplinary course, namely Urban Planning and BIM, and through group activities such as exercises and laboratory sessions. Judgment autonomy The student will be able to critically analyze and effectively evaluate the risk of any actions of a dynamic nature applied to the structures from an interdisciplinary perspective. These skills will be developed through active engagement in lectures, careful examination of recommended readings, site visits (both guided and self-guided), collaborative group projects, laboratory activities, and active participation in debates and seminars. Communication skills The student will be able to communicate with competence and propriety of complex language problems of structure dynamics even in highly specialized contexts. These skills will be developed through classroom discussions, planned interdisciplinary lessons, and seminars. Additionally, these skills will be honed during laboratory sessions and through interactions during guided inspections with residents, community organizations, technical experts, and institutional figures. Learning ability - The student will be able to deal with the problems independently of the dynamics of the structures. - The student will be able to deepen complex issues such as: the Dynamic response to structures even to non-linear behavior, Dynamics of complex systems, random dynamics.
ASSESSMENT METHODS	Students will be evaluated through an intermediate test and a final exam. The intermediate test will encompass the interdisciplinary activities planned in collaboration with the teachings of Urban Planning and BIM (equivalent to 2 credits for Planning and BIM and 1 credit for Vibrations), and its results will contribute to the overall evaluation of the individual courses' final exams. In this case, student groups will be assessed based on the following criteria: (a) level of interaction with the subjects involved; (b) research skills; (c) problem-solving skills; (d) quality of the products produced. The exam score is awarded by a thirty-plus vote according to the following parameters: excellent (30-30 cum laude); Very good (26-29): Good (24-25); Satisfactory (21-23): Sufficient (18-20): Insufficient. The final exam will take into account the outcome of the intermediate test, and it will consist of an oral examination with the presentation of an assigned project. The interview involves open-response questions focused on the dynamic of structures subject to deterministic loads or stochastic loads such as wind or seismic phenomena, The student will have to demonstrate the ability to develop the basic knowledge acquired during the course by using them to overcome the practical problems and to express themselves with a technically correct language on the content of the teaching. Particular attention will be paid to the units of measurement of physical quantities of interest. The exam score is awarded by a thirty-plus vote according to the evaluation scheme in the bulletin board at the bottom of the site of the study site under "Metodi di valutazione".
EDUCATIONAL OBJECTIVES	The course aims to provide the student with criteria and methods for the design of any physical system solicited by external dynamic sources, starting from the calculation of the response in the time domain of single degree of freedom

	systems excited by deterministic forcing up to the calculation of the response in the frequency domain of systems with several degrees of freedom stressed by random forcing such as wind, earthquake, stormy sea etc.
TEACHING METHODS	Lectures, Classroom Exercises, Visits to the Dynamic Experimental Lab of DI. The lectures will be taught in english and the course will be entitled VIBRATIONS. During the course, an interdisciplinary training environment will be established in collaboration with the teachings of Urban Planning and BIM. This collaborative initiative aims at integrating different disciplinary views into the design of physical systems solicited by external dynamic sources, in order to encourage students' learning motivation, preparing them for future challenges in their professional and work practices. Specifically, the Vibrations course will provide the necessary knowledge to address critical issues related to dynamic forces acting on existing or hypothetical structures/infrastructures. The Urban Planning course will focus on regenerating a study area in response to prevalent environmental and social concerns while considering various stakeholder requirements. The BIM course will contribute to the innovation of the methods of representation, design and/or recovery and management of infrastructures and buildings. Therefore, a part of the Vibrations course will be dedicated to joint activities with the other involved courses including a guided inspection, three seminars, and two laboratory sessions. Interdisciplinary experimentation will be guided by principles such as Project Based Learning methodologies, inclusion (in teaching and design practice), action research and Tinkering, particularly suitable for engineering students. Among the transversal skills, the training project will contribute to consolidate/strengthen teamwork abilities, interdisciplinary training, problem-solving skills and the inclusion of any students with DSA or off-course. In order to promote inclusion, joint activities will be recorded and conducted in mixed mode and/or in the afternoon sessions.
SUGGESTED BIBLIOGRAPHY	Muscolino G., 2002, Dinamica delle Strutture, McGraw-Hill. ISBN : 8838609004 Thomson W.T., Dillon Dahleh M., 1997, Theory of Vibration with Applications, Pearson ISBN : 013651068X

SYLLABUS

Hrs	Frontal teaching
3	Introduction to the course Interdisciplinary Seminar 1: Presentation of the educational project in coordination with the teachings of BIM and Urban Planning: objectives, methodologies, timing, case study, and evaluation methods. Classroom discussion.
2	Single degree of freedom systems: free vibrations and forced vibrations
2	Interdisciplinary Seminar 2, in coordination with BIM and Urban Planning, aimed at discussing the outcome of the site visit, fostering critical reflection on the studied area, generating interest in collecting data, researching existing or ongoing plans and projects, and defining graphic representation methods.
1	Duhamel integral and step-by-step integration
2	Interdisciplinary Seminar 3, in coordination with BIM and Urban Planning, aimed at formulating analyses, problem-solving hypotheses, and representation methods for the studied area from the perspectives of the different disciplines involved.
2	Introduction to the multi degree of freedom systems; Properties of eigenvalues and eigenvectors
2	Modal Analysis for Multiple Degrees of Freedom; Modal truncation
1	Modal analysis for non-classically damped systems
2	Frequency domain analysis and frequency response function
1	Modal analysis of forced systems
2	Introduction to random dynamics, cumuland
1	Feature of the random variable
1	Two-dimensional random variables
1	N-dimensional random variables
1	Introduction to random processes
1	Correlation function
1	Stationary processes
1	Broadband signals, narrowband signals and white noise
1	Spectral Power Density Function

Hrs	Practice
8	Free and forced vibrations of the systems with single degree of freedom
2	Logarithmic decreasing method
3	Half-band bandwidth method
5	Free vibrations of multi-degree of freedom systems
4	Forced vibrations of multi-degree of freedom systems
4	Passive vibration control systems
3	Dynamic analysis of multi-storey buildings and project assignment
3	Design of a seismic base isolation system assisted by a designer freelance
2	Smart structures through innovative passive control devices to reduce vibrations in civil structures (Tuned Mass Dampers and Tuned Liquid Column Dampers)
6	Dynamics of the continuous system
8	stochastic vibrations

Hrs	Workshops
5	Numerical analysis of single degree of freedom systems using calculation software
3	Interdisciplinary Laboratory 1 for defining analyses (data, urban functions, mobility, planning and project forecasts, examples, conceptual maps, resource and criticality frameworks, etc.)
3	Interdisciplinary Laboratory 2 for outlining design hypotheses, structured in objectives and actions to be undertaken, exploring potential options.
5	Numerical analysis of multi-degree of freedom systems using calculation software
1	Frequency domain analysis using calculation software

Hrs	Others
3	Guided site visit to the studied area for the realization of a video/photographic report documenting the experience.