

COURSE DESCRIPTION – ACADEMIC YEAR 2023/2024

Course title	Machine Design
Course code	42179
Scientific sector	ING-IND/14
Degree	Bachelor in Industrial and Mechanical Engineering (L-9)
Semester	2
Year	3
Credits	6
Modular	No
Total lecturing hours	36
Total lab hours	24
Attendance	Required
Prerequisites	
Course page	Microsoft Teams and https://ole.unibz.it/
Specific educational objectives	<p>In a first part the course provides a basic introduction to the method of finite elements (FEM) and its application to the structural analysis in the field of machine design, with beam and plane elements.</p> <p>The second part of the course deals with machine elements and their design and application in mechanical systems.</p>
Lecturer	Carlo Gorla
Contact	carlo.gorla@polimi.it
Scientific sector of lecturer	ING-IND/14
Teaching language	English
Office hours	24 – by appointment
Lecturing Assistant (if any)	
Contact LA	
Office hours LA	
List of topics	<ul style="list-style-type: none"> ● Part 1: FEM ● Introduction to Finite Element Method ● 2D Bar and Beam Element ● Shape Functions, Stiffness matrix. Loads and boundary conditions ● Structural Plane Problems Plane Elements ● Part 2: Machine Elements ● Mechanical Springs. Types, classification, Properties, Stiffness, Leaf Springs, Helical Springs, Stresses, Assessment ● Transmission Shafts ● Shaft-Hub Connection ● Basics on Gears ● Rolling Bearings: Types, Properties, Application, Calculation of Life, Mounting conditions ● Design Application: Gearbox ● Pressure vessel design. Cylindrical shell and spherical end, Bolts, Flange, Gasket

Teaching format	Frontal lectures, exercises, Design Application with a Written report.
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Learning outcomes	<p>Knowledge and understanding:</p> <ol style="list-style-type: none"> 1. Knowledge of the basics of the Finite Elements Method 2. Fundamental machine elements and parts. <p>Applying knowledge and understanding:</p> <ol style="list-style-type: none"> 3. Application of FEM to simple cases 4. Design and assessment of a practical application consisting in a mechanical gearbox <p>Making judgments</p> <ol style="list-style-type: none"> 5. Conditions of applicability of the tools for structural analysis, analysis of a complex mechanical systems and identification of the required assessments and their criticality <p>Communication skills</p> <ol style="list-style-type: none"> 6. Writing a technical report of a design application <p>Learning skills</p> <ol style="list-style-type: none"> 7. Ability to identify the requirements of deeper investigations in a practical application
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Assessment	<p>Formative assessment</p> <table border="1"> <thead> <tr> <th>Form</th> <th>Length /duration</th> <th>ILOs assessed</th> </tr> </thead> <tbody> <tr> <td>Exercise on FEM</td> <td>2 x 2 hours</td> <td>3</td> </tr> <tr> <td>Exercise on machine elements with design application and written report</td> <td>10 x 2 hours</td> <td>4,6</td> </tr> </tbody> </table> <p>Summative assessment</p> <table border="1"> <thead> <tr> <th>Form</th> <th>%</th> <th>Length /duration</th> <th>ILOs assessed</th> </tr> </thead> <tbody> <tr> <td>Written Questions</td> <td>50%</td> <td>90 min</td> <td>1,2</td> </tr> <tr> <td>Oral Exam: discussion of the report</td> <td>50%</td> <td></td> <td>5,7</td> </tr> </tbody> </table>	Form	Length /duration	ILOs assessed	Exercise on FEM	2 x 2 hours	3	Exercise on machine elements with design application and written report	10 x 2 hours	4,6	Form	%	Length /duration	ILOs assessed	Written Questions	50%	90 min	1,2	Oral Exam: discussion of the report	50%		5,7
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Assessment language	English						
Assessment Typology	Monocratic						
Evaluation criteria and criteria for awarding marks	<table border="1"> <thead> <tr> <th>Form</th> <th>Weight</th> </tr> </thead> <tbody> <tr> <td>Written Questions</td> <td>Correct Answers (100%)</td> </tr> <tr> <td>Oral Exam: discussion of the report</td> <td>Report (40 %) Correctness of the Results (30%) Critical Discussion (30%)</td> </tr> </tbody> </table>	Form	Weight	Written Questions	Correct Answers (100%)	Oral Exam: discussion of the report	Report (40 %) Correctness of the Results (30%) Critical Discussion (30%)
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Required readings	<i>Lecture notes and documents for exercise, that will be available on the course site</i>						
Supplementary readings	<ul style="list-style-type: none"> • COOK, R.D., Finite Element modeling for stress analysis, L Wiley & Sons, 1995 (ENG) • P. DAVOLI, M. FILIPPINI, C. GORLA, A. LO CONTE, Lezioni sugli organi di macchine, Politecnica (ITA) • Shigley's Mechanical Engineering Design, McGraw-Hill (ENG) • G. NIEMANN, H. WINTER, Maschinenelemente, Springer (GER) 						
Software used							