Freie Universität Bozen
Libera Università di Bolzano
Università Liedia de Bulsan

Syllabus
Course description

Course title	Design with Composite Materials
Course code	47564
Scientific sector	ING-IND/21
Degree	Master in Industrial Mechanical Engineering
Semester	1
Year	2
Academic year	2024/2025
Credits	5
Modular	No

Total lecturing hours	28
Total lab and exercise hours	18
Attendance	Not mandatory but strongly recommended
Recommended preliminary knowledge	basic material science, construction and production technologies, experimental physics
Connections with other courses	Design and manufacturing of industrial products, Advanced Topics on Machine Design, Finite Element Analysis
Course page	https://www.unibz.it/en/faculties/engineering/master-industrial-mechanical-engineering/course-offering/?academicYear=2024

Specific educational objectives	Achieving an understanding of composite materials as an important technical means beyond structural applications; to be able to select material combinations based on the external load acting on the object; to get acquainted with different approaches to composite material design with an additional perspective on nature and biological inspired approaches; to gain knowledge on how to characterize composite materials and to assess their failure in operation to derive design optimizations

Lecturers	Dr.-Ing. Leibenguth Peter peter.leibenguth@unibz.it
Scientific sector of the lecturers	ING-IND/14
Teaching language	English
Office hours	15
Teaching assistant *(if any)*	none
Office hours	Upon appointment to be agreed via email, preferably after course times

List of topics covered	1. General introduction to composites and their history 2. Materials in composite technology 3. Technical applications going beyond the structural use 4. Production and processing technologies 5. Interfaces and surfaces 6. Behaviour of composites: lab v. operational conditions 7. Design and construction a. Classical toolsets b. Biomimetics and nature-inspired approaches c. Optimization technologies d. Material selection strategies 8. Joining technologies 9. Destructive and non-destructive characterization 10. Failure assessments and their impact on design 11. Recycling and sustainability considerations
Professional applications of the covered topics	Widespread application in automotive, aerospace, medical and sporting good products and technologies
Teaching format	Lecture and exercise

Learning outcomes (ILO)	**1. Knowledge and understanding:** Students should know the theoretical background of diverse composite materials from materials, processing, calculation, and design perspective **2. Applying Knowledge and understanding:** Students should be able to discern the different properties and production methods of the basic material classes from those of composite materials. They should be able to select and use basic calculation methods to determine composite behaviour from data of the constituent materials. **3. Making judgments:** Students should be able to critically decide when to employ composite materials in component/product design, how to experimentally assess their properties and how to use failure cases analyses as a means to improve designs. **4. Communication skills:** Students should be able to present results of the exercises and contributions to discussions/own talks in appropriate technical/scientific language. **5. Learning skills** Students should be able to autonomously search and critically appraise technically relevant data, publications and case studies.

<table>
<tr><td>Assessment</td><td>Formative assessment
<table>
<tr><th>Form</th><th>Length /duration</th><th>ILOs assessed</th></tr>
<tr><td>In-class exercises</td><td>9 x 120 min</td><td>1, 2, 3, 4, 5</td></tr>
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Summative assessment
<table>
<tr><th>Form</th><th>%</th><th>Length /duration</th><th>ILOs assessed</th></tr>
<tr><td>Written exam</td><td>100 %</td><td>2 hours</td><td>1, 2, 3, 4</td></tr>
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<tr><td>Assessment language</td><td>English</td></tr>
<tr><td>Evaluation criteria and criteria for awarding marks</td><td>Performance in written exam</td></tr>
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<tr><td>Required readings</td><td>T.W. Clyne et al., "An Introduction to Composite Materials", Cambridge University Press, 3rd ed., 2019, ISBN 978-0-521-86095-6

K.K. Chawla, "Composite Materials – Science and Engineering", Springer, 4th ed., 2019, ISBN 978-3-030-28982-9

M.F. Ashby, "Materials Selection in Mechanical Design", Butterworth-Heinemann, 5th ed., 2017, ISBN 978-0-08-100599-6</td></tr>
<tr><td>Supplementary readings</td><td>J. Rösler et al., "Mechanisches Verhalten der Werkstoffe", Vieweg+Teubner, 3rd ed., 2008, 978-3-8351-0240-8

M.F. Ashby, "Materials and the Environment – Eco-informed Material Choice", Butterworth-Heinemann, 3rd ed., 2021, ISBN 978-0-12-821521-0

C. Mattheck, "Design in Nature – Learning from Trees", Springer, 1st ed., 1998, ISBN 978-3-642-58747-4</td></tr>
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