Studiengang: *Program:*	**Master of Science Maschinenbau** *Master of Science in Mechanical Engineering*			FACH HOCHSCHULE LÜBECK University of Applied Sciences
1 Modul: *Module:*	**Composite Materials** *Verbundwerkstoffe*			**English** *Englissh*
Fach-Nr. *Course number*	**Semester** *Semester*	**Dauer** *Duration*	**Status** *Status*	**Turnus** *Regular cycle*
	2. Semester	1 Semester	elective	annual
Kreditpunkte *Credits*	**Aufwand** *Workload*	**Kontaktzeit** *Contact-hours*	**Selbststudium** *Student's efforts*	
5 ECTS	150hrs	4hrs/week = 60h lecture	30hrs exam preparation 30hrs cont. preparation and exercises 30hrs Self-study	

2 Beschreibung
Description

Composite materials are increasingly used in mechanical and system engineering design. However, designing with composite materials is quite different from designing with conventional materials: The composite materials and their property profiles have to be tailored to the according application and the processing technologies are quite different from other materials.

3 Lernziele
Learning Outcomes

- The student will be able to choose the most suitable fibre type among the available fibres for certain practical applications,
- to select the most suitable matrix material,
- and the most suitable preform and processing method.
- The student will be able to derive the in-plane properties of laminates (elastic behaviour, strength, thermal expansion coefficient, internal thermal stresses) from simple fibre and matrix data and to tailor laminate properties to external loads.

4 Schlüsselqualifikationen
Key qualifications

Sozialkompetenz *Social Competence*	Methodenkompetenz *Competence in Methods*	Selbstkompetenz / Personenkompetenz *Self-Competence Personal Competence*	Interkulturelle Kompetenz *Intercultural Competence*	Medienkompetenz *Media-Competence*
	X	X		

5 Lehrveranstaltung/ -methoden
Course type and methods

Lecture

- Seminar-like teaching
- Exercises and examples (case studies)

6 Vorbedingungen / Vorkenntnisse
Prerequisites

- Basic knowledge of polymers and polymer processing
- Good understanding of material mechanics and stress distributions

7 Arbeitsmittel / Literatur
Required material / Literature

- O. Jacobs, Composite Materials, Manuscript, FH Lübeck
- D. Hull, An introduction to composite materials, Cambridge Univ. Press
- R.F. Gibson, Principles of Composite Materials Mechanics, McGraw Hill
- A. Kelly, C. Zweben (eds.), Comprehensive Composirte Materials, Vol. 1-6, Elsevier, Amsterdam et al.

Detailinformationen

8 Inhalte

Course topics

Introduction

- Technical and economic significance of composite materials,
- typical applications and problems,
- overview: classification of composite materials

Fibres and matrices

- CF, GF, AF, other synthetic and natural fibres: structures and properties, selection rules
- Thermoplastics, thermosets, elastomeres: properties and processing, selection rules
- Tayloring of interfaces: internal stresses, adhesion, coupling agents

Processing of polymer composites

- Textile processing of fibres (knitting, brading, weaving, stiching etc.), semi-finished products (pultrusion, prepregs, textile preforms,…), manufacturing of composite components (lamination, RTM, filament winding etc.).
- Effects of processing method on mechanical properties
- Processing of short fibre reinforced polymers and resulting microstructures (anisotropy)

Micromechanics

- Fibre/matrix interaction, rules of mixture, internal stresses,
- Properties of UD laminae and of textile preforms

Calculation of laminate properties

- Network theory, calculation of optimal fibre orientations, symmetry considerations
- Laminate theory: calculation of elastic constants and strength of laminates, laminates under stress (stress distribution, interaction of laminae), hygrothermal stresses and their effects on laminate properties
- Stresses at edges: FEM

Failure mechanisms in fiborous laminates

- Failure modes under static loading: fibre matrix debonding, matrix cracking, fibre fracture, delamination
- Damage development under cyclic stresses
- Failure criteria and calculation of laminate failure

Designing with composite materials

- Tailoring of material properties to loadings
- Joining of composites
- Design to manufacture rules

Practice

- Laboratory: Production and testing of RTM specimens, anisotropy of injection moulded parts
- Visit at a company

9 Prüfungsform

Assessment

Written exam at the end of the term: 2 hours

10 Voraussetzung für die Vergabe von Kreditpunkten

Requirements for granting of credits

Successful passing of exam

11 Weiterführende Veranstaltungen

Related courses

Master Thesis

12 Zuordnung

Classification

Mathematik & Naturwissenschaft *Mathematics & Natural Sciences*	Ingenieur-wissenschaften *Engineering Science*	Ingenieur-anwendungen *Engineering Application*	Entwicklung & Konstruktion *Design*	Werkstoffe *Material*	Wirtschaft, Management, Sprachen *General Education*	Anderes *Other*
X	X	X	X	X		

13 Modulbeauftragter / Lehrpersonen

Responsible person / Lecturers

Prof. Dr. Jacobs/ Prof. Dr. Jacobs