Faculty of Technology and Science
Mechanical and Materials Engineering

Syllabus

Course Approval
The syllabus was approved by the Faculty Board of Technology and Science on 17 October 2011 , and is valid from the Autumn semester of 2009 at Karlstad University.

Course Code: MTAE10
Polymers and polymer based composites, 7.5 ECTS Credits
(Polymerer och polymerbaserade kompositer, 7.5 Swedish credit points)
Degree Level: Master
Progressive Specialisation: A1N (Second cycle, has only first-cycle course/s as entry requirements)

Language of Instruction
Swedish or English

Prerequisites
Mechanical Engineering 75 ECTS cr, including materials engineering courses 15 ECTS cr and solid mechanics with basic FEM 15 ECTS cr, or equivalent

Major Field of Study
MTA (Mechanical Engineering)

Learning Outcomes

Upon completion of the course, students should be able to:
- give an account of the concepts monomers, polymers and plastics,
- describe the two main classes of polymer induced reactions (stage or chain reactions),
- give an account of the concept copolymerisation and its variants,
- give an account of the concept molecular weight and molecular weight distribution,
- explain what the concept part-crystallinity entails and describe the hierarchical structure of part crystalline polymeres and how these can be studied experimentally,
- explain the concept glass transition and estimate glass temperature based on a known construction,
- give an account of kinetic, free volume and thermodynamic theories on glass transition,
- explain the relation between chemical structure and the properties of materials,
- give an account of the concept viscoelasticity, linear and non-linear, and the consequences caused by viscoelasticity in calculating the mechanical properties of polymer materials,
- give an account of the testing methods tensile testing and creep testing and of how external factors such as temperature affect the mechanical properties,
- give an account of the difference in the effect of static and dynamic load,
- give an account of different processing methods,
- explain the basic condition for the elasticity of rubber,
- identify and describe the different classes of polymer materials and for each class give examples of commercial materials and their applications,
- explain the relation between the structure of composites and their macroscopic properties,
- give an account of the main mechanisms controlling the behaviour of composites and how they affect elastic properties and break properties,

- use and formulate simulation tools for laminate analysis,
- choose a suitable polymer material for a given simple application with regard to structure, properties and commercial availability.

Content and Form of Instruction

Instruction is in the form of lectures and seminars, in regard to polymer materials, dealing with molecular construction, organisation, structure, use and properties, basic concepts, materials information, rubber elasticity and rubber materials, viscoelasticity, testing methods and the handling of materials data, selecting materials and moulding techniques.

In regard to fibre- and particle-reinforced composite materials with polymer matrices the focus is on analysis methods, properties and manufacturing techniques, the importance of geometrical aspects, interface and static effects, micromechanism-based models for unidirectional composites, the thin lamella mechanics and laminate theory, thermomechanical effects and break mechanisms.
The course includes mandatory laboratory work with the manufacturing of fibre composite materials and testing of their mechanical properties.

Reading List

See separate document.

Examination

Assessment is based on a written exam, hand-in assignments and participation in mandatory laboratory sessions.

Grades

One of the grades Fail, 3 (Pass), 4 (Pass not without Distinction) or 5 (Pass with Distinction) is awarded in the examination of the course.

Quality Assurance

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course assessment is based on student views and experiences as reported in written course evaluations and/or group discussions. Students will be informed of the result of the evaluation and of the measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional Information

Students who enrolled before 1 July 2007 will complete their studies in accordance with the requirements of the earlier admission. Upon completion students may request degree and course certificates to be issued under the current ordinance if they meet its requirements.

The local regulations for studies at the Bachelor's and Master's levels at Karlstad University stipulate the obligations and rights of students and staff.

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