



Course: **Mechanics of Fibre Networks and Materials**

Course leader: **Prof. Artem Kulachenko**

Date: **Oct. 14-18, 2019**

All lectures will be held in
Seminar Room, Department of Solid Mechanics, KTH
Teknikringen 8D, 1st floor

6 ECT Credits

KTH course code: SE3048

Examiner: Prof. Artem Kulachenko, KTH

Literature: *Mechanics of paper products* (2012), Walter de Gruyter GmbH & Co. KG, Berlin, Germany.

Examination: Home assignments and written examination

Time table and course contents

Time	Instructor	Contents
Monday, 2019-10-14 10.15-12.30	Prof. Sören Östlund KTH Royal Institute of Technology, Stockholm	<i>Paper as an engineering material</i> Linear elasticity of paper, stress-strain behaviour of paper, visco-elastic effects, mechanical properties in relation to the papermaking process, preparation of papermaking fibres, effect of the paper machine
13.30-15.00	Prof. Sören Östlund	<i>Paper as an engineering material</i> Test methods
15.15-17.00	Prof. Sören Östlund	<i>Packaging performance</i> Corrugated board, box manufacturing process, carton board, loads imposed on boxes, strength of boxes, short-term compressive loading, empirical models for static box strength, finite element models, long-term loading
Tuesday, 2019-10-15 8.15-11.00	Prof. Mikael Nygårds RISE Bioeconomy, Stockholm	<i>Behaviour of corners in carton board boxes</i> Folding of a multiply carton board, creasing, important material properties
12.15-15.00	Prof. Artem Kulachenko KTH Royal Institute of Technology, Stockholm	<i>Web dynamics in paper transport systems</i> Dynamics of web transport, basic formulation of web transport problems, the case of an axially moving web, moving thread problem, fluttering of a two-dimensional web
15.15-17.00	Prof. Artem Kulachenko	<i>Statistical aspects of failure of paper products</i> Web breaks in printing press and on paper machine, stacking performance of boxes, statistical approaches for failure in materials or systems, the chain model, the bundle model, time-dependent, statistical failure model, statistical failure of paper
Wednesday, 2019-10-16 8.15-11.00	Prof. Sören Östlund	<i>Fracture properties</i> Crack tip modelling in paper materials, linear elastic fracture mechanics LEFM, non-linear fracture mechanics using J-integral, cohesive zone models, continuum

		damage mechanics, compressive failure
12.15-16.00	Prof. Sören Östlund	<i>Creep and relaxation</i> Relaxation and creep as phenomena, modelling of time-dependence, creep and relaxation properties of paper, moisture effects, accelerated creep, prediction of box lifetime, creep response of a box
Thursday, 2019-10-17 8.15-12.00	Prof. Artem Kulachenko KTH Royal Institute of Technology, Stockholm	<i>Moisture-induced deformations</i> Moisture-induced deformations, hygroexpansion of paper, fluting, cockling
13.15-17.00	Prof. Artem Kulachenko	<i>Mechanics in printing nip for paper and board</i> Nip mechanics in offset printing of paper, nip mechanics in flexographic post-printing of corrugated board, micro-fluidics of ink in printing nip
17.00-19.00	Course buffet dinner	
Friday, 2019-10-18 8.15-11.00	Prof. Artem Kulachenko	<i>Micromechanics</i> Fibre network structure, two-dimensional network, densification mechanisms, elastic modulus, stress-strain behaviour, creep and bond opening, fracture process in the fibre network, hygroexpansion
(Preliminary) Monday, 2019-11-18 8.00-12.00 Department of Solid Mechanics, Seminar room, Teknikringen 8D, 1 st floor, alternatively at your own organisation		Written examination