



FOREST PRODUCTS INDUSTRY  
RESEARCH COLLEGE



Skogsindustriella  
forskarskolan

## Course: **Paper Mechanics**

Course leader: **Assoc. prof. Artem Kulachenko**

Date: **Oct. 16-18, and 23-24, 2017**

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

### **6 ECT Credits**

**Examiner:** Assoc. 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
<i>Week 42:</i>		
<b>Monday, 2017-10-16</b> 10.15-12.30	<b>Prof. Sören Östlund</b> 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
<b>Monday, 2017-10-16</b> 13.30-15.00	<b>Prof. Sören Östlund</b>	<i>Paper as an engineering material</i> Test methods
<b>Monday, 2017-10-16</b>  15.15-17.00	<b>Prof. Sören Östlund</b>	<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
<b>Tuesday, 2017-10-17</b>  8.15-11.00	<b>Prof. Mikael Nygårds</b> RISE Bioeconomy, Stockholm	<i>Behaviour of corners in carton board boxes</i> Folding of a multiply carton board, creasing, important material properties
<b>Tuesday, 2017-10-17</b>  12.15-15.00	<b>Prof. Tetsu Uesaka</b> FSCN, Mid Sweden University, Sundsvall	<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
<b>Tuesday, 2017-10-17</b>  15.15-17.00	<b>Prof. Tetsu Uesaka</b>	<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
<b>Wednesday, 2017-10-18</b>  8.15-11.00	<b>Prof. Sören Östlund</b>	<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

<b>Wednesday, 2017-10-18</b> 12.15-16.00	<b>Prof. Sören Östlund</b>	<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
		<b>Home assignments</b>
<i>Week 43:</i>		
<b>Monday, 2017-10-23</b> 8.15-12.00	<b>Prof. Artem Kulachenko</b> KTH Royal Institute of Technology, Stockholm	<i>Moisture-induced deformations</i> Moisture-induced deformations, hygroexpansion of paper, fluting, cockling
<b>Monday, 2017-10-23</b> 13.15-17.00	<b>Prof. Artem Kulachenko</b>	<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
<b>Monday, 2017-10-23</b> 17.00-19.00	<b>Course buffet dinner</b>	
<b>Tuesday, 2017-10-24</b> 8.15-11.00	<b>Prof. Artem Kulachenko</b>	<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
<i>Week 47 (preliminary):</i> <b>Monday, 2017-11-07</b> 8.00-12.00 Department of Solid Mechanics, Seminar room, Teknikringen 8D, 1 <sup>st</sup> floor, alternatively at your own organisation		<b>Written examination</b>