CHEM-C3410 Nanomaterials

Course Information 2021

AALTO UNIVERSITY

SCHOOL OF CHEMICAL ENGINEERING

Teachers

Responsible Teacher:

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Course Assistants:

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After this course you can

- **Understand why nanomaterials are different from bulk materials**
- **Classify nanomaterials and give examples of different synthesis and characterisation methods**
- **Understand the main electric, optic, magnetic, dielectric, thermal and mechanical phenomena observed in nanomaterials**
- **Discuss about the critical issues related to nanomaterials like stability, nanotoxicity and nanosafety**

Course consists of

LECTURES in ZOOM (Period I)

- MON 10-12 and TUE 08-10

EXERCISES in Hybrid mode, coronavirus allowing (Period I)

- THU 09-12: Aluminium & Platinum (Circular Raw Materials Hub, Vuorimiehentie2) and ZOOM

SCIENCE PROJECT in ZOOM (choose always either a, b, or c)

- Discussions 1a-b and Discussions 2a-c
- Video Session A-C

ONLINE GROUP EXAM

- Course exam: 25th October or 14th December
- Make-up exam: 22nd February (remember to register also in SISU)

Course Material (for the exam)

1. M.F. Ashby, P.J. Ferreira, D.L. Schodek: Nanomaterials, Nanotechnology and Design - An Introduction for Engineers and Architects, Elsevier 2009.
   pp. 177-239, 257-290. (e-book)

2. G. Cao, Y. Wang: Nanostructures and Nanomaterials - Synthesis, Properties and Applications, World Scientific 2004.
   pp. 26-42, 205-208, 238-249. (e-book)

3. A. K. Geim, K. S. Novoselov, The rise of graphene,
   Nature Materials **6** (2007) 183-191.
   ONLY pp. 183-186 and 189-191. (a paper)

4. H. Hu, D. Li, Y. Gao, L. Mu, Q. Zhou, Knowledge gaps between nanotoxicological research and nanomaterial safety,
   Environment International **94** (2016) 8–23.
   ONLY chapters 1-3. (a paper)

5. **Short video lectures, available in MyCourses**

6. **Other course material** such as lecture slides and exercises

All course material can be found from MyCourses:

Links to electronic books and papers, short video lectures, lecture slides etc.

Course Schedule 2021
Period I

WEEK / Dates	THEME	LECTURE 1 Mon 10-12	LECTURE 2 Tue 08-10	WED, 23:59pm Exercise submission	EXERCISE SESSION THU 09-12
Week 37: 13.9.-19.9.	**Introduction & Stability**	Introduction to Nanoscale Science	Stability: Ostwald Ripening and DLVO theory	-	Exercises 1
Week 38: 20.9.-26.9.	**Synthesis & Carbon Nanomaterials**	Synthesis of Nanomaterials and Self-Assembly	Carbon Nanomaterials	*Submit Exercises 1 to MyCourses*	Exercises 2
Week 39: 27.9.-3.10.	**Properties at Nanoscale I-II**	Properties at Nanoscale I: Electrical Properties	Properties at Nanoscale II: Optical	*Submit Exercises 2 to MyCourses*	Exercises 3
Week 40: 4.10.-10.10.	**Properties at Nanoscale III-IV**	Properties at Nanoscale III: Magnetic and Dielectric Properties	Properties at Nanoscale IV: Mechanical and Thermal	*Submit Exercises 3 to MyCourses*	Exercises 4
Week 41: 11.10.-17.10.	**Characterization & Nanotoxicity**	Characterization	Nanotoxicity and Nanosafety	*Submit Exercises 4 to MyCourses*	Exercises 5
Week 42: 18.10.-24.10.	**Start of Science Project**	Science Project Discussion 1A	Science Project Discussion 1B	*Submit Exercises 5 to MyCourses*	**Review of the theory part of the course**

Student goes either to A or B session: basics of the topics, can go both if want.

Course Schedule 2021
Period II

WEEK / Dates	MON 10-12	WED 10-12	THU 10-12
Week 44: 1.11.-7.11.	Science Project Discussion 2A	Science Project Discussion 2B	Science Project Discussion 2C
Week 45: 8.11.-14.11.			
Week 46: 15.11.-21.11.			
Week 47: 22.11.-28.11.			
Week 48: 29.11.-5.12.	**Science Project Video Session A (2 h)**	**Science Project Video Session B (2 h)**	**Science Project Video Session C (2 h)**
Week 49: 6.12.-12.12.	Independence Day		

Discussion 2: Asking questions, showing video tools

Group goes either to **A, B or C session**

Monday 6th December – Finland's Independence Day

Three alternative exam times: only ONE needs to be passed

Course Exam - option 1: 25th October 2021, 09:00-13:30
remember to choose the group by 17th October

Course Exam - option 2: 14th December 2021, 09:00-13:30
remember to choose the group by 6th December

Make-up Exam: 22nd February 2022, 09:00-13:30
remember to 1) register in **SISU** and 2) choose the group by 14th February

Grading Criteria

TASK	Points	TOTAL	To pass the course	Note
Lectures	-	**-**	**-**	
Exercises	5 weeks x 3 p/week	**15 p**	**-**	*PERIOD I: Submitted to MyCourses on* ***Wednesdays 23:59pm on the next week***
Science Project	<u>Group Grading</u> Video: 12 p <u>Individual Grading</u> Questions: 3 p	**15 p**	• **Video submitted on time** • **Present in one Video Session**	*PERIOD II:* • *Submitted to MyCourses* ***SUN 28th November*** • ***Showing a video + asking at least ONE question*** *in one Video Session (A, B or C)*
Exam	4 questions x 5 p	**20 p**	**Min. 7 points**	
TOTAL		**50 p**	**23 p**	

Exercises

Exercise sessions in Period I, THU 09-12

- "Place" to come and make calculation, and get hints & help from teachers
- In each session, the questions of that week are discussed
- Joining Exercise Sessions is totally voluntary

Exercises are published in MyCourses when the course starts

- 3 Questions / Week and 1 p / question
- 5 Weeks
- **TOTAL: 15 points**

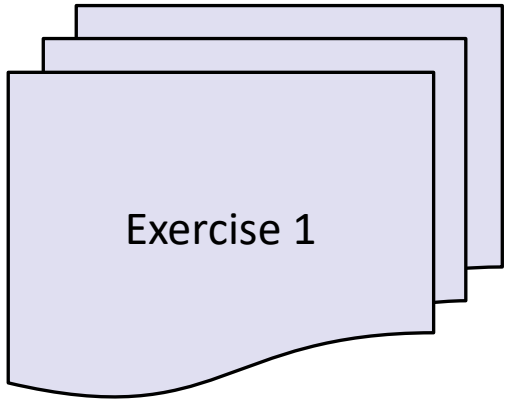
Exercises submitted to MyCourses weekly

- **Wednesdays 23:59 pm, one week AFTER the session in question**
- Calculations, multichoices and Excel exercises are automatically assessed
- Essays are assessed by teachers

Hybrid Exercise Sessions: Attend either Face-to-Face or in ZOOM

Due to corona situations,
limited capacity in the lecture halls
→ If you are coming to
Face-to-Face Exercise Session in campus
(*Vuorimiehentie 2, Aluminium or Platinum*):

1) **Pre-register to each exercise session separately in MyCourses** *(Max. capacity 57 students)*:
   - You cannot enter the lecture hall without this pre-registration
   - Register only if you are truly coming, and cancel if not attending
2) **Come only if you are healthy**
3) **Wearing a mask is strongly recommended, as well as using Koronavilkku app**



No need to register separately to ZOOM session, pre-registration ONLY if you attend Face-to-Face session

Science Project: Making a Video about Nanomaterials

https://aalto.cloud.panopto.eu/Panopto/Pages/Viewer.aspx?pid=6773cd9e-fe1b-4029-90a1-ad9800c72f67

Science Project is Performed in Groups of 2-4 students

Choose one 0D nanomaterial (=one material and one shape) and find from literature

1) one example of how it can be prepared
2) how could you control at least one type of physical property (electrical, optical, etc.)
3) how could you monitor or image the shape and/or behaviour of these 0D materials
4) find a killer application related to one of the following UN Sustainable Development Goals: 2, 3, 6, 7, 13 or 14

Remember to keep in mind the environmental framework.

Science Project Timetable

PERIOD I			
WEEK / Dates	**LECTURE 1 Mon 10-12**	**LECTURE 2 Tue 08-10**	**Agenda**
Week 42: 18.10.-24.10.	**Science Project Discussion 1A** UN Sust. Development Goals: 2, 3, 6	**Science Project Discussion 1B** UN Sust. Development Goals: 7, 13, 14	• Sustainability and UN Goals • How to use Panopto • How to search for papers and read them • If you have no group, come and find one • Groups formed by the end of this week

PERIOD II				
WEEK / Dates	**Mon 10-12**	**Wed 10-12**	**Thu 10-12**	**Agenda**
Week 44: 1.11.-7.11.	**Science Project Discussion 2A**	**Science Project Discussion 2B**	**Science Project Discussion 2C**	• Book a session (as a group) and come and ask for help
Week 47	**Submit your Group's Video to MyCourses no later than SUNDAY 28th November, 23:59pm** Format: mp4 (max. 200 MB). If the video is too large, submit a Word document with the link to the video: remember to change also the video settings so that people with the link can view the video			
Week 48: 29.11.-5.12.	**Science Project Video Session A**	**Science Project Video Session B**	**Science Project Video Session C**	• Book a video presentation time • Present your video • Watch other videos • Ask at least one question of someone else's video

Science Project Grading

Make 10-15 min video

- Submit to MyCourses **SUN 28th November**
- Be present in the Video Session (A, B or C) of your group

Grading

Video (Group grading: 0-12 p)

- Scientific content: 7 p, Fun factor : 2 p, Clarity :2 p, Subtitles: 1 p (remember references, e.g. the last slide with a reference list)

Questions in Video session (Individual grading: 0 p or 3 p)

- Ask at least one question from someone else's video in one of Video Sessions A, B or C

Online Group Exams

All questions related to the exam to be asked publicly in teaching sessions

- No private chats or emails
- Not in Breakout Rooms but lecture hall or big room in ZOOM
- During exam: only if emergency, not “help/problem with question X”
  - If there is a mistake in questions, it will be taken care in grading: everyone has the same mistake
  - Just write it in your exam paper

Possible Exam Times

- **Exam: 25th October 2021, 09:00-13:30**
  remember to choose the group by 17th October

- **Exam: 14th December 2021, 09:00-13:30**
  remember to choose the group by 6th December

- **Make-up Exam: 22nd February 2022, 09:00-13:30**
  remember to register in **SISU** and choose the group by 14th February

There are three possible times to take the exam.

- You need to pass only one exam (min. 7 points).
- You can attend even all of the exams if you want: the best grade will be valid.

You cannot make this course simply by exam = Science Project is compulsory

ONLINE Group Exam

- **Exam is done in groups of 1 – 3 persons**
  - The whole group will get the same points
  - The group must be chosen in MyCourses a week before the exam
    - **CHOOSE THE GROUP ALSO IF YOU TAKE THE EXAM ALONE (OTHERWISE YOU CANNOT SUBMIT THE EXAM TO MYCOURSES)**
  - *If someone randomly joins your group: inform Kirsi Yliniemi 6 days before the exam and the person is removed (he/she will do the exam alone)*
- **All communication is allowed within the group, but communication is NOT allowed outside the group**
- **You are allowed to use course material or google but you are NOT allowed to ask help outside your group (not ask help from friends, partners, chats, forums etc.)**

You need to pass only
ONE of the following exams:

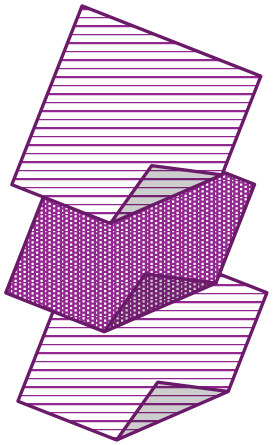
TWO POSSIBILITIES FOR COURSE EXAMS
25th October, 09:00-13:30
14th December, 09:00-13:30
- Choose the group in MyCourses

MAKE-UP EXAM
22nd February 2022, 09:00-13:30
- Choose the group in MyCourses
- Register also in SISU

ONLINE Group Exam

How does this work?

- Choose the exam group in MyCourses one week before the exam
- Questions are published in MyCourses at the start of the exam
- Answer to the questions as a group
- Combine answers **to ONE PDF file and submit to MyCourses** before the exam time is finished
  - You can answer by pen/pencil +paper, by computer or both
  - For essays etc. text you may use computer (it is actually preferred), but of course you can also write answers by hand.
  - Calculations you can do by hand or by computer: but you always must show equations & substitution of numbers to all necessary steps, unit analysis, correct accuracy (simple copy-paste from Excel sheet is not enough)
  - Hand-written answers: take a photo and embed to the Word-document on which you have answers by computer. Check that everything is readable.
  - Create then a pdf.



HINT! Save the last 30 mins of the exam time to combine answers, create pdf and submit to MyCourses

The exam is planned so that 4 h is enough to answer to the questions.

Exam Questions

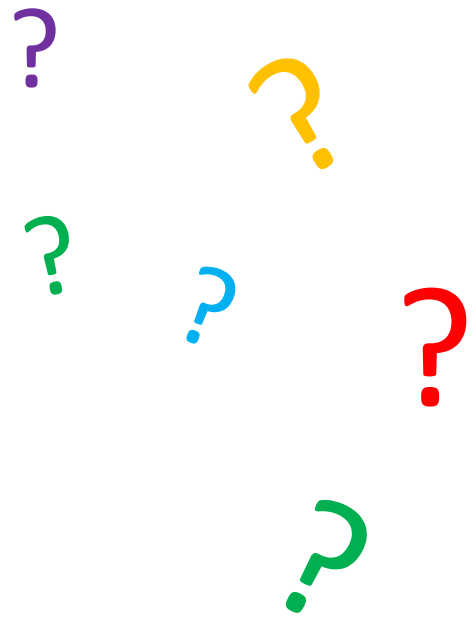
Answer to all 4 questions (each question 5 p)

- A question may have (a), (b), etc. parts

→Answer all these oarts

A question can be

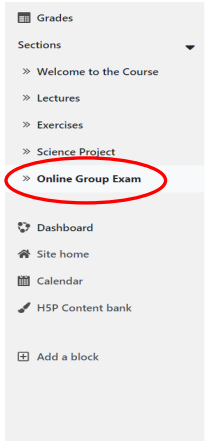
- A calculation
- An essay or explanation of some observation
- Explanation of a research result
- A combination of all above
- *Hint: more essays& explanations than calculations*

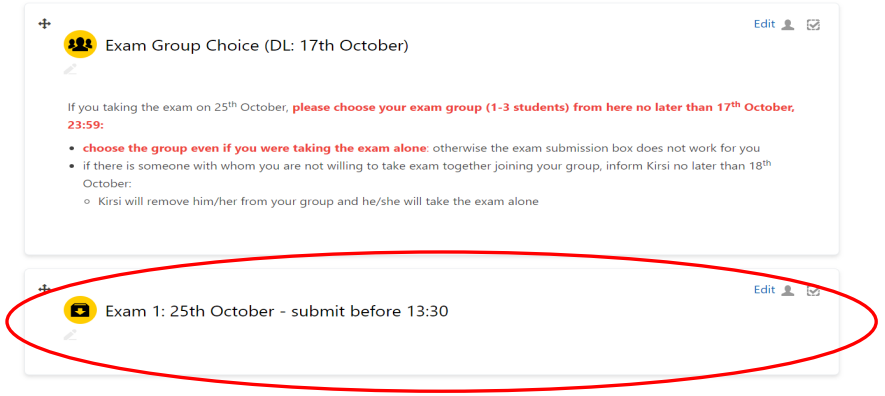


Always when answering,
think that you are showing what you know,
not testing what the reader knows
(i.e. do not make the reader to guess)

When the Exam Starts

- Go to the MyCourses
- **Refresh your browser at the starting time of the exam**
- The exam submission box should become visible
- Exam questions can be found from the Submission box





Click this open and you will find the questions

Depth of Answering in Exam

- As this is an Open Book type exam (i.e. all material is allowed) the **exam is evaluated based on the depth of understanding** rather than a simple statement of key facts (e.g. NO bullet point list).
- All text should be your own, i.e. no copy-pasting from any sources.
- In essays, **do not make reader to guess what you know and mean, but write it clearly out, i.e. in-depth answers required.**
- In calculations, show the equations & the different steps (**with substituted numbers and unit analysis**) used and use the correct accuracy.
  - *Simply copy-paste from Excel sheet is not enough.*
- It is allowed to use course material and Google/Search Engines.
- You can use schematics & figures (also from the books, papers etc. you may find) to make your explanations deeper BUT you must also explain them in your written answer.

Submitting Your Exam Answers

Must be done before the ending time of the exam

- It is enough if one group member makes the submission

You can submit only ONE pdf file

- You can answer by pen/pencil + paper, by computer or both – but you must combine all your answers to one file and create a pdf.
- Make certain that all figures and text are easily readable: too dark pictures, text which cannot be read, etc. → 0 p
- **Practice creating a pdf file already beforehand**

You can submit only if you have chosen the exam group

- You must choose the group even if you took exam alone (group size 1-3 persons)
- You must choose a new group to every exam

Emergencies during the exam

*E.g. MyCourses is not responding… or other **emergencies***

- CALL Kirsi Yliniemi (+358 50 592 3690)
- You are provided a licence to submit the answers by email
- Answers must be sent before the end of exam time
- However, you MUST submit exam answers ALSO to MyCourses **as soon as possible**
- **ONLY MYCOURSES SUBMISSIONS WILL BE GRADED**

Reasoning Behind the Tasks

Lectures:

- Learning the theoretical background
- Concept checks and discussions to deepen the knowledge right away

NOTE! There are short video lectures available in MyCourses

Exercises:

- Deepening the understanding
- Learning with friends

Science Project

- Learning about nanomaterials, their applications and sustainability
- Learning how to make short videos
- Group Work Skills
- Doing things together

Online Group Exam

- Overview of the course
- Solving problems more like in a real working life: in a small group, in a hurry, trying to bring out the best parts of the team