

*Drug Development  
&  
Polymer Chemistry*

# **Nanotechnology**

**Student Manual**

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## **1. Introduction**

*This elective block focuses on Drug Development or Polymer Chemistry. Nanotechnology, however, is a joint course for all third-year students.*

*The development of drugs is one of the most important developments for mankind in the 20<sup>th</sup> and 21<sup>st</sup> century. The life expectancy in the western world has increased considerably and this is in part thanks to the development of effective medication. Every day there are more and more new drugs being developed in the emerging field of Nanomedicine.*

*Polymer materials are found everywhere around us and are at the same time responsible for life itself but also for communication, food, clothes, buildings, highways, etc. It is actually very difficult to imagine life without (natural) polymers. There are more and more novel polymer nanomaterials being developed with new, special and often tunable properties.*

*Nanotechnology focuses on the science and technology at the nanoscale and how molecules can be engineered to display special functions. The same principles can be used to develop novel and smart materials, drugs, catalysts, machines and other macro objects. This course aims at providing an insight into the possibilities of nanotechnology and I hope that you enjoy it.*

## **2. Objective**

This course aims at familiarizing you with the most relevant concepts in nanotechnology and training you in critically analyzing and discussing contemporary topics in the field of nanotechnology. A spectrum of most recent applications of this emerging field will be presented and critically discussed. Next to this you will choose a hot topic within nanotechnology that you will review with the help of literature and propose an original research proposal to tackle some of the existing challenges or to introduce a new application. You will present and defend your topic and proposal in front of the class and write a research proposal about it.

*Jurica Bauer*

### 3. Course Evaluation 2017-2018 and 2016-2017

Every year students evaluate the courses they followed in order to keep the quality of education high. In light of that please find the evaluation of *Nanotechnology* below for the last two academic years.

#### Nanotechnology (number of students in 2017-2018 = 27)

		2017-2018	2016-2017
1.1	Where did you follow the course?	Amsterdam	Amsterdam
1.2	Which study year are you?	3	3
2.1	The importance of this course is obvious to me.	4,1	3,7
2.2	I am satisfied with how the lecturer runs the course.	4,6	4,4
2.3	I have learned a lot in this course.	4,0	4,0
2.4	The study materials for this course are good.	3,7	3,9
2.5	There is sufficient time to complete this course.	4,1	4,0
2.6	The course is well organized.	4,0	4,2
2.7	I understand how I am being assessed in this course.	4,1	3,9
2.8	I am in general satisfied with my study program.	3,7	3,5

Marks: 1-fully disagree, 5-fully agree

Pass rate 2017-2018: 83%

#### Modifications done to the course 2018-2019:

- The lectures and topics have been updated with the most recent advances.

### 4. Internationalization

Internationalization is an important aspect of this study program. This also becomes obvious in the course *Nanotechnology*. The lessons and all the study materials are in English as are all the products that the students need to deliver. By presenting, discussing, reading and writing in English you are being trained for an international labor market.

## 5. Study Materials

*For this course you will need the following materials:*

- *Lectures (available on Moodle)*
- *Various relevant documents (templates, examples, student manual, etc) (available on Moodle)*
- *Relevant scientific articles that you will collect yourself through the Inholland search engines or the library*

You may use the following books as additional sources to learn more about certain aspects of nanotechnology:

- Burgess, M. Understanding Nanomedicine - An Introductory Textbook, Pan Stanford Publishing, Singapore, 2012.
- Johal, M. S. Understanding Nanomaterials, CRC Press, Boca Raton, 2011.
- Ramsden, J. J. Nanotechnology: An Introduction, Elsevier, Oxford, Waltham, 2011.

## **6. Assessment**

In this course there are two assessment methods: an oral presentation (in pairs) and a written research proposal (in pairs). Both the presentation and the written proposal need to be in English. Active participation in the scientific discussions in the classroom is mandatory. You may therefore not miss more than one lecture and one student presentation session. In the event of illness or another justified circumstance you may be assigned a replacement task for the missed lessons. More information about the assessment may be found in section 9 of this student manual.

## 7. Study Table

Study and calendar week		Activities*	Group	Contact hours	Total study hours per week
<b>Study week 1</b>	Week 15	Lecture	Whole group	2	10
<b>Study week 2</b>	Week 16	Lecture	Whole group	2	10 + part of 13
<b>Study week 3</b>	Week 17	Lecture	Whole group	2	10 + part of 13
		Student Presentation Session	Subgroup	2	
<b>Study week 4</b>	Week 19	Lecture	Whole group	2	10 + part of 13
		Student Presentation Session	Subgroup	2	
<b>Study week 5</b>	Week 20	Guest Lecture	Whole group	2	15 + part of 13
		Lecture	Whole group	2	
		Student Presentation Session	Subgroup	2	
<b>Study week 6</b>	Week 21	Work Discussion	Pair	0.5	14 + part of 13
		Lecture	Whole group	2	
		Student Presentation Session	Subgroup	2	
<b>Study week 7</b>	Week 22	Lecture	Whole group	2	13 + part of 13
		Student Presentation Session	Subgroup	2	
<b>Study week 8</b>	Week 23	Self-study	Pair	-	30
	Friday 7 June 2019 5:00 PM	Submit the written research proposal	Pair	-	1
<b>Study week 9</b>	Week 24	-	-	-	-
<b>Study weeks 10-12</b>	Week 25-27	Resubmit the written research proposal	Pair	-	20
	Monday 24 June (see schedule)	Retake presentation	Pair	1	1

\*next to these, self-study is expected

## 8. Study Tasks

### **Week 1 (calendar week 15) (10 study hours<sup>1</sup>)**

#### **Task 1: Lecture 1 + preparation (4 study hours)**

Lecture 1 will give an *Introduction to Nanotechnology*. In order to prepare for the lecture, please read this student manual and have a look at the project topics available on Moodle. Think about which topics you find interesting and who you would like to work with on the project. You are encouraged to propose your own topic even if it is not listed on Moodle. Bring any questions and ideas you may have to the lecture.

#### **Task 2: Initial literature study (6 study hours)**

Have a first look in the literature and find at least three scientific articles that provide relevant information about the topic you will be working on for the nanotechnology project. These will be the basis for your presentation. You can already start working on your presentation.

### **Week 2 (calendar week 16) (10 + part of 13 study hours)**

#### **Task 3: Lecture 2 + preparation (4 study hours)**

In order to prepare for Lecture 2, please go through the slides and video clips of Lecture 1 and note down questions you may still have. Bring these to this week's lecture. Lecture 2 will focus on *Supramolecular Chemistry and Self-Assembly*. Pay attention in the lecture as you may easily find inspiration for your own project.

#### **Task 4: Working on the presentation (10 study hours) (spread over the weeks until your presentation)**

Work on your presentation. Make sure you can explain the topic to the audience. Have another look in the literature for additional information. Think about your research proposal. What are the challenges in the field? Which new applications can you think of? Take the lectures as a source of inspiration.

#### **Task 5: Working on the written research proposal (6 study hours)**

Next to working on your presentation you should also start putting your findings on paper. This will be a good start of your written research proposal. Next week you should submit 5 articles to the lecturer by email that you think will be the foundation for reviewing your topic and working on your research proposal. Your written research proposal will need to have at least 15 literature sources, 10 of which are recent scientific articles (not older than 5 years). The references should be reported in ACS style (please see the format and examples on Moodle). The final document should be approximately 3-5 pages long in total (it should have at least 2.5 pages of pure text without tables, figures, references, etc.).

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<sup>1</sup> Study hours = hours spent on this course, be it in the form of contact hours or self-study



**Task 6: Read and summarize two scientific articles in the field of nanotechnology that are not related to the topic you are working on (3 study hours) (spread over 7 weeks)**

In order to also read articles and familiarize yourself with topics other than the one of your project you should read and summarize two scientific articles in the field of nanotechnology that are not related to your project topic. You may read articles mentioned in the lectures or choose any other nanotechnology articles that capture your interest but make sure you read recent articles. Please send an individually written summary of these articles (half a page to a page) to your lecturer by email. Do not forget to report the references in your summary. Make sure you do this by the end of week 7.

**Week 3 (calendar week 17) (10 + part of 13 study hours)**

**Task 7: Lecture 3 + preparation and Student Presentation Session (5 study hours)**

In order to prepare for Lecture 3, please go through the slides and video clips of Lecture 2 and note down questions you may still have. Bring these to this week's lecture.

Lecture 3 will focus on *Bionanotechnology*. Pay attention in the lecture as you may easily find inspiration for your own project.

This week we will start with the student presentation sessions. Typically there will be 1-3 presentations per session. Each presentation will give an overview of the chosen topic and a research proposal. Students in the audience are expected to ask questions and engage in discussion. Pay attention in this session as you may easily find inspiration for your own project.

**Task 8: Working on the project (5 study hours)**

Send a list of 5 literature references to the lecturer that you think form the basis for your topic and proposal. Report them in ACS style followed by a link to the digital version of the article or book (if available). Please do this before 24<sup>th</sup> of April at 5 PM. You will receive feedback from the lecturer by the end of the week.

Start working on the writing plan for your written research proposal. A writing plan is an overview of the sections and topics that you wish to have in your written research proposal. This will give structure to your document. Don't forget that your proposal needs to have a section "Research Proposal" and a section "Conclusion, Outlook and Perspectives" along with the sections relating to a review of your topic.

**Week 4 (calendar week 19) (10 + part of 13 study hours)**

**Task 9: Lecture 4 + preparation and Student Presentation Session (5 study hours)**

In order to prepare for Lecture 4, please go through the slides and video clips of Lecture 3 and note down questions you may still have. Bring these to this week's lecture.

Lecture 4 will focus on *Nanotechnology in Catalysis*. Pay attention in the lecture as you may easily find inspiration for your own project. The same goes for this week's student presentation session.

**Task 10: Working on the project (5 study hours)**

Finish your writing plan and email it to the lecturer for feedback. Please do this before the 8<sup>th</sup> of May at 5 PM. You will receive feedback at the end of the week. That will give you an idea of how to proceed with your research proposal.

**Week 5 (calendar week 20) (15 + part of 13 study hours)**

**Task 10: Lecture 5 + preparation and Student Presentation Session (5 study hours)**

In order to prepare for Lecture 5, please go through the slides and video clips of Lecture 4 and note down questions you may still have. Bring these to this week's lecture.

Lecture 5 will focus on *Molecular Machines*. Pay attention in the lecture as you may easily find inspiration for your own project. The same goes for this week's student presentation session.

**Task 12: Working on the project (8 study hours)**

Proceed to work out your writing plan into a written research proposal. Make use of the feedback received by the lecturer. Think about how you would like to present your research proposal in the final document.

**Task 13: Sign up for a work discussion with the lecturer**

Next week you have the opportunity to have a work discussion with the lecturer. In that meeting you can ask questions about your written research proposal. Make sure you prepare your questions. Please sign up for the work discussion no later than 15<sup>th</sup> of May at 5 PM. The lecturer will make a schedule and notify you about the time and location.

**Task 14: Guest Lecture (2 study hours)**

This week there's a guest lecture from a scientist from industry. In this lecture you will see how nanotechnology can be applied in real-life applications. Attending the guest lecture is mandatory. Make sure you ask questions during the lecture. Think about whether you would be interested in such research for your graduation project or future job.

**Week 6 (calendar week 21) (14 + part of 13 study hours)**

**Task 15: Lecture 6 + preparation and Student Presentation Session (5 study hours)**

In order to prepare for Lecture 6, please go through the slides and video clips of Lecture 5 and note down questions you may still have. Bring these to this week's lecture.

Lecture 6 will focus on *Nanomaterials*. Pay attention in the lecture as you may easily find inspiration for your own project. The same goes for this week's student presentation session.

**Task 16: Working on the project (8 study hours)**

Proceed with working out your written research proposal. Prepare the first draft for the work discussion with lecturer. Work on the section “Research Proposal” where you present your own original ideas for research within your topic. This is the most important part of your proposal. Do not forget to be critical of your proposal. Make sure you always support your claims with literature.

**Task 17: Work discussion (0.5 study hours)**

Attend the work discussion according to the schedule provided by the lecturer. Take the written research proposal draft with you and prepare questions for the lecturer. Think about which part of the document you would like to discuss and get feedback on. Make sure you discuss the research proposal part and ask for feedback on which aspects should still be covered in the document.

**Week 7 (calendar week 22) (15 + part of 13 study hours)****Task 18: Lecture 7 + preparation and Student Presentation Session (5 study hours)**

In order to prepare for Lecture 7, please go through the slides and video clips of Lecture 6 and note down questions you may still have. Bring these to this week’s lecture.

Lecture 7 will focus on *Nanomedicine*. Pay attention in the lecture as you may easily find inspiration for your own project. The same goes for this week’s student presentation session.

**Task 19: Working on the project (8 study hours)**

Continue working out your written research proposal. Try to work out as much feedback as possible that you got from the lecturer. Finish the proposal content-wise.

**(Task 6: Read and summarize two scientific articles in the field of nanotechnology that are not related to the topic you are working on (3 study hours) (spread over 7 weeks)**

If you still have not finished this task, make sure you do it this week.

**Week 8 (calendar week 23) (30 study hours)****Task 20: Working on the project (23 study hours)**

Finish your written research proposal. The document needs to be formatted in ACS style (see supporting documents on Moodle). Your final proposal should feature at least 15 literature references, 10 of which should be recent scientific articles (not older than 5 years). Do not

forget to check your written research proposal with the help of the assessment form on Moodle. The proposal will only be read by the lecturer if it meets the form criteria as described in the assessment form. If it doesn't meet the form requirements, the proposal will be graded with a 4,0. Also make sure that you have worked out your research proposal sufficiently and that you have a section "Conclusions, Outlook and Perspectives". Also make sure that your research proposal is written in own words as it will be checked for plagiarism in Ephorus software. The document should not score higher than 5 % on plagiarism.

### **Task 21: Check the language (6 study hours)**

Now that you have finished your written research proposal, you should check the language as the document needs to be written in correct and professional English. You are also advised to exchange proposals with another pair for peer-review.

### **Task 22: Finish the project (1 study hour)**

If you have completed tasks 20 and 21, your research proposal is ready to be handed in to the lecturer. Check the form of the document one more time (use the assessment form on Moodle) before handing it in. **Email the written research proposal to the lecturer before Friday, the 7<sup>th</sup> of June 2019 at 5 PM.** Make sure you hand in the document both as a Word and pdf file. Research Proposals that get submitted too late, will not be graded.

The research proposal will be graded before Friday, the 28<sup>th</sup> of June. In the event that you still need to improve your proposal for a passing grade, a resubmission deadline will be provided along with the feedback. See Task 24.

### **Task 23: Redo your presentation (1 study hour)**

In the event that your presentation did not receive a passing grade in weeks 3 through 7, you may give your presentation again this week.

## **Week 9 (calendar week 24) (0 study hours)**

This week you will be focusing on exams.

## **Weeks 10-12 (calendar weeks 25-27) (20 or more study hours)**

**In case your written research proposal was deemed insufficient, you may work on improving it in these weeks.**

### **Task 24: Improving the research proposal (20 or more study hours)**

Make sure that you understand the feedback received by the lecturer and know what you need to do to improve the research proposal. Work out all the received feedback and ask a few colleagues for feedback. Once you are convinced that your proposal is sufficiently improved, email it to the lecturer. Make sure you do not miss the deadline provided by the lecturer.

## 9. Assessment Information

In order to check to which extent the objectives of the course have been met, you will be assessed. The presentation, the written research proposal and discussion in the lessons will all be assessed to reach a final grade for this course. You are expected to ask questions and engage in discussion during all the activities. Please see the table below for details.

In line with the Inholland guidelines you have the right to two attempts per year to pass the exam. In the event that you do not pass in your first attempt, you have one more take this academic year.

<b>Assessment information for the “Nanotechnology” course</b>	
<b>Presentation (1815NANOTB)</b>	
Exam form	Oral presentation
Exam in week	period 12, week 3-7
Assessment due	period 12, week 8
Retake in week	period 12, week 11
Assessment duration	15 minuten (+ 5 min discussion)
Minimum score	n.a.
Assessment individual or group	In pairs
Feedback	Assessment form and oral feedback
Mock exam	n.a.
Additional criteria	No more than 1 lecture and 1 student presentation session should be missed.

<b>Project (1815NANOTA)</b>	
Exam form	Written research proposal (3-5 pages in total or approximately 2.5 pages pure text without tables, figures, references)
Exam in week	period 12, week 8
Assessment definitive	period 12, before week 11
Retake in week	period 12, week 10-13 (to be agreed upon)
Assessment duration	n.a.
Minimum score	Must meet certain criteria
Assessment individual or group	In pairs
Feedback	Assessment form and feedback in written form (if form is a pass)
Mock exam	No, but format available.
Additional criteria	Two non-related nanotechnology articles should be summarized.

Partial grades with corresponding weighting factors:

Presentation	(1815NANOTB)	30%
Project	(1815NANOTA)	70%

## 10. Contact

In case you would like to ask a question or give feedback on this student manual or the course, please contact [jurica.bauer@inholland.nl](mailto:jurica.bauer@inholland.nl).