

# **SEMESTER LESSON PLAN (RPS)**

**KIM 456**

**Chemical Innovation in Industry and Environment 4(1-3)**

By:

**Chemistry Undergraduate Study Program Team**

**DEPARTMENT OF CHEMISTRY**

**FACULTY OF MATHEMATICS AND SCIENCE AAM BOGOR  
AGRICULTURAL UNIVERSITY**

**2022**

### SEMESTER LESSON PLAN (RPS)

Course Name	: Chemical Innovation in Industry and Environment
Code/Credits	: KIM456/4(1-3) <sup>1)</sup>
Semester	: 7
Course Description	: <i>This capstone</i> includes lectures from lecturers and industrial practitioners and their implementation in industry and the environment. The lecture explains the concept of industrial chemistry, including process knowledge (material balance, energy balance, material conversion in industry), material knowledge (polymers, surfactants, advanced materials), product formulation, QC and QA knowledge, environmental chemistry concepts, industrial waste treatment, and the concept of <i>green chemistry</i> . This <i>capstone</i> provides opportunities for students to interact with industry and environmental practitioners, conduct industrial visits, train the spirit of entrepreneurship through simple industrial projects, and compile a concept, program, or package of action that can be applied directly in industry and society.
Prerequisite Courses (if ada)	: -
AchievementsUnited Learning Courses (CPMK)- <i>Learning Outcomes</i>	: <ol style="list-style-type: none"> <li>1. Able to describe the concept of industrial chemistry and the environment in general and specifically.</li> <li>2. Able to interact with industry and environmental practitioners actively and receive knowledge transfer from industry and environmental practitioners.</li> <li>3. Able to recognize the problems faced by the industry related to industrial processes and their environment.</li> <li>4. Able to compile concepts to solve the problems faced by industry and the environment.</li> </ol>
Divisions/Fields of Science	: Department of Chemistry
Coordinator	: Head of Chemistry Study Program

## LESSON PLAN

WEEK	EXPECTED FINAL CAPABILITY - Sub-CPMK	STUDY MATERIALS (TEACHING MATERIALS)	LEARNING METHODS	ESTIMATED TIME	STUDENT LEARNING EXPERIENCE	VALUATION			REFERENCE LIBRARY
						CRITERIA	INDICATOR	Score (%)	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
1	Able to understand the innovation process and use innovation fingerprint devices pd innovation analysis	Principles and Process of Innovation in summary form	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:  a. Talk b. Discussion Interactive Classes and groups c. Review of Discussion Results	2 x 50 minute	a. Gain insights and explanations about creativeposes, driving factors, and levels of innovation through visual learning and examples. b. Interacting between students and: (i) lecturer (ii) other students (iii) teaching materials c. Obtain conformity/agreement of understanding, opinion, agreement, and joint decision on a problem	<b>Hard Skills:</b> Completeness and truth about: a. Understand and use points in the innovation fingerprint b. Understand and make innovation process analysis c. Selection of the level of innovation  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. Accuracy and completeness in making questions and statements during interactive discussions	Students answer correctly (>90%) questions: a. criteria for the purpose of innovation b.selection of the main design, c.option design selection d.design selection base	2,5	1
2	Able to explain and analyze innovations in the mass balance yg selected in the theme	Innovations on the balance of mass on one operating unit and multi units of operation	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:  a. Theme selection b. Selection of the type of design c. Search for	2 x 50 minute	a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and	Students make fingerprint reports and innovation analyses from the chosen theme.	7,5	2

			<p>d. supporting data Class Discussions and Kelompok</p>		<p>d) data related to industry, environmental and consumer innovations selection of the level of innovation based on the fingerprint of innovation</p>	<p>make innovation process analysis</p> <p><b>Soft Skill:</b></p> <p>a. Liveliness b. Collaborate c. Responsibility d. Discipline e. Accuracy and completeness in making questions and statements during interactive discussions</p>			
3	Able to complete and analyze the innovation of the selected energy balance in the theme	Innovations on the energy balance	<p>Synchronous-Lectures Tatap Muka Lu ar Jaringan /Offline include:</p> <p>a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group</p>	2 x 50 minute	<p>a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to the industry, environmental and consumer innovations selection of the level of innovation based on the fingerprint of innovation d)</p>	<p><b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis</p> <p><b>Soft Skill:</b></p> <p>a. Liveliness b. Collaborate c. Responsibility d. Discipline e. Accuracy and completeness in making questions and statements during interactive discussions</p>	Students make fingerprint reports and innovation analyses from the chosen theme.	7,5	3

4	Able to complete and analyze the innovation of the mass balance and energy balance simultaneously selected in the theme	Innovations in the mass balance and energy balance simultaneously	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:  a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group	2 x 50 minute	a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to the industry, environmental, and consumer innovations d) selection of the level of innovation based on the fingerprint of innovation	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and completeness in making a search and statement between the discussions interactive	Students make fingerprint reports and innovation analysis from the selected themes.	7,5	4
5	Able to complete and analyze the green chemical process innovations selected in the theme	Green Chemical Process Innovation	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:  a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group	2 x 50 minute	a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to the industry, environmental, and consumer innovations d) selection of the level of innovation based on the fingerprint of innovation	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and completeness in making a search and statement between the discussions	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	5

						interactive			
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6	Able to complete and analyze the innovation of natural material products and plantation industries selected in the theme	Product Innovation of Natural Materials and Plantation Industry	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:  a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group	2 x 50 minute	a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to industry, environmental and consumer innovations d) selection of the level of innovation based on the fingerprint of innovation	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and completeness in making a search and statement between the discussions interactive	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	6
7	Able to complete and analyze the innovations of the herbal and neutraceutical industry selected in the theme	Herbal and Neutraceutical Industry Innovations	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:  a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group	2 x 50 minute	a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to industry, environmental and consumer innovations d) selection of the level of innovation based on the fingerprint of innovation	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and completeness in making a search and statement between the discussions	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	7

						interactive			
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UTS	Evaluation of Reports from group assignments by facilitator lecturers								
8	Able to complete and analyze the innovations of the cosmetics industry selected in the theme	Cosmetic Industry Innovation	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include: a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group	2 x 50 minute	a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to industry, environmental and consumer innovations d) selection of the level of innovation based on the fingerprint of innovation	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and completeness in making a search and statement between the discussions interactive	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	8
9	Able to complete and analyze the selected circular process innovations in the theme	Circular Process Innovation	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include: a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group	2 x 50 minute	a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to industry, environmental and consumer innovations d) selection of the level of innovation based on the fingerprint of innovation	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and completeness in making a search and statement between the	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	9

						discussions interactive			
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10	Able to complete and analyze the selected recycling industry innovations in the theme	Recycling Industry Innovation	<p>Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:</p> <ol style="list-style-type: none"> <li>Theme selection</li> <li>Selection of the type of design</li> <li>Search for supporting data</li> <li>Class Discussions and Group</li> </ol>	<ol style="list-style-type: none"> <li>gain insight and explanation of the relationship between theme and topic choices.</li> <li>carrying out the division of group tasks in</li> <li>tracing and compiling data related to industry, environmental and consumer innovations</li> <li>selection of the level of innovation based on the fingerprint of innovation</li> </ol>	<p><b>Hard Skills:</b> Completeness and truth about:</p> <ol style="list-style-type: none"> <li>Understand and understand how to use points in innovation fingerprints</li> <li>Understand and make innovation process analysis</li> </ol> <p><b>Soft Skill:</b></p> <ol style="list-style-type: none"> <li>Liveliness</li> <li>Collaborate</li> <li>Responsibility</li> <li>Discipline</li> <li>accuracy and completeness in making a search and statement between the discussions interactive</li> </ol>	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	10
11	Able to complete and analyze the ecoenzyme innovations selected in the theme	Ecoenzyme Innovations	<p>Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:</p> <ol style="list-style-type: none"> <li>Theme selection</li> <li>Selection of the type of design</li> <li>Search for supporting data</li> <li>Class Discussions and Group</li> </ol>	<ol style="list-style-type: none"> <li>gain insight and explanation of the relationship between theme and topic choices.</li> <li>carrying out the division of group tasks in</li> <li>tracing and compiling data related to industry, environmental and consumer innovations</li> <li>selection of the level of innovation based on the fingerprint of innovation</li> </ol>	<p><b>Hard Skills:</b> Completeness and truth about:</p> <ol style="list-style-type: none"> <li>Understand and understand how to use points in innovation fingerprints</li> <li>Understand and make innovation process analysis</li> </ol> <p><b>Soft Skill:</b></p> <ol style="list-style-type: none"> <li>Liveliness</li> <li>Collaborate</li> <li>Responsibility</li> <li>Discipline</li> <li>accuracy and completeness in making a search and statement between the discussions</li> </ol>	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	

						interactive			
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12	Able to complete and analyze innovations in the conversion of waste into selected feed / food in the theme	Industry innovation in the conversion of waste into feed/food	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:  a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group		a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to industry, environmental and consumer innovations d) selection of the level of innovation based on the fingerprint of innovation	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and completeness in making a search and statement between the discussions interactive	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	
13	Able to complete and analyze the innovation of palm oil and sugarcane waste conversion selected in the theme	Innovation in the conversion of palm oil and sugarcane waste	Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:  a. Theme selection b. Selection of the type of design c. Search for supporting data d. Class Discussions and Group		a) gain insight and explanation of the relationship between theme and topic choices. b) carrying out the division of group tasks in c) tracing and compiling data related to industry, environmental and consumer innovations d) selection of the level of innovation based on the fingerprint of innovation	<b>Hard Skills:</b> Completeness and truth about: a. Understand and understand how to use points in innovation fingerprints b. Understand and make innovation process analysis  <b>Soft Skill:</b> a. Liveliness b. Collaborate c. Responsibility d. Discipline e. accuracy and completeness in making a search and statement between the discussions	Students make fingerprint reports and innovation analysis from the chosen theme.	7,5	

						interactive			
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14	Able to complete and analyze the sugarcane waste conversion innovation selected in the theme	Sugarcane waste conversion innovation	<p>Synchronous-LecturesTatapMuka Lu arJaringan /Offline include:</p> <ul style="list-style-type: none"> <li>a. Theme selection</li> <li>b. Selection of the type of design</li> <li>c. Search for supporting data</li> <li>d. Class Discussions and Group</li> </ul>	<ul style="list-style-type: none"> <li>a) gain insight and explanation of the relationship between theme and topic choices.</li> <li>b) carrying out the division of group tasks in</li> <li>c) tracing and compiling data related to industry, environmental and consumer innovations</li> <li>d) selection of the level of innovation based on the fingerprint of innovation</li> </ul>	<p><b>Hard Skills:</b> Completeness and truth about:</p> <ul style="list-style-type: none"> <li>a. Understand and understand how to use points in innovation fingerprints</li> <li>b. Understand and make innovation process analysis</li> </ul> <p><b>Soft Skill:</b></p> <ul style="list-style-type: none"> <li>a. Liveliness</li> <li>b. Collaborate</li> <li>c. Responsibility</li> <li>d. Discipline</li> <li>e. accuracy and completeness in making a search and statement between the discussions interactive</li> </ul>	7,5	
UAS	Evaluation of Reports from group assignments by facilitator lecturers						

Reference Library :

1. Edwin Zondervan, Cristhian Almeida-Rivera, Kyle Vincent Camarda, 2019, Product-Based Processes Design\_ From Molecules to Companies, De BATANG Gruyter
2. André B. de Haan, H. Burak Eral dan Boelo Schuur, 2019, Proses Pemisahan Industri: Fundamental, De Gruyter
3. Nayef Ghasem, Redhouane Henda, 2015, Principles of Material Chemical Engineering Processes And Energy Balance, CRC Press, 2nd Ed
4. Alfons Mersmann, Matthias Kind, Johann Stichlmair, 2011, Principles of Thermal Separation Technology, Methods, Process Design, Springer-Verlag Berlin Heidelberg
5. Ameta Suresh C, Dake Satish A, Haghi A. K, Shinde Ravindra S, 2021, Green chemistry and sustainable technology\_ biology, pharmaceuticals, and macromolecular systems, Apple Academic Press
6. Richard Firn, 2010, Chemicals\_ Natural Products That Shape Our World, Oxford University Press
7. Luis Munoz-Acevedo by Martinez Jos, Amner Rai, Mahendra, 2019, Ethnobotanical applications of medicinal plants-CRC Press Taylor & Francis Group
8. Bruno Burlando, Luisella Verotta, Laura Comara, Elisa Bottini-Massa, 2010, Herbal Principles in Cosmetics\_ Properties and Mechanisms Action, CRC Press
9. Gallaud Delphine, Laperche Blandine, 2016, Circular economy Of Industrial ecology and short supply chains, Wiley-ISTE
10. Vincent Rich, 2001, Handbook of international scrap and recycling industry, woodhead publishing limited



## ANALYSIS OF INNOVATION

Group:

Members:           1.  
                          2.  
                          3.  
                          4.  
                          5.

Theme:

Innovation Title:

Innovation Class:

Innovation Fingerprint Table :

	Product Concept	Consumer Desires	Function Properties	Process Integration	Equipment Design (option)	Final design/product (option)
Scope						
Knowledge						
Synthesize						
Analyze						
Evaluate						
Choose						

**K:** Key design focus

**O:** Optional design focus

**D:** Default design activity

**C:** Check implications design changes

**-:** no activity/No activity

(1) Define the **scope** of the design, which involves:

- Design objectives
- Constraints

(2) Acquire and assess knowledge about potential building blocks (depending on

at the design level):

- Target size and market dynamics
- Competitor/patent activities
- Raw material supply specifications
- Pure component properties (physical, security, health data) for components, and streams  
Combined
- Thermodynamic equilibrium, kinetics

(3) Synthesize alternative designs (networks/structures) to meet the scope of the design with:

- Choose the appropriate block/object build at this design level
- Vary the order and connectivity of these building blocks

It is important to aim for a number of solutions first before moving to step 4, Analysis, in order to avoid the premature removal of design options that are also valuable in combination with other options. The methods and tools of creativity were discussed by Tassoul [11], the 'TRIZ' methodology [12], and the synthesis heuristics were the source to help create a large number of design options.

(4) Analyze the physico-chemical behavior of the resulting alternative design (network):

– Estimation, computation, and/or simulation of models that connect the flow of resources to blocks

building

- Expert analysis with sketches and drawings of product and process block flowcharts

The purpose of this step is to measure the behavior of design choices at the existing design level. Aim to arrive at quantitative data such as the estimated mass yield and heat balance, separation efficiency, utilities used, etc. as much as possible. This quantitative data is an input for the next design step, evaluation, where the quantitative data is translated into performance criteria.

(5) **Evaluate** the performance of alternative solutions against SHEETS sustainability goals and constraints:

S: Security

H: Health

E: Environment

E: Economy

Q: Technology

S: Social

For supply chain-related design levels, the estimates will be less accurate than estimates at the equipment design level; it is very important to make every effort to measure the performance of various design options for each level of design, such as:

(6) Select a number of preferred solutions from alternatives for the next level of design.

- Eliminate/get rid of unfeasible options.
- Keep the promising part/interesting aspect of the omitted option for implementation in other options.