

SEMESTER LEARNING PLAN (Syllabus)

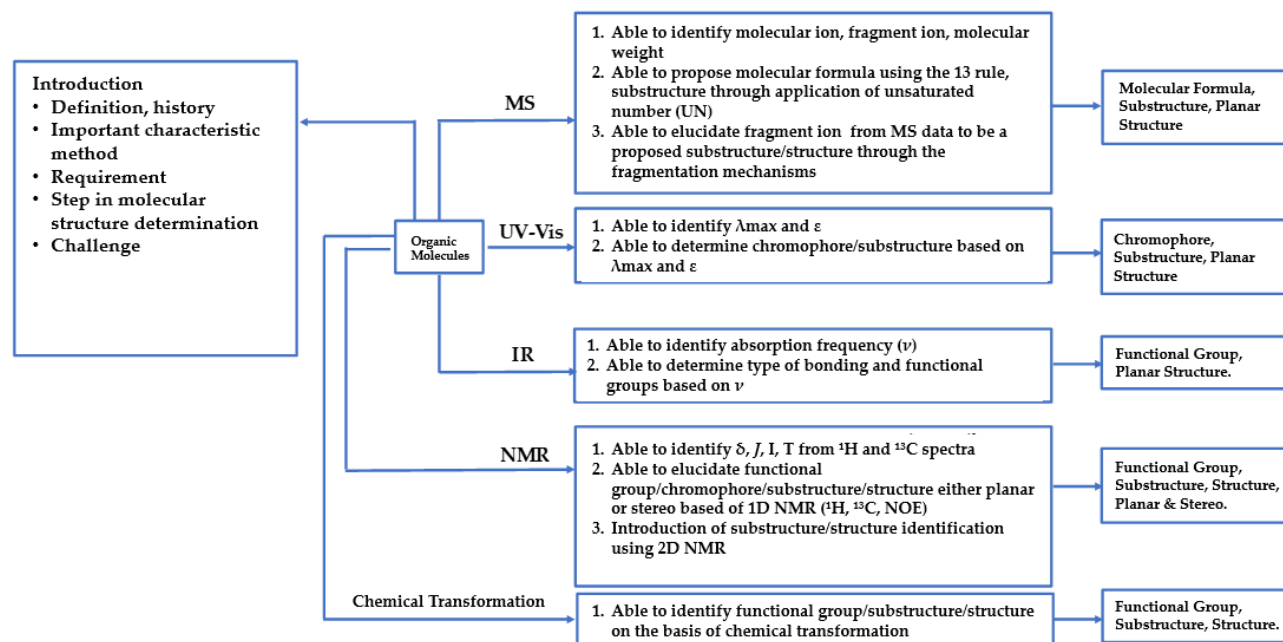
KIM 1325 MOLECULAR STRUCTURE DETERMINATION 2 (2-0)

Pengesahan		Persetujuan		Penyusunan	
Tanggal	DD/MM/YYYY	Tanggal	DD/MM/YYYY	Tanggal	DD/MM/YYYY
Ketua Departemen	(.....)	Kepala Divisi	(.....)	Koordinator Mata Kuliah	(.....)

Instructional Analysis

Learning outcomes:

Able to elucidate planar (2D) and stereo (3D) structures/substructures of organic molecules based on spectroscopic, spectrometric, and chemical transformation data.



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SEMESTER LEARNING PLAN (SYLLABUS)

Name	: Molecular Structure Determination
Code/Credit	: KIM 1325/2(2-0)
Semester	: 6
Description	: The lecture discusses about the molecular structure determination either planar or stereo using spectroscopy strategies [UV, IR, MS, NMR 1D (^1H , ^{13}C , NOE) and introduction of NMR 2D (COSY, TOCSY, HSQC, HMBC) as well as chemical transformation. The learning process includes presentation, understanding of concepts as well as independent practice questions. Learning will be carried out fully synchronously.
Requirement	: Organic Chemistry II
Learning Outcome	: <ol style="list-style-type: none"> 1. Able to identify molecular and fragment ions, determine molecular weight and molecular formula from MS data of organic molecules. 2. Able to identify MS fragment of organic molecules and propose substructure/structure based on fragmentation mechanisms. 3. Able to identify λ_{max} and ϵ, determine chromophore/substructure from UV-Vis data of organic molecules. 4. Able to identify absorption frequency (ν), determine a type of bonding and functional group from IR data of organic molecules. 5. Able to identify δ, J, I, T from NMR 1D data of organic molecules.

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	<p>6. Able to determine functional group/chromophore/substructure/structure either planar or stereo from an organic molecule on the basis of NMR 1D data and introduction of NMR 2D.</p> <p>7. Able to identify and determine functional group/substructure/structure of organic molecules based on chemical transformation.</p>
Scope and curriculum map of royal society of chemistry (RSC)	: Identification and structure determination including substructure, functional group of organic molecules using spectroscopy (UV, IR, NMR, MS) and chemical transformation.
Division/Field	: Organic Chemistry/Molecular Structure Determination
Lecturer (Team)	: Novriyandi Hanif, S.Si., M.Sc., D.Sc. Dr. Auliya Ilmiawati, S.Si., M.Si. Dr. Drs. Muhammad Farid, M.Si. Luthfan Irfana, S.Si., M.Si.

¹⁾kegiatan responsi/praktikum dinyatakan dalam sks bukan dalam jumlah jam

²⁾lihat file excel Chemistry Curriculum Map dari RSC

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I. Plans for Study

Week (1)	Expected capability (2)	Topic (3)	Method (4)	Duration (5)	Student Experience (6)	Assesment			Reference (10)
						Criteria (7)	Indicator (8)	Percent age (%) (9)	
1	Able to identify: definition, history, position, characteristic, requirement, step, and challenge in molecular structure determination	Introduction of molecular structure determination and study contract a. Definition, position, history. b. Important characteristic strategies in modern molecular structure determination. c. Requirement d. Step in molecular structure determination e. Challenge in molecular structure determination	<i>Synchronous-On-line/Off-line</i> lecture: a. Lecture b. Discussion c. Independent Exercise d. Assignment	2 x 50 minutes	a. Gain insight and explanation regarding the determination of molecular structures including definition, position, history, important characteristic, requirement, and challenge through visual learning. b. Carry out interactions between students and: (i) Lecturer (ii) Other students (iii) Teaching materials c. Obtain an agreement of understanding, opinion and joint decision on a problem.	Hard Skills: Completeness and truth about: a. Definition, position, history molecular structure determination b. Important characteristic in molecular structure determination c. Requirement/understanding in molecular structure determination d. Step in molecular structure determination e. Challenge in molecular structure determination	Correct concept's molecular structure determination: definition, position, history, important characteristic, requirement, and challenge		

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						Soft Skills: a. Creativity, imagination, motivation. b. Problem solving skill c. Team works and communication. d. Systematic solution and critical thinking. e. Integrity and discipline Independent			
2	Able to identify λ_{\max} and ϵ , determine chromophore/substructure based on λ_{\max} and ϵ data of organic molecules.	Molecular structure determination via UV-Vis Spectroscopy: a. The concept of electronic transitions of an organic molecule interacting with UV-Vis light includes selection rules and the Lambert-Beer law b. Identification of λ_{\max} and ϵ of an organic compound based on electronic, steric and solvent effects (qualitative). c. Identify λ_{\max} and ϵ of an organic compound based on the Woodward-	<i>Synchronous-On-line/Off-line</i> lecture: a. Lecture b. Discussion c. Independent Exercise d. Assignment	2 x 50 minutes	a. Gain insight and explanation regarding the determination of molecular structures <i>via</i> UV-Vis spectroscopy through visual learning. b. Carry out interactions between students and: (i) Lecturer (ii) Other students (iii) Teaching materials a. Obtain an agreement of understanding, opinion and joint	Hard Skills: Completeness and truth about: a. The concept of electronic transitions of an organic molecule interacting with UV-Vis light includes selection rules and the Lambert-Beer law. b. Identification of λ_{\max} and ϵ of an organic compound based on electronic, steric and solvent	Correct concept's molecular structure determination <i>via</i> Ultraviolet-Visible (UV-Vis) Spectroscopy		

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		Fieser rule (quantitative).			decision on a problem.	effects (qualitative). c. Identify λ_{\max} and ϵ of an organic compound based on the Woodward-Fieser rule (quantitative). Soft Skills: a. Creativity, imagination, motivation. b. Problem solving skill c. Team works and communication. d. Systematic solution and critical thinking. e. Integrity and discipline Independent			
3	Able to identify absorption frequency (ν), determine type of bonding and functional group of organic molecules	Molecular structure determination via infrared spectroscopy (IR): a. The concept of vibrational transitions of an organic molecule interacting with IR rays including Hooke's law.	<i>Synchronous-On-line/Off-line</i> lecture: a. Lecture b. Discussion c. Independent Exercise d. Assignment	2 x 50 minutes	a. Gain insight and explanation regarding the determination of molecular structures via IR spectroscopy through visual learning. b. Carry out interactions between students and:	Hard Skills: Completeness and truth about: a. The concept of vibrational transitions of an organic molecule interacting with IR rays including Hooke's law.	Correct concept's molecular structure determination via IR Spectroscopy		

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		<p>b. Identification the type of bond and functional group of an organic compound based on four main regions of absorption frequency (ν).</p> <p>c. Identification of ν based on sp, sp^2, sp^3 hybridization and determining the functional groups of an organic compound.</p> <p>d. Identification of ν of an organic compound based on electronic and steric effects and determining the functional group of an organic compound.</p>			<p>(i) Lecturer (ii) Other students (iii) Teaching materials</p> <p>b. Obtain an agreement of understanding, opinion and joint decision on a problem.</p>	<p>b. Identification the type of bond and functional group of an organic compound based on four main regions of absorption frequency (ν).</p> <p>c. Identification of ν based on sp, sp^2, sp^3 hybridization and determining the functional groups of an organic compound. Identification of ν of an organic compound based on electronic and steric effects and determining the functional group of an organic compound.</p> <p>Soft Skills:</p> <p>a. Creativity, imagination, motivation. b. Problem solving skill</p>			
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	(.....)		(.....)		(.....)

						<ul style="list-style-type: none"> c. Team works and communication. d. Systematic solution and critical thinking. Integrity and discipline Independent 			
4-6	Able to identify molecular ions, fragment ions and molecular weights from MS data of organic compounds as well as propose molecular formulas (rule 13), proposed substructures (unsaturated number, UN), determine MS fragment ions to become proposed substructures/structures that are in accordance with the mechanism fragmentation.	<p>Molecular structure determination via MS</p> <ul style="list-style-type: none"> a. The concept of interaction between organic molecule and electron. b. Identification of molecular ion based on MS data and determination molecular weight, molecular formula with the rule of 13, and unsaturated number (propose initial substructure). c. Elucidation of fragment ion to become substructure/structure rationalizing with fragmentation mechanisms 	<p><i>Synchronous-On-line/Off-line</i> lecture:</p> <ul style="list-style-type: none"> a. Lecture b. Discussion c. Independent Exercise d. Assignment 	6 x 50 minutes	<ul style="list-style-type: none"> a. Gain insight and explanation regarding the determination of molecular structures via MS through visual learning. b. Carry out interactions between students and: <ul style="list-style-type: none"> (i) Lecturer (ii) Other students (iii) Teaching materials c. Obtain an agreement of understanding, opinion and joint decision on a problem. 	<p>Hard Skills: Completeness and truth about:</p> <ul style="list-style-type: none"> a. The concept of interaction between organic molecule and electron. b. Identification of molecular ion based on MS data and determination molecular weight, molecular formula with the rule of 13, and unsaturated number (propose initial substructure). c. Elucidation fragment ion to become substructure/structure rationalizing 	Correct concept's molecular structure determination via MS		

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						with fragmentation mechanisms Soft Skills: a. Creativity, imagination, motivation. b. Problem solving skill c. Team works and communication. d. Systematic solution and critical thinking. e. Integrity and discipline f. Independent			
7	Able to identify dan determine functional group/substructure/structure based of chemical transformation	Determination of molecular structure via chemical transformation a. The concept of elucidation of molecular structures based on chemical transformations: forward reactions (synthesis) and reverse reactions (degradation). b. Chemical transformations in determining various functional groups, substructures and structures of organic compounds.	<i>Synchronous-On-line/Off-line lecture:</i> a. Lecture b. Discussion c. Independent Exercise d. Assignment	2 x 50 menit	a. Gain insight and explanation regarding the determination of molecular structures <i>via</i> MS through visual learning. c. Carry out interactions between students and: (i) Lecturer (ii) Other students (iii) Teaching materials	Hard Skills: Completeness and truth about: a. The concept of elucidation of molecular structures based on chemical transformations: forward reactions (synthesis) and reverse reactions (degradation).	Correct concept's molecular structure determination <i>via</i> chemical transformation		

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					d. Obtain an agreement of understanding, opinion and joint decision on a problem.	b. Chemical transformations in determining various functional groups, substructures and structures of organic compounds. Soft Skills: a. Creativity, imagination, motivation. b. Problem solving skill c. Team works and communication. d. Systematic solution and critical thinking. e. Integrity and discipline f. Independent			
8–12	Able to identify δ , J , I , T from 1D N (^1H dan ^{13}C) of organic molecules and able to determine functional group/substructure/structure either planar or stereo molecules based on 1D NMR (^1H , ^{13}C , NOE) and introduction of 2D NMR (COSY,	Molecular structure determination via <i>Nuclear Magnetic Resonance</i> (NMR) spectroscopy a. The concept of interaction between an organic molecule (^1H and ^{13}C nuclei) and radio waves. The outcomes are	<i>Synchronous-On-line/Off-line</i> lecture: a. Lecture b. Discussion c. Independent Exercise d. Assignment e. PBL f. Software Application	10 x 50 menit	a. Gain insight and explanation regarding the determination of molecular structures via NMR through visual learning. b. Carry out interactions	Hard Skills: Completeness and truth about: a. The concept of interaction between an organic molecule (^1H and ^{13}C nuclei) and radio waves. The	Correct concept's molecular structure determination via NMR spectroscopy		

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	(.....)		(.....)		(.....)

	TOCSY, HSQC, HMBC, NOESY)	<p>in in the form of δ, J, I, T.</p> <p>b. Identification of δ from a ^1H and ^{13}C nuclei of organic compounds based on electronegativity effects, PEB, steric effects, anisotropy effects and hydrogen bonds as well as their elucidation of organic compounds.</p> <p>c. Identification of J of the ^1H nucleus and its multiplicity and its application in the elucidation of the planar and stereo structure of an organic compound.</p> <p>d. ^1H nuclear interactions in space: NOE applications.</p> <p>e. Substructure/structure identification with 2D NMR (^1H-^1H connectivity, ^1H-^{13}C, and ^1H-^1H space interactions).</p>			<p>between students and:</p> <p>(i) Lecturer (ii) Other students (iii) Teaching materials</p> <p>a. Obtain an agreement of understanding, opinion and joint decision on a problem.</p>	<p>outcomes are in in the form of δ, J, I, T.</p> <p>b. Identification of δ from a ^1H and ^{13}C nuclei of organic compounds based on electronegativity effects, PEB, steric effects, anisotropy effects and hydrogen bonds as well as their elucidation of organic compounds.</p> <p>c. Identification of J of the ^1H nucleus and its multiplicity and its application in the elucidation of the planar and stereo structure of an organic compound.</p> <p>d. ^1H nuclear interactions in space: NOE applications.</p> <p>e. Substructure/structure</p>			
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						<p>identification with 2D NMR (^1H-^1H connectivity, ^1H-^{13}C, and ^1H-^1H space interactions).</p> <p>Soft Skills:</p> <ol style="list-style-type: none"> Creativity, imagination, motivation. Problem solving skill Team works and communication. Systematic solution and critical thinking. Integrity and discipline Independent 			
13–14	Able to determine the structure of small molecules (stable and unstable molecules) based spectroscopic and chemical transformation strategies	Integrated molecular structure determination	<i>Synchronous-On-line/Off-line</i> lecture: <ol style="list-style-type: none"> Lecture Discussion Independent Exercise Assignment 	4 x 50 menit	<ol style="list-style-type: none"> Gain insight and explanation regarding integrated molecular structure determination through visual learning. Carry out interactions between students and: <ol style="list-style-type: none"> Lecturer Other students 	<p>Hard Skills: Completeness and truth about: integrated molecular structure determination</p> <p>Soft Skills:</p> <ol style="list-style-type: none"> Creativity, imagination, motivation. Problem solving skill 	Correct concept's integrated molecular structure determination		

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					(iii) Teaching materials	c. Team works and communication.			
					c. Obtain an agreement of understanding, opinion and joint decision on a problem.	d. Systematic solution and critical thinking. e. Integrity and discipline f. Independent			

II. Plan Assessment

No	Learning outcome	Independent Exercise/Quiz/Assignment	Exam			
			U1	U2	U3	U4
1	Introduction, Structure Determination via UV-Vis Spectroscopy	✓	✓			
2	Structure Determination via IR	✓	✓			
3	Structure Determination via MS	✓		✓		
4	Structure Determination via chemical transformation	✓				✓
5	Structure Determination via NMR	✓			✓	
6	Integrated Structure Determination	✓				✓

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III. Assessment

Kriteria Penilaian	Kisaran Nilai	Bobot Nilai (%)	Keterangan
Independent exercise/Quiz/ Assignment	0-100	20	Individu
Lecture			
Exam I	0-100	15	Individu
Exam II (UTS)	0-100	25	Individu
Exam III	0-100	45	Individu
Exam IV (UAS)	0-100	15	Individu

IV. References

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