



# MODULE HANDBOOK

Bachelor of Chemistry



## 1. Indonesian

<b>Module designation</b>	Indonesian														
<b>Semester(s) in which the module is taught</b>	I														
<b>Person responsible for the module</b>	Hani Subaksi, S.Pd., M.Pd														
<b>Language</b>	Indonesian														
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>														
<b>Teaching methods</b>	Lecture, discussion, assignment, final project														
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester														
<b>Credit points</b>	2 credits / 3.18 ECTS														
<b>Required and recommended prerequisites for joining the module</b>	-														
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Demonstrate a sense of gratitude and pride in the Indonesian language as a manifestation of nationalistic spirit in preserving the unity of the Unitary State of the Republic of Indonesia (NKRI).</li> <li>2. Use the Indonesian language appropriately according to its various registers. Understand the rules for using the Indonesian language in academic writing.</li> <li>3. Demonstrate proficiency in using the Indonesian language as a means of communication to process, reason, and present information through scientific writing.</li> </ol>														
<b>Content</b>	This course discusses the Indonesian language as a manifestation of nationalistic spirit in preserving the unity of the Unitary State of the Republic of Indonesia (NKRI); the use of Indonesian in accordance with language variations; the rules of using Indonesian in academic writing; and Indonesian as a means of communication for processing, reasoning, and presenting information through scientific writing.														
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td>C</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C
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	70 ≤ FG < 75	3.0	B
	75 ≤ FG < 80	3.5	
	80 ≤ FG ≤ 100	4.0	A
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>		
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Permendikbud Nomor 50 Tahun 2015 tentang Pedoman Umum Ejaan Bahasa Indonesia.</li> <li>2. Permendiknas Nomor 146/U/2004 tentang Pedoman Umum Pembentukan Istilah.</li> <li>3. Undang-Undang Nomor 24 Tahun 2009 tentang Bendera, Bahasa, Lambang Negara, dan Lagu Kebangsaan Indonesia Raya</li> </ol>		

## 2. English

<b>Module designation</b>	English
<b>Semester(s) in which the module is taught</b>	I
<b>Person responsible for the module</b>	Dr. Noor Rachmawaty, S.Pd., M.End
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 4. Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 5. Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Mahasiswa mampu memahami Aturan Penilaian, RPS, Silabus serta Kontrak Kuliah</li> <li>2. Mahasiswa mampu mendengarkan dan menangkap makna pembicaraan dalam bahasa Inggris parts of speech dalam bahasa Inggris</li> <li>3. Mahasiswa mampu mengidentifikasi menggunakan tata bahasa dasar dalam bahasa Inggris</li> <li>4. Mahasiswa mampu mengenal berbagai macam paragraf dalam bahasa Inggris.</li> <li>5. Mahasiswa mampu memahami teks bacaan dengan beragam topik khususnya topik sains</li> <li>6. Mahasiswa mampu menyampaikan ide/gagasan dalam bahasa Inggris secara lisan berkaitan dengan bacaan teks sains</li> <li>7. Mahasiswa mampu menulis essay pendek dalam bahasa Inggris dengan tata bahasa yang baik</li> <li>8. Mahasiswa mampu mengidentifikasi strategi umum dalam mengerjakan MUEPT Listening Comprehension</li> <li>9. Mahasiswa mampu mengerjakan soal- soal MUEPT Listening Comprehension sesuai dangan waktu dan strategi umum yang diberikan</li> <li>10. Mahasiswa mampu mengidentifikasi strategi umum dalam mengerjakan Test MUEPT Reading Comprehension.</li> <li>11. Mahasiswa mampu mengerjakan soal-soal MUEPT Reading Comprehension sesuai dangan waktu dan strategi umum yang diberikan.</li> </ol>

	<p>12. Mahasiswa mampu mengidentifikasi strategi umum dalam mengerjakan Test MUEPT Grammar</p> <p>13. Mahasiswa mampu mengerjakan soal-soal MUEPT Grammar sesuai dengan waktu dan strategi umum yang diberikan.</p>																								
<b>Content</b>	This course covers conversation in English; parts of speech in English; types of paragraphs in English; expressing ideas orally in English; essay structure; MUEPT Listening Comprehension; MUEPT Reading Comprehension; and MUEPT Grammar.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Hancock, Mark., and A. McDonald. English Result Intermediate Student's Book. Oxford University Press.</li> <li>Murphy, R. 2012. English Grammar in Use. Cambridge University Press.</li> <li>MUEPT (Lokakarya MUEPT) Link: <a href="https://youtu.be/HAw1YgQUbw?si=jybf7TFJMGAQotLu">https://youtu.be/HAw1YgQUbw?si=jybf7TFJMGAQotLu</a></li> </ol>																								

### 3. Fundamental of Chemistry

<b>Module designation</b>	<b>Fundamental Chemistry</b>
<b>Semester(s) in which the module is taught</b>	1
<b>Person responsible for the module</b>	Dr. Eva Marliana, M.Si Dr. Teguh Wirawan, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 180 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the development of atomic theory and electron configuration.</li> <li>2. Students are able to understand the periodic system and its relationship to electron configuration and periodic properties of elements.</li> <li>3. Students are able to understand the physical and chemical properties of elements.</li> <li>4. Students are able to understand the basics of stoichiometry, namely the concept of moles in determining empirical formulas and molecular formulas.</li> <li>5. Students are able to understand the basics of stoichiometry to complete calculations in chemical reactions.</li> <li>6. Students are able to the concept of kinetics in chemical reactions</li> <li>7. Students are able to understand the role of electrons in forming chemical bonds.</li> <li>8. Students are able to understand the VSEPR theory, valence bond theory, shape and nomenclature of molecules.</li> <li>9. Students are able to understand the basic concepts of Molecular Orbital theory.</li> <li>10. Students are able to understand the characteristics and reactions of hydrocarbon compounds</li> </ol>

	<ol style="list-style-type: none"> <li>11. Students are able to understand the characteristics of functional groups of several derivatives of hydrocarbon compounds</li> <li>12. Students are able to explain the structure, properties, classification of amino acids and proteins</li> <li>13. Students are able to understand the structure, properties and classification of carbohydrates and lipids</li> </ol>																								
<b>Content</b>	The basic chemistry course discusses matter and changes in matter, atomic structure, the periodic table of elements, elemental chemistry, stoichiometry, chemical kinetics, molecular structure and covalent bonds, molecular orbitals in chemical bonds, hydrocarbon compounds, functional groups in organic compounds and the basics of biomolecular chemistry.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>3. Students have a minimum attendance rate of 80%.</li> <li>4. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>4. Chang, R. and Goldsby, K. (2010) Chemistry. 11th Edition, Mcgraw Hill, New York.</li> <li>5. Brady, J.E , (1990), General Chemistry: Principles And Structure, 4th Edition, Wiley, New York.</li> <li>6. Petrucci, RH., Herring, FG., Madura, JD., and Bissonnette, C., (2017), General Chemistry: Principles and Modern Applications, Pearson Education</li> </ol>																								

#### 4. Pancasila

<b>Module designation</b>	Pancasila
<b>Semester(s) in which the module is taught</b>	I
<b>Person responsible for the module</b>	Endang Herlihah, S.Pd., M.Pd
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the position, background, and objectives of Pancasila education.</li> <li>2. Students are able to explain the history of the Indonesian nation's struggle from the pre-independence period to the post-independence era.</li> <li>3. Students are able to explain the process of formulating and ratifying Pancasila as the foundation of the state.</li> <li>4. Students are able to explain Pancasila as the foundation of the life of the nation and the Republic of Indonesia.</li> <li>5. Students are able to explain Pancasila as the foundation of the life of the nation and the Republic of Indonesia.</li> <li>6. Students are able to explain Pancasila as political ethics.</li> <li>7. Students are able to explain Pancasila as an ideology among other major world ideologies.</li> <li>8. Students are able to master the expected competencies.</li> <li>9. Students are able to explain Pancasila as an ideology among other major world ideologies.</li> <li>10. Students are able to understand Pancasila in the context of the constitutional system of the Republic of Indonesia.</li> <li>11. Students are able to elaborate and provide examples of the implementation of Pancasila as a development paradigm.</li> <li>12. Students are able to elaborate and provide examples of the implementation of Pancasila as a development paradigm.</li> </ol>

	<p>13. Students are able to explain the actualization of Pancasila as a paradigm in the life of the Indonesian nation within the campus environment.</p> <p>14. Students are able to master the expected competencies.</p>																								
<b>Content</b>	<p>This course discusses the position, background, and objectives of Pancasila education; the history of the Indonesian nation's struggle from the pre-independence era to the post-independence period; the process of formulating and ratifying Pancasila as the foundation of the state; Pancasila as the foundation of the life of the nation and the Republic of Indonesia; Pancasila as political ethics; Pancasila as an ideology among other major world ideologies; Pancasila in the context of the constitutional system of the Republic of Indonesia; the implementation of Pancasila as a development paradigm; and the actualization of Pancasila in the life of the Indonesian nation within the campus environment.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Reading list</b>	<ol style="list-style-type: none"> <li>AMW. Pranrka, 1985, Sejarah Pemikiran tentang Pancasila, CSIS Jakarta.</li> <li>Suprayogi, dkk, 2018, Pendidikan Pancasila, UNNES: Semarang Press.</li> <li>Dardji Darmodihardjo, dkk, 1978, Santiaji Pancasila, Usaha Nasional Surabaya.</li> <li>-----, 1983, Pancasila Dalam Beberaoa Persektif, Aries Lima, Jakarta.</li> <li>Ending Daroesni Asdi, 1985, Memahami Pancasila, PD Lukman, Yogyakarta.</li> <li>Faisal Ismail, 1999, Ideologi Hegemoni dan Otoritas Agama, Tiara Wacana, Yogyakarta.</li> <li>Francisco Budi Hardiman, 1990, Kritik Ideologi, Kanisus Yogyakarta.</li> <li>Herqutanto Sosronegoro, 1990, Beberapa Ideologi dan Implementasinya dalam Kehidupan Kenegaraan.</li> <li>Kaelan, 1992, Pancasila Yuridis Kenegaraan, Fakultas Filsafat UGM.</li> <li>-----, 1992, Filsafat Pancasila, Fakultas Filsafat UGM.</li> </ol>																								

11. Kirdi Dipoyudo, 1984, Pancasila Arti dan Pelaksanaannya, CSIS, Jakarta.
12. Laboratorium Pancasila UNNES Malang, 1979, Pokok-pokok Pembahasan Pancasila Dasar Filsafat Negara RI, Usaha Nasional, Surabaya.
13. -----, 1990, Pendidikan Pancasila di Perguruan Tinggi, UNNES Malang.
14. M. Yamin, 1952, Proklamasi dan Konstitusi RI.
15. Moerdiono dkk, 1996, Pancasila Sebagai Ideologi, BP-7 Pusat, Jakarta.
16. M. Taopan, 1992, Keunggulan Pancasila Sebagai Filsafat Kenegaraan, Citra Aditya Bakti, Bandung.
17. -----, 1993, Pengkajian dan Pengembangan Butir-Butir Nilai Pancasila, Citra Aditya Bakti, Bandung.
18. Marsilam Simanjuntak, 1994, Pandangan Negara Integralistik, Pustaka Utama Grafiti.
19. Mohammad Noor Syam, 1984, Filsafat Pendidikan dan Dasar Filsafat Pendidikan Pancasila, Usaha Nasional, Surabaya.
20. Muzayin AR, 1992, Ideologi Pancasila, Golden Trayon Press, Jakarta.
21. Notonagoro, 1982, Beberapa Hal Mengenai Filsafat Pancasila, Pantjuran Tudjuh, Jakarta.
22. -----, 1984, Pancasila Secara Ilmiah Populer, Bina Aksara, Jakarta.
23. Nugroho Notosusanto, 1983, Naskah Proklamasi Yang Otentik dan Rumusan Pancasila Yang Otentik, PN Balai Pustaka, Jakarta.
24. -----, 1983, Proses Perumusan Pancasila Dasar Negara, PN Balai Pustaka, Jakarta.
25. Padmo Wiyono, 1984, Membudayakan UUD 1945, IND-HILL-CO, Jakarta.
26. SA Kodhi dan Soejadi, 1989, Filsafat Ideologi dan Wawasan Bangsa Indonesia, Penerbitan UAJ Yogyakarta.
27. Sekretariat Negara RI, 1995, Risalah Sidang BPUPKI dan PPKI, Setneg RI, Jakarta.
28. Soediman Kartohadiprojo, 1980, Beberapa Pikiran Sekitar Pancasila, Alumni, Bandung.
29. Soerjanto Poeswardojo, 1989, Filsafat Pancasila, Gramedia, Jakarta.
30. Soeprapto, t, th., Pancasila Sebagai Ideologi Terbuka Dalam Menghadapi Liberalisme Perdagangan Internasionalisme, BP-7 Pusat, Jakarta.
31. Sunoto, 1982, Mengenal Filsafat Pancasila Pendekatan Melalui Sejarah dan Pelaksanaannya, FE UII, Yogyakarta.
32. -----, 1984, Filsafat Sosial dan Politik Pancasila, Andi Offset, Yogyakarta.
33. -----, 1981, Mengenal Filsafat Pancasila Pendekatan Melalui Metafisika Logika Etika, Bagian Penerbitan FE UII, Yogyakarta.
34. Susanto Tirtoprodjo, 1961, Sejarah Pergerakan Nasional Indonesia, PT Pembangunan, Jakarta.
35. Suyahmo, 2014, Filsafat Pancasila, Magnum, Yogyakarta.

## 5. Fundamental of Phisic

<b>Module designation</b>	<b>Fundamental of Phisic</b>
<b>Semester(s) in which the module is taught</b>	I
<b>Person responsible for the module</b>	Dr. Dadan Hamdani, M.Si Muhammad Riza, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain introductory materials, including measurement, quantities and units, models, theories, laws, significant figures, and vectors.</li> <li>2. Students are able to apply the concept of particle kinematics in solving problems related to physical systems.</li> <li>3. Students are able to apply the concept of particle dynamics in solving physical problems.</li> <li>4. Students are able to explain the concept of work and energy and their applications in the development of science and technology.</li> <li>5. Students are able to apply the fundamental concepts of momentum and impulse comprehensively in relation to the center of mass, reduced mass, variable mass systems, and collisions.</li> <li>6. Students are able to formulate the relationships among angular momentum, torque, the law of conservation of momentum, and moment of inertia based on the laws of motion, as well as their relation to rotational kinetic energy and rolling motion.</li> </ol>

	<ol style="list-style-type: none"> <li>7. Students are able to analyze problems related to the equilibrium of rigid bodies under various conditions, as well as elasticity, stress, and strain.</li> <li>8. Students are able to apply the concepts of vibration, waves, sound, and hearing, along with their applications in everyday life.</li> <li>9. Students are able to apply the laws of static fluids in solving related physical problems.</li> <li>10. Students are able to apply the laws of dynamic fluids in solving related physical problems.</li> <li>11. Students are able to apply the concepts of heat and gases in relation to phase changes, gas laws, specific heat, latent heat, and heat transfer.</li> <li>12. Students are able to apply the basic concepts and laws of thermodynamics and their applications in system cycles, heat engines, refrigeration systems, the Carnot cycle, and entropy.</li> </ol>																								
<b>Content</b>	<p>This course covers introductory materials, including measurement, quantities and units, models, theories, laws, significant figures, and vectors; the concept of particle kinematics in solving physical system problems; the concept of particle dynamics in solving physical problems; the concept of work and energy and their applications in the development of science and technology; the fundamental concepts of momentum and impulse comprehensively; the relationship between angular momentum, torque, the law of conservation of momentum, and moment of inertia; equilibrium of rigid bodies under various conditions, as well as elasticity, stress, and strain; the concepts of vibration, waves, sound, and hearing, along with their applications in daily life; the laws of static fluids; the laws of dynamic fluids; the concepts of heat and gases; and the basic concepts and laws of thermodynamics.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Abdullah, M. Fisika Dasar I, 2016. Buku elektronik</li> <li>2. D. Halliday, R. Resnick, J. Walker. 2013. Fundamental of Physics, 10th Edition. Wiley.</li> <li>3. D. C. Giancoli. 2010. Physics: Principles with Application, 6th Edition. Addison-Wesley.</li> <li>4. Resnick, R &amp; Halliday, D. 1966. Physics. John Wiley &amp; Son. 5. Giancoli, D.C. 1884. General Physics. Prentice Hall</li> </ol>																								

## 6. Calculus Elementer

<b>Module designation</b>	<b>Calculus Elementer</b>
<b>Semester(s) in which the module is taught</b>	I
<b>Person responsible for the module</b>	Desi Fitriani Putri, S.Si., M.Si Rito Goejantoro, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the Real Number System.</li> <li>2. Students are able to explain Coordinate Systems and Functions.</li> <li>3. Students are able to explain functions and operations on functions.</li> <li>4. Students are able to demonstrate the calculation of limits.</li> <li>5. Students are able to explain continuity.</li> <li>6. Students are able to explain the concept of derivatives.</li> <li>7. Students are able to demonstrate derivatives of specific functions.</li> <li>8. Students are able to apply the concept of derivatives in basic mathematical problems.</li> <li>9. Students are able to apply the concept of derivatives in applied mathematical problems.</li> <li>10. Students are able to explain the concept of integrals.</li> </ol>
<b>Content</b>	This course covers the Real Number System; Coordinate Systems and Functions; functions and operations on functions; calculation of

	limits; continuity; the concept of derivatives; derivatives of specific functions; derivatives in basic mathematical problems; derivatives in applied mathematical problems; and the concept of integrals.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Leithold, L. (1986). (terjemahan M. Margha). Kalkulus dan ilmu ukur analitik. Jilid I. Jakarta: PT Bina Aksara</li> <li>2. Verberg, Dale., Purcell, Edwin., dan Rigdon, Steve. (2006), Calculus (9th Edition). Pearson Publisher. USA</li> <li>3. Stewart, James, (2015), Calculus 8th edition, Brooks-Cole</li> </ol>																								

## 7. Basics Social and Cultural Sciences

<b>Module designation</b>	<b>Basics Social and Cultural Sciences</b>
<b>Semester(s) in which the module is taught</b>	I
<b>Person responsible for the module</b>	Dr. Hamdi Mayulu, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the foundational concepts, vision, mission, objectives, and content of ISBD, as well as its approaches and alternative learning methods.</li> <li>2. Students understand the manifestation, substance, characteristics, and systems of culture, the role of humans as determinants of culture, and the essence of human life and modernization.</li> <li>3. Students are able to explain the nature, function, and position of humans within their civilization, and the essence of human life in the context of modern times.</li> <li>4. Students are able to explain and distinguish between humans as individuals and as social beings, differentiate between rural and urban communities, and understand social interaction and social stratification.</li> <li>5. Students are able to explain the meaning of humans, values, morals, and law.</li> <li>6. Students are able to understand, explain, and differentiate between humans, diversity, and equality.</li> <li>7. Students are able to explain and understand the position of humans in relation to science, technology, and art.</li> <li>8. Students are able to explain, actively participate, and demonstrate insight into the relationship between humans and the environment, particularly in the context of tropical rainforests and their ecosystems.</li> </ol>

<b>Content</b>	This course discusses the foundational concepts, vision, mission, objectives, interdisciplinary approaches, and alternative learning models of ISBD (Social and Cultural Sciences Education); the manifestation, substance, characteristics, and systems of culture; humans as determinants of culture; humans and civilization; the essence of human life and modernization; humans as individuals and social beings; humans, values, morals, and law; humans, diversity, and equality; humans, science, technology, and art; and humans and the environment.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 741 1385 1048"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Ahmadi, Abu. 2009. Ilmu Sosial Dasar, Jakarta: Rineka Cipta.</li> <li>Abdul Hakam, Kama, Manusia dan Lingkungan Sosial Budayanya,</li> <li>Makalah, Lokakarya Dosen ISBD, DIKTI Depdiknas, Batam.</li> <li>Abd. al-Baqi, Muhammad Faud, tanpa tahun</li> <li>Allpot, Godon W., The Nature of Prejudice, Doubleday Anchor Books, Gar-den City, new York, 1958.</li> <li>Abdullah. 1992. Materi Pokok Pndidikan IPS-2: Buku 1, Modul 1, Jakarta: Departemen Pendidikan dan Kebudayaan.</li> </ol>																								

## 8. Laboratory Techniques

<b>Module designation</b>	<b>Laboratory Techniques</b>
<b>Semester(s) in which the module is taught</b>	I
<b>Person responsible for the module</b>	Dr. Teguh Wirawan, M.Si Ika Yekti, Liana Sari, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective/ specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1 : Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, ; and being environmentally conscious.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the meaning, function, types, sarpras, and rules in the laboratory.</li> <li>2. Students are able to analyze accidents in the laboratory</li> <li>3. Students are able to apply K3 in the laboratory</li> <li>4. Students are able to describe the meaning, storage, symbols, and disposal of hazardous and toxic chemical waste.</li> <li>5. Students are able to describe types of laboratory equipment and apply how to use and maintain them.</li> <li>6. Students are able to describe about solutions, basic techniques of glassware and simple instrumentation.</li> <li>7. Students are able to use filter paper and pipette solutions properly and correctly.</li> <li>8. Students are able to operate analytical balances and make solutions.</li> <li>9. Students are able to use separating funnels properly and correctly</li> <li>10. Students are able to use/operate titration tools properly and correctly</li> </ol>
<b>Content</b>	This course discusses the meaning, function, types, infrastructure, and laboratory rules; laboratory accidents; K3 in the laboratory; waste management of hazardous and toxic chemicals; laboratory equipment, how to use, and maintain it; simple instrumentation tools; analytical balance and techniques for making solutions, techniques for using separating funnels; and titration techniques.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) ; Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="643 450 1385 752"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Soleh Kosela. 1998. <i>Managemen Laboratorium</i>. FMIPA UI. Jakarta.</li> <li>Refirman dan Rosminar Suna. 1995. <i>Disain, Perlengkapan dan Tata Ruang Laboratorium IPA dalam Pengelolaan Laboratorium IPA</i>. Depdikbud Dirjen Dikdasmen. Jakarta.</li> <li>Moeljadi, 1995. <i>Keselamatan dan Kerja di Laboratorium dalam Pengelolaan Laboratorium IPA</i>. Depdikbud Dirjen Dikdasmen. Jakarta.</li> <li>Sanusi Ibrahim. 1994. <i>Laboratory Safety and Security</i>. Universitas Andalas. Padang</li> <li>Soemanto Imam Khasani. 1994. <i>Keselamatan Kerja Dalam Laboratorium Kimia</i>, Gramedia. Jakarta.</li> <li>Kemal, A.K. dan Bambang, S. 1996. <i>Pertolongan Pertama Pada Kecelakaan, (Makalah Pelatihan Pengelola Laboratorium PMIPA LPTK)</i>. IKIP. Bandung.</li> <li>Vogel, A.I. 1989. <i>Vogel's textbook of Quantitative Chemical Analysis, 5th ed.</i> Longman Group. United Kingdom.</li> <li>Basset, J., Danney, R.C., dkk., 1994. <i>Buku Ajar Vogel Kimia Analisis Kuantitatif Anorganik</i>. EGC.Jakarta.</li> <li>Mulyono, H.A.M., 2016. <i>Membuat Reagen Kimia di Laboratorium</i>. Bumi aksara. Jakarta.</li> </ol>																								

## 9. Islam

<b>Module designation</b>	Islam
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	Joko Susilo, S.Pd.I., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>Students are able to explain the definition of Islam along with its scope.</li> <li>Students are able to explain the nature of human beings in Islam.</li> <li>Students are able to understand the meaning and essence of aqidah (creed).</li> <li>Students are able to understand and analyze the concept of sharia, worship, and social transactions (muamalah).</li> <li>Students are able to understand the essence of Islam and knowledge.</li> <li>Students are able to understand the concept of morality in Islam.</li> <li>Students are able to understand and analyze insights into moderate Islam.</li> <li>Students are able to explain and present about social interactions in Islam.</li> </ol>
<b>Content</b>	This course discusses the definition of Islam along with its scope; the nature of human beings in Islam; the meaning and essence of aqidah (creed); the concept of sharia, worship, and social transactions (muamalah); the essence of Islam and knowledge; the concept of morality in Islam; insights into moderate Islam; and social interactions in Islam.

<p><b>Examination forms</b></p>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 450 1385 752"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<p><b>Study and examination requirements</b></p>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<p><b>Reading list</b></p>	<ol style="list-style-type: none"> <li>1. Tim Dosen MKAI MPK-Unmul, Pendidikan Agama Islam, Semarang: Akademika, 2016</li> <li>2. M. Kholid Muslih, et.al. Worldview Islam, Unida Gontor: 2018</li> <li>3. Abul A'la Al-Maududi, Khilafah Dan Kerajaan, Bandung: Mizan, 1984.</li> <li>4. Ahmad Kosasih, HAM dalam Perspektif Islam: Menyingkap persamaan dan perbedaan antara Islam dan Barat. Jakarta:Salemba Diniyah, 2003.</li> <li>5. Amir Mualim dan Yusdani, Konfigurasi Pemikiran Hukum Islam. Yogyakarta: UII Press, 2001.</li> <li>6. Departemen Agama RI, Islam Untuk Disiplin Ilmu Hukum, Sosial Dan Politik. Jakarta: 1996.</li> <li>7. Departemen Agama RI, Islam Untuk Disiplin Ilmu Hukum. Jakarta: 2000.</li> <li>8. Departemen Agama RI, Suplemen Buku Daras pendidikan Agama Islam Pada Perguruan Tinggi Umum. Jakarta;1998.</li> <li>9. H. Abdoer Raoef, Alqur'an Dan Ilmu Hukum. Jakarta: Bulan Bintang, 1970.</li> <li>10. Lili Rasyid dan Arief Sidharta, Filsafat hukum Mazhab Dan Refleksinya. Bandung: Remaja karya, 1989.</li> <li>11. Maulana Muhammad Ali, Islamologi. Jakarta: Darul Kutubil Islamiyah, 1996.</li> <li>12. Mohammad Daud Ali, Pendidikan Agama Islam. Jakarta: PT Raja Grafindo Persada, 2000.</li> <li>13. Muhammed Abed Al-Jabiri, Syura: Tradisi Partikularitas Universalitas, Yogyakarta: LKIS, 2003.</li> <li>14. T.M. Hasbi Ash-Shiddieqy, Falsafah Hukum Islam. Jakarta: Bulan Bintang, 1975.</li> <li>15. T.M. Hasbi Ash-Shiddieqy, Pengantar Hukum Islam. Jakarta: Bulan Bintang, 1980.</li> <li>16. Iberani; Mengenal Islam, jakarta: Elkahfi, 2003.</li> <li>17. Mohammad Daud Ali, hukum Islam; Pengantar Ilmu Hukum dan Tata hukum Islam di Indonesia, Jakarta: PT. Raja Grafindo Persada, 1999.</li> <li>18. Mohammad Tahir Azhary, Negara Hukum: Suatu studi tentang Prinsip-Prinsipnya Dilihat dari segi hukum Islam,</li> </ol>																								

	19. implementasinya Pada Periode Negara Madinah dan Masa kini, Jakarta: Bulan Bintang, 1992
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## 10. Roman Catholicism

<b>Module designation</b>	<b>Roman Catholicism</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to develop a sense of faith based on the human vocation according to the Holy Scriptures.</li> <li>2. Students are able to cultivate social awareness and environmental concern based on God's teachings about the relationship of humans with themselves, others, the environment, and God.</li> <li>3. Students are able to enhance faith and foster interreligious tolerance among students.</li> <li>4. Students are able to gain a deeper understanding of Jesus Christ.</li> <li>5. Students are able to internalize the essence and meaning of the Kingdom of God as the core and manifestation of Jesus' mission in the world.</li> <li>6. Students are able to develop a sense of compassion and gratitude based on God's teachings about the Passion, Death, and Resurrection of Jesus Christ.</li> <li>7. Students are able to strengthen their faith and devotion to God through a proper understanding of the meaning of the Most Holy Trinity.</li> </ol>

	8. Students are able to foster a spirit of community engagement through the role of the Church based on an understanding of the Church and socially integrated faith.																								
<b>Content</b>	This course discusses the human vocation according to the Holy Scriptures; the relationship of humans with themselves, others, the environment, and God; living out religion and faith in a pluralistic society; Jesus Christ; the essence and meaning of the Kingdom of God as the core and manifestation of Jesus' mission in the world; the meaning of the Passion, Death, and Resurrection of Jesus Christ; the meaning of the Most Holy Trinity, and the Church and socially integrated faith.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="3">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> <td rowspan="2">C</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> <td>B</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	$65 \leq FG < 70$	2.5	C	$70 \leq FG < 75$	3.0	$75 \leq FG < 80$	3.5	B	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
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## 11. Protestantism

<b>Module designation</b>	<b>Protestantism</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	Dr. Anna Margaretha Tombeng, S.PAK., M.Si., M.Th Dr. Diliyus, M.Th., MM.
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to develop religious awareness in accordance with God's guidance.</li> <li>2. Students are able to enhance their faith and devotion to God by deepening their understanding of God in the Christian faith.</li> <li>3. Students are able to strengthen the spirit of humanism based on a sound understanding of the concept of humanity according to Christian teachings.</li> <li>4. Students are able to foster attitudes and behaviors aligned with Christian ethics and character formation.</li> <li>5. Students are able to be responsive and adaptive to developments in science and technology in the era of disruption and the Fourth Industrial Revolution, based on Christian values.</li> <li>6. Students are able to promote a spirit of tolerance among religious communities in accordance with God's teachings.</li> <li>7. Students are able to develop an inner awareness to live in harmony, balance, and unity with the universe.</li> <li>8. Students are able to cultivate a strong social conscience in line with God's teachings.</li> </ol>
<b>Content</b>	This course discusses religion and its function in human life; God in the Christian faith; human beings according to Christian teachings; ethics and the formation of Christian character; the relationship

	between Christian faith and science and technology; fostering interreligious harmony; and proper social interaction.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
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## 12. Hinduism

<b>Module designation</b>	Hinduism
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the essence and values of Yajna contained in the Ramayana.</li> <li>2. Students are able to practice the implementation of Yadnya according to the Ramayana in daily life.</li> <li>3. Students are able to identify the teachings of Upayeda as life guidance.</li> <li>4. Students are able to reason the teachings of Upayeda as life guidance.</li> <li>5. Explain the essence of Padewasaan (wariga) in the life of Hindus.</li> <li>6. Students are able to practice how to determine Padewasaan (wariga) in Hindu life.</li> <li>7. Students are able to explain and practice Hindu religious teachings as part of Hindu philosophy.</li> </ol>
<b>Content</b>	This course discusses the values of Yadnya and the Ramayana; the teachings of Upadewa; the teachings of Dharsana; and Catur Asmara.
<b>Examination forms</b>	Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%). The final grade (FG) for each student is calculated by the formula : $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$

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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Astana, I Made, C.S. Anomdiputra, Kautilya (Canakya) Asthasastra, Paramita, Surabaya. 2003</li> <li>Awanita, Made, Agama Hindu (Modul Orientasi Pembekalan Calon PNS), Proyek Pembibitan Calon Tenaga Kependidikan</li> <li>Biro Kepegawaian Sekretariat Jendral Deprtement Agama RI. Jakarta 2003.</li> <li>Bagus Wirawan, A.A, dkk, Dharma Agama dan Dharma Negara, Balai Pustaka, Depansar, 1995.</li> <li>Dicki Hartoko, Manusia dan Seni, Kanisius, Yogyakarta, 1991.</li> <li>Donder, I Ktut, Acarya Sista Guru dan Dosen Yang Bijaksana, Pramita. Surabaya, 2008.</li> <li>Edi Sedyawati, Saiwa dan Buddha di Masa Jawa Kuno, Widya Dharma, 2009.</li> <li>Nala, I Gusti Nugrah dan IGK Adia Wiratmadja, Murddha Agama Hindu, Upada Sastra, Jakarta, 1996.</li> <li>Redenda S, I.B., Ekonomi dan Politik Dalam Artha Sastra, PT. Mabhakti, Denpasar, 2007.</li> <li>Saraswati, Sri Chandrasekharendra. Peta Jalan Veda. Terj. Media Hindu. Jakarta. 2009</li> <li>Sharma, Mengapa? Tradisi dan Upacara, Surabaya: Pramita, 2007.</li> </ol>																								

### 13. Buddhism

<b>Module designation</b>	<b>Buddhism</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
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<b>Content</b>	This course discusses actions and their consequences in human life and beyond; living with full awareness (mindfulness) in daily life; the attitudes and behaviors of ethical individuals as agents of social transformation in building the nation's civilization; the Noble Eightfold

	<p>Path; Right View and Right Thought as part of the practice of the Noble Eightfold Path; the concept of the universe and realms of existence; the concept of meditation and clear insight; social issues from the perspective of Buddhism; a conceptual map of realms of existence; living mindfully in daily life; and life issues in accordance with Buddhist teachings.</p>																								
<p><b>Examination forms</b></p>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 678 1385 981"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<p><b>Study and examination requirements</b></p>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<p><b>Reading list</b></p>	<ol style="list-style-type: none"> <li>Ajhan Sumedho. n.d..The four noble truths. Hertfordshire: Amaravati Publications.</li> <li>Arifin, H.M. 1990. Menguak Misteri Ajaran Agama-Agama Besar. Jakarta: Golden Trayon Press. Batchelor, S. 2012. A secular Buddhism. Journal of Global Buddhism. Vol. 13.</li> <li>Baumann, M. 2001. Global Buddhism: Developmental Periods, Regional Histories, and a New Analytical Perspective. Journal of Global Buddhism.Vol. 2.</li> <li>Buddhadassa Bhikkhu. 1988. Buddhadhamma for university students. Bangkok: Dhamma Study and Practice Group.</li> <li>Chan, K.S. 2006. Buddhis Course. Kuala Lumpur:</li> <li>Chan Khoon San. Chin, K. 2000. Buddhism as an Education. Ceylon: Buddha Darma Education Association Inc.</li> <li>Chin, K. 1996. To Understand Buddhism. Ceylon: Buddha Darma Education Association Inc.</li> <li>Daing, U.T. 1995. Cittanupassana and vedananupassana (2nd ed.). Yangon: U Aung Chi.</li> <li>Departemen Agama RI. 1991. Pengkajian dan Pengembangan Kerukunan Hidup Beragama di Indonesia. Jakarta: Balitbang Departemen Agama RI.</li> <li>Dewaraja, L.S. 2000. Kedudukan Wanita dalam Agama Buddha. Jakarta: FPM Sekolah Tri Ratna</li> </ol>																								

## 14. Civics

<b>Module designation</b>	<b>Civics</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	Dr. Thomas Robert Hutauruk, SP., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to cultivate a spirit of patriotism through Civic Education.</li> <li>2. Students are able to foster a humanistic attitude and behave in accordance with human dignity and worth.</li> <li>3. Students are able to develop an awareness of the Indonesian national identity and maintain a balance between rights and responsibilities as citizens.</li> <li>4. Students are able to actualize efforts in national defense in facing global challenges.</li> <li>5. Students are able to foster a democratic spirit to support the upholding of the Unitary State of the Republic of Indonesia (NKRI).</li> <li>6. Students are able to develop a comprehensive and holistic perspective on Indonesia, including its characteristics and diversity.</li> <li>7. Students are able to build strong mental resilience and character in the younger generation to contribute to strengthening national resilience.</li> <li>8. Students are able to support national interests in order to create societal welfare.</li> </ol>
<b>Content</b>	This course discusses the spirit of patriotism; human dignity and worth; rights and obligations as citizens; national defense; a democratic spirit; the characteristics and diversity of Indonesia; the

	mentality and character of the younger generation; and national interests aimed at creating societal welfare.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Andrain, Charles. 1992. Kehidupan Politik dan Perubahan Sosial. Yogyakarta: Tiara Wacana.</li> <li>Bachtiar, Harsja W.1987. Integrasi Nasional Indonesia dalam Wawasan Kebangsaan Indonesia. Jakarta: Badan Komunikasi Penghayatan Kesatuan Bangsa (Bakom.PKB) Pusat.</li> <li>Baswir, Revrison. 1999. Sistem Ekonomi Kerakyatan (Makalah). Yogyakarta: Tidak diterbitkan.</li> <li>Budiarjo, Meriam, 1998, Dasar-Dasar Ilmu Politik, Jakarta : Gramedia.</li> <li>Darmodiharjo, Darji, 1983, Pancasila dalam Perspektif, Jakarta: Aries Lima.</li> <li>Ebenstein, Wiliam H, Soeri Soeroto. 1982. Pemahaman Sejarah Indonesia Sebelum dan Sesudah Revolusi. Jakarta: LP3ES.</li> <li>Ebenstein, William &amp; Fagelman, Edwin, 1994, Isme-Isme Dewasa Ini (Terjemahan), Jakarta, Erlangga.</li> <li>Gaffar, Afan. 2002. Politik Indonesia. Yogyakarta: Pusataka Pelajar.</li> <li>Kantaprawira, Rusadi, 1983, Sistem Politik Indonesia, Bandung : Sinar Baru.</li> <li>Lemhanas. 2000. Pendidikan Kewarganegaraan. Jakarta.</li> <li>Margenthou, Hans J. 1990. Politik Antar Bangsa (Terjemahan). Jakarta: Yayasan Obor Indonesia.</li> <li>Mas'ood, Mohtar dan Mac Andrew, Colin (ED). 1990. Perbandingan Sistem Politik, Yogyakarta : UGM. Press.</li> <li>Morgenthou, Hans, 1990, Politik Antar Bangsa (Terjemahan), Jakarta : Yayasan Obor Indonesia.</li> <li>Nasikun, 1993, Sistem Sosial Indonesia, Jakarta: Rajawali Press.</li> <li>Pamuji S, 1985, Demokrasi Pancasila dan Ketahanan Nasional, Jakarta : Bina Aksara.</li> <li>Puspowardoyo. 1991. Pancasila sebagai _deology Ditinjau dari Pandangan Hidup Bersama, Pancasila Sebagai _deology. Jakarta: BP7 Pusat.</li> <li>Dan Ditjen. Dikti. Depdikbud. 1997. Kewiraan Buku Induk Pendidikan Kewarganegaraan. Jakarta: Lemhanas</li> </ol>																								

	<ol style="list-style-type: none"><li>18. Sunarto,dkk. 2011. Pendidikan Kewarganegaraan. Semarang: IKIP Semarang Press.</li><li>19. Suryosumarto, Budi Santoso. 1989. Sistem Informasi Manajemen Nasional. Jakarta: Aries Lima.</li><li>20. Usman, Oetojo dan Alfian, 1991, Pancasila sebagai Ideologi, Jakarta; BP-7 Pusat.</li><li>21. Wibisono S, Koento. 2001. Demokrasi sebagai Sarana Kehidupan Berbangsa dan Bernegara. Jakarta: Dirjen Dikti</li></ol>
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## 15. Advanced Chemistry

<b>Module designation</b>	<b>Advanced Chemistry</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	Dr. Teguh Wirawan, M.Si Moh. Syaiful Arif, S.Pd., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Fundamental of Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the meaning of solution and determine the concentration of solution</li> <li>2. Students are able to analyze colligative properties and applications in everyday life.</li> <li>3. Students are able to apply the concepts of acid-base and ion equilibrium in solutions</li> <li>4. Students are able to apply the concept of acid-base for titration</li> <li>5. Students are able to describe colloids and their applications</li> <li>6. Students are able to analyze equilibrium in chemical reactions.</li> <li>7. Students are able to analyze gas law and gas kinetic theory.</li> <li>8. Students are able to analyze the first and second laws of thermodynamics.</li> <li>9. Students are able to apply redox concepts in electrochemical cells.</li> <li>10. Students are able to apply the concept of redox in Volta cells and electrolysis</li> <li>11. Students are able to describe the concepts of nuclear chemistry and radiochemistry</li> </ol>

<b>Content</b>	This course studies solution chemistry; colligative properties of solutions; acids and bases; hydrolysis; buffers; colloids; chemical equilibrium; gaseous states; thermodynamics; redox and electrochemistry; voltaic/galvanic cells and electrolysis; nuclear chemistry; and radiochemistry.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 577 1385 887"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Brady and Humiston. 2004. General Chemistry, Principles and Structures. New York: John Willey and Sons.</li> <li>Chang, Raymond. 2005. General Chemistry The Essential Concepts Third Edition. USA: McGraw Hill.</li> <li>Keenan, C.W., Kleinfelter, D.C., Wood, J.H., 1980, Kimia Untuk Universitas, Jilid I, Edisi Keenam, Erlangga, Jakarta.</li> <li>Whitten, Davis, Peck, dan Stanley, General Chemistry, 7th Edition, Brooks Cole, New York.</li> </ol>																								

## 16. Chemical Element

<b>Module designation</b>	<b>Chemical Element</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	Husna Syaima, S.Si., M.Si Irfan Ashari Hiyahara, S.Pd., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Fundamental of Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the contents of the Lecture Contract and the abundance of elements and their tendencies in nature</li> <li>2. Students are able to understand and explain the distribution of elements and the composition of elements in the earth's crust in the form of compounds</li> <li>3. Students are able to understand and explain the types of elements in the form of metals in nature</li> <li>4. Students are able to explain the existence of hydrogen in nature, the oxidation state of hydrogen in compounds and how hydride salts are formed.</li> <li>5. Students are able to explain and understand the properties of elements in groups 1 and 2, the preparation and use of elements, the formation of compounds both ternary and binary and the diagonal relationship between elements</li> <li>6. Students are able to explain and understand elements in group 13 including the properties of elements in group 13, the preparation and use of elements, the formation of compounds both ternary and binary</li> <li>7. Students are able to explain and understand the properties of elements in group 14, the preparation and use of elements, the formation of compounds both ternary and binary</li> </ol>

	<p>8. Students are able to explain their electronic properties, how to obtain/prepare elements in groups 15, 16, 17 and 18 and explain their use.</p> <p>9. Students are able to explain the properties, existence, abundance, isolation, and use of transition elements.</p> <p>10. Students are able to explain about lanthanide, actinide, trans actinide elements</p>																								
<b>Content</b>	<p>This course discusses the abundance of elements and trends in nature; the distribution of elements and the composition of elements in the earth's crust in the form of compounds; types of elements that are metallic in nature; the presence of hydrogen in nature, the degree of oxidation of hydrogen in compounds, and how to form hydride salts; the properties of group 1 and 2 elements, preparation and use of elements, the formation of compounds both ternary and binary and diagonal relationships between elements; group 13 elements include properties, preparation and use of elements, as well as the formation of both ternary and binary compounds; properties of group 14 elements, preparation and use of elements, as well as the formation of both ternary and binary compounds; electronic properties, how to obtain, and applications of group 15, 16, 17 and 18 elements; properties, existence, abundance, isolation, and use of transition group elements; and lanthanide, actinide, and transactinide elements.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Bowser, J.R., 1990, "Inorganic Chemistry", John Willey &amp; Sons, New York.</li> <li>Cotton, F.A &amp; Wilkinson G., 1987, "Basic Inorganic Chemistry", John Willey &amp; Sons, New York.</li> <li>Lee, J.D.,1991, "Concise Inorganic Chemistry", 4th Edition, Chapman &amp; hall Inc.</li> </ol>																								

## 17. Fundamental of Statistic

<b>Module designation</b>	<b>Fundamental of Statistic</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	Siti Mahmuda, S.Si., M.Si Meirinda Fauziyah, M.Stat
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Mahasiswa mampu menjelaskan arti statistika. Mampu mendeskripsikan data</li> <li>2. Mahasiswa mampu menjelaskan dan mampu melakukan perhitungan terkait probabilitas.</li> <li>3. Mahasiswa mampu menjelaskan dan menghitung distribusi probabilitas</li> <li>4. Mahasiswa mampu menentukan variabel random diskrit</li> <li>5. Mahasiswa mampu menentukan variabel random kontinu</li> <li>6. Mahasiswa mampu menjelaskan inferensi statistik</li> <li>7. Mahasiswa mampu melakukan inferensi statistik untuk satu sampel</li> <li>8. Mahasiswa mampu melakukan inferensi statistik untuk dua sampel</li> </ol>
<b>Content</b>	This course discusses the meaning of statistics; data; probability-related calculations; probability distributions; discrete random variables; continuous random variables; statistical inference; statistical inference for a single sample; and statistical inference for two samples.

<p><b>Examination forms</b></p>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 450 1385 752"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<p><b>Study and examination requirements</b></p>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<p><b>Reading list</b></p>	<ol style="list-style-type: none"> <li>1. Sudjana. (2005). Metode Statistik. Tarsito: Bandung.</li> <li>2. Walpole, Ronald E. (2006). Pengantar Statistika. Edisi ke-3. PT. Gramedia Pustaka Utama: Jakarta.</li> <li>3. Supranto, J (2000). Statistika: Teori dan Aplikasi Jilid 1. Edisi ke 6. Erlangga: Jakarta</li> </ol>																								

## 18. General of Biology

<b>Module designation</b>	<b>General of Biology</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	Dr. Lariman, M.Si Dr. Dwi Susanto, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>Students are able to explain the definition, scope, and objectives of Basic Biology learning.</li> <li>Students can explain theories of the origin of life and distinguish between abiogenesis and biogenesis theories, as well as understand population genetics.</li> <li>Students are able to explain the definition and structure of organism cells and relate them to their functions.</li> <li>Students are able to explain the purpose and various types of cell reproduction and differentiate the stages in the cell division process.</li> <li>Students are able to explain the purpose of cell transport, types and processes of cell transport, and its application in daily life.</li> <li>Students are able to explain the concept of photosynthesis and relate it to plant physiological processes and its benefits for other organisms.</li> </ol>

	<ol style="list-style-type: none"> <li>7. Students are able to explain the concept of respiration and relate it to physiological processes and its benefits for other organisms.</li> <li>8. Students are able to explain the structural components of chromosomes, the chemical structure of genes (DNA and RNA), DNA replication, and protein synthesis.</li> <li>9. Students are able to explain Mendel's laws and relate them to inheritance processes and genotype and phenotype frequencies in populations.</li> <li>10. Students are able to classify various living organisms based on classification systems and explain the causes of variation.</li> <li>11. Students are able to explain the division and structure of basic animal and plant tissues, organs, and organ systems and relate them to their functions.</li> <li>12. Students are able to explain ecological concepts, conduct investigations, communicate the results, and apply them in daily life.</li> <li>13. Students are able to explain the differences between traditional and modern biotechnology and apply biotechnology in daily life.</li> <li>14. Students are able to explain the steps of the scientific method in experimental research.</li> </ol>																								
<b>Content</b>	<p>This course covers the definition, scope, and objectives of General Biology learning; theories of the origin of life, including the theory of evolution, abiogenesis, biogenesis, and population genetics; the structure and function of organism cells; cell reproduction; cell transport; photosynthesis; respiration; the structural components of chromosomes, the chemical structure of genes (DNA and RNA), DNA replication, and protein synthesis; Mendel's laws; the concept of biological classification systems; the division and structure of basic tissues in animals and plants; ecological concepts; biotechnology; and the steps of the scientific method.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 1487 1385 1794"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Campbell, Neil A, Jane B.Reece dan Lawrence G.Mitchell. 2003. Biologi. California: Benjamin Cummings</li> <li>2. Kimball, J.W. 1989. Biologi Jilid I, II, III. Edisi Kelima. Cetakan Kedua. Jakarta: Penerbit Erlangga.</li> </ol>																								

	<ol style="list-style-type: none"><li data-bbox="616 194 1390 293">3. Villee, C.A., Walker, Jr W.F., Barnes, R.D. 1999. Zoologi Umum Edisi ke Enam. Cetakan Kedua, Ahli bahasa: Nawang Sari Soegiri. Jakarta: Penerbit Erlangga.</li><li data-bbox="616 293 1390 324">4. Luria. 1981. A View of Life. California: Benyamin Cumming.</li></ol>
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## 19. Organic Chemistry I

<b>Module designation</b>	<b>Organic Chemistry I</b>
<b>Semester(s) in which the module is taught</b>	II
<b>Person responsible for the module</b>	Prof. Dr. Subur P Pasaribu, M.Si Dr. Saibun Sitorus, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Fundamental of Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the contents of the lecture contract</li> <li>2. Students are able to analyze carbon compounds</li> <li>3. Students are able to analyze molecular orbitals</li> <li>4. Students are able to analyze alkane compounds</li> <li>5. Students are able to analyze alkene compounds</li> <li>6. Students are able to analyze alkyne compounds</li> <li>7. Students are able to analyze the stereochemistry of organic compounds</li> <li>8. Students are able to explain benzene compounds</li> <li>9. Students are able to analyze benzene derivative compounds (phenol and aryl halide)</li> <li>10. Students are able to explain free radical reactions</li> <li>11. Students are able to analyze alkyl halides</li> <li>12. Students are able to analyze alcohol compounds</li> <li>13. Students are able to explain ethers</li> </ol>
<b>Content</b>	This course discusses Carbon Compounds; Molecular Orbitals; Alkane compounds; Alkene Compounds; Alkyne Compounds; Stereochemistry of organic compounds; benzene compounds; benzene derivative

	compounds (Phenol and aryl halide); Free Radical Reactions; Alkyl Halides; Alcohol Compounds; and ether compounds.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Carey, F.A., organic Chemistry, 4<sup>th</sup> edition, McGraw Hill Company, New York.</li> <li>Fessenden, R.J. &amp; Fessenden, J.S., 1989, Kimia Organik, Jilid 2, Erlangga, Jakarta.</li> <li>March, J., Advanced Organic Chemistry, Fourth Edition, John Wiley &amp; Sons, New York, 1992.</li> <li>Maskil, H., "The Physical Basis of Organic Chemistry", Oxford University Press, New York, 1985</li> </ol>																								

## 20. Chemical Kinetics

<b>Module designation</b>	<b>Chemical Energetics</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Veliyana Londong Allo, S.Si., M.Si Dr. Abdul Aziz, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Advanced Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>Students are able to analyze the basic concepts of gas</li> <li>Students are able to describe real gases and ideal gases</li> <li>Students are able to analyze the basic concepts of Thermodynamics</li> <li>Students are able to analyze the First Law of Thermodynamics and derive the equations for the First Law of thermodynamics using differential and integral systems</li> <li>Students are able to analyze the Second Law of Thermodynamics and derive the equations for the Second Law of thermodynamics using differential and integral systems</li> <li>Students are able to analyze the Third Law of Thermodynamics and derive the equations for the Third Law of thermodynamics using differential and integral systems</li> <li>Students are able to analyze the concept of Thermochemistry</li> </ol>
<b>Content</b>	This course discusses the basic concepts of gases; real gases and ideal gases; basic concepts of Thermodynamics; Thermodynamic Law 1 and

	<p>deriving the equations of Thermodynamic Law 1 differential and integral systems; Thermodynamic Law 2 and deriving the equations of Thermodynamic Law 2 differential and integral systems; the concept of Thermodynamic Law 3 and deriving the equations of Thermodynamic Law 3 differential and integral systems; and the concept of Thermochemistry.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Atkins,P.W., 1990, <i>Physical Chemistry</i>, Oxford: University Press.</li> <li>Atkins, P.W., 1999. <i>Kimia Fisika Jilid 1 Edisi Keempat</i>. Penerbit Erlangga: Jakarta.</li> <li>Dogra, S.K. dan S. Dogra. 1990. <i>Kimia Fisik dan Soal-Soal</i>. UIPress: Jakarta.</li> <li>Atkins, P.W. 2010. <i>Instructor'S Solution Manual to Accompany : Physical Chemistry Ninth Edition</i>. Oxford University Press: United State</li> </ol>																								

## 21. Structural In Inorganic Compounds

<b>Module designation</b>	<b>Structural In Inorganic Compounds</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Irfan Ashari Hiyahara, S.Pd., M.Si Husna Syaima, S.Si., M.Si.
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Advanced Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>Students are able to explain the atomic structure</li> <li>Students are able to explain the concept of the Rutherford-Bohr atomic structure, wave mechanics theory, Schrodinger theory and electron configuration</li> <li>Students are able to explain the periodic system of elements (SPU)</li> <li>Students are able to classify elements in the periodic system of elements (SPU)</li> <li>Students are able to determine the molecular structure in the form of chemical bonds through the Valence Shell Electron Pair Repulsion model approach: "repulsion of valence electron shell pairs</li> <li>Students are able to analyze the structure of solids and metals</li> </ol>
<b>Content</b>	Classical atomic theory, Dalton and Thomson atomic theory, Rutherford atomic structure concept, Bohr atomic theory, wave mechanics theory, Schrodinger theory, Electron configuration, history of the development of the periodic system of elements Lavoisier, Dobereiner, Newlands, Mendeleev, Moseley, Properties of elements based on SPU, SPU Trend, Molecular structure, Chemical bonding

	model, valence electron skin pair repulsion model, Structure of solids, Structure of metals, Applications of solids and metals in daily life.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Shriver, D.F., Atkins, P.W and Langford, C.H, 1989, Inorganic Chemistry, Oxford University Press, London.</li> <li>Philip P. P. Inorganic Syntheses, Volume 37, 2018 John Wiley &amp; Sons, Inc.</li> <li>Ningsih, S.W. Sintesis Anorganik. 2016. UNP Press.</li> <li>Dirgayanti, D. S., Koesnarpadi, S., &amp; Hindryawati, N. (2021). Synthesis and characterization of Fe<sub>3</sub>O<sub>4</sub>-activated carbon and its application to adsorb methylene blue. IOP Conference Series: Earth and Environmental Science, 623(1), 012070. doi:10.1088/1755-1315/623/1/012070</li> </ol>																								

## 22. Analytical Chemistry I

<b>Module designation</b>	<b>Analytical Chemistry I</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Prof. Dr. Aman Sentosa Panggabean, M.Si Drs. Alimuddin, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Advanced chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1 : Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5 : Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the scope of analytical chemistry and its problems.</li> <li>2. Students are able to describe the differences between qualitative and quantitative analysis, as well as the stages in qualitative analysis.</li> <li>3. Students are able to describe the differences between qualitative and quantitative analysis, as well as the stages in qualitative analysis.</li> <li>4. Students are able to analyze theoretical concepts about precipitate formation reactions and apply them in qualitative analysis.</li> <li>5. Students are able to analyze the theoretical concepts of complex compound formation reactions and apply them in qualitative analysis.</li> <li>6. Students are able to analyze theoretical concepts about redox reactions and apply them in qualitative analysis.</li> </ol>

	<ol style="list-style-type: none"> <li>7. Students are able to describe cation preliminary test analysis.</li> <li>8. Students are able to analyze the classification of cations and identify group I cations.</li> <li>9. Students are able to identify group II cations</li> <li>10. Students are able to identify group III cations</li> <li>11. Students are able to identify group IV and V cations</li> <li>12. Students are able to analyze anion classification schemes and anion preliminary tests.</li> <li>13. Students are able to identify anions</li> </ol>																							
<b>Content</b>	<p>This course discusses the scope of analytical chemistry and its problems; the difference between qualitative and quantitative analysis, as well as the stages in qualitative analysis; the concept of acid base and its application in qualitative analysis; the concept of precipitate formation reaction and its application in qualitative analysis; the concept of complex compound formation reaction and its application in qualitative analysis; the concept of redox reaction and its application in qualitative analysis; cation preliminary test analysis; cation classification and identification of class I cations; identification of class II cations, identification of class III cations; identification of class IV and V cations; anion classification scheme and anion preliminary test; and anion identification.</p>																							
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) ; Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project, P (15%) ; Case Study, CS (15%) ; Practicum, Pr (20%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="3">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> <td rowspan="2">C</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> <td rowspan="2">B</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	$65 \leq FG < 70$	2.5	C	$70 \leq FG < 75$	3.0	$75 \leq FG < 80$	3.5	B	$80 \leq FG \leq 100$	4.0
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>3. Students have a minimum attendance rate of 80%.</li> <li>4. Students have a minimum FG score of 40</li> </ol>																							
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Harjadi, W., 1985, <i>Ilmu Kimia Analitik Dasar</i>, PT. Gramedia, Jakarta</li> <li>2. Sulistarti, H., 2017, <i>Kimia Analisa Dasar Untuk Analisis Kualitatif</i>, PT. UB Pres, Malang.</li> <li>3. Skoog, D.A., West, D.M., &amp; Holler F.J., 1994, <i>Analytical Chemistry</i>, sixth edition, Saunders College Publishing, Tokyo</li> <li>4. Svehla, G., 1985, <i>Vogel (Buku Teks Analisis Anorganik Kualitatif Makro dan Semimikro)</i>, Jakarta: PT. Kalman Media</li> </ol>																							

## 23. Structure and Function of Biomolecules

<b>Module designation</b>	<b>Structure and Function of Biomolecules</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Dr. Rudi Kartika, M.Si Dr. Winni Astuti, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 180 minutes/week/semester
<b>Credit points</b>	4 (3-1) credits / 6.36 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry I
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the concept of the scope of biochemistry</li> <li>2. Students are able to explain various types of carbohydrate structures and functions</li> <li>3. Students are able to explain the structure and function of lipids</li> <li>4. Students are able to explain the structure and function of membranes and their relationship to the transport system</li> <li>5. Students are able to explain the structure and function of amino acids.</li> <li>6. Students are able to explain the structure and function of proteins</li> <li>7. Students are able to explain the structure, function and mechanism of enzyme action</li> <li>8. Students are able to explain enzyme kinetics, enzyme inhibition and regulation</li> <li>9. Students are able to Coenzymes and Cofactors</li> <li>10. Students are able to explain the structure and function of nucleic acids.</li> </ol>
<b>Content</b>	This course discusses the definition of biochemistry; macromolecules that make up organisms; Fields related to biochemistry; Benefits of biochemistry in various fields; Structure and function of carbohydrates; Structure and function of lipids; Structure and function of membranes;

	<p>Transport systems; Structure, properties and functions of amino acids; Peptide bonds; Definition of proteins; Structure of proteins; Denaturation and factors causing it; Definition, Structure, Mechanism of action, Naming, and Kinetics of Enzymes, Michaelis Menten Equation, Km and Kcat, Various enzyme inhibitions; Enzyme regulation; Structure of Coenzymes and Cofactors; Function of Coenzymes and Cofactors; Mechanism of action of Coenzymes and Cofactors; Structure of Nucleic Acids; DNA and RNA; Function of DNA; and Function of RNA.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project, P (15%) ; Case Study, CS (15%) ; Practicum, Pr (20%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Mathews C.K. &amp; Van Holde K.E. 2000. <i>Biochemistry</i>. Third Edition. The Benjamin Cumming Publishing</li> <li>Nelson, D.L. &amp; Cox, M. M., 2000. <i>Lehninger Principles of Biochemistry</i>, Worth Publisher Inc, New York</li> <li>Stryer L., Jeremy M. B., Tymoczko J. L., 1998. <i>Biochemistry</i>. Fifth Edition. WH Freeman &amp; Co. New York</li> <li>Devlin M.T, 1997. <i>Textbook of Biochemistry with Clinical Correlation</i>, 4th ed. John Wiley &amp; Sons INC, New York</li> <li>Albert, B., Bray, D., Lewis, J., Raff, M., Robert, K. And Watson, J. D. 1998. <i>Essential Cell Biology of The Cell: an Introduction to the Molecular Biology of the Cell</i>, Garland Publishing</li> </ol>																								

## 24. Organic Chemistry II

<b>Module designation</b>	<b>Organic Chemistry II</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Dr. Eva Marliana, M.Si Rita Hairani, M.Sc., Ph.D
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry I
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze compounds with carbonyl groups</li> <li>2. Students are able to implement isolation and synthesis methods in analyzing carboxylic acid compounds</li> <li>3. Students are able to implement synthesis methods in analyzing carboxylic acid derivatives</li> <li>4. Students are able to analyze amine compounds</li> <li>5. Students are able to implement isolation and synthesis methods in analyzing carbohydrate macromolecules</li> <li>6. Students are able to analyze amino acids and protein macromolecules.</li> <li>7. Students are able to implement synthesis methods in analyzing lipid macromolecules</li> </ol>
<b>Content</b>	This course discusses compounds with carbonyl groups; methods of isolation and synthesis of carboxylic acid compounds; methods of synthesis of carboxylic acid derivatives; amine compounds; methods of isolation and synthesis of carbohydrate macromolecules; amino acids and protein macromolecules; and methods of synthesis of lipid macromolecules.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 450 1383 757"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Carey, F.A., organic Chemistry, 4<sup>th</sup> edition, McGraw Hill Company, New york.</li> <li>Fessenden, R.J. &amp; Fessenden, J.S., 1989, Kimia Organik, Jilid 2, Erlangga, Jakarta.</li> <li>March, J., Advanced Organic Chemistry, Fourth Edition, John Wiley &amp; Sons, New York, 1992.</li> <li>Maskil, H., "The Physical Basis of Organic Chemistry", Oxford University Press, New York, 1985.</li> </ol>																								

## 25. Principle In Inorganic Reaction

<b>Module designation</b>	<b>Principle In Inorganic Reaction</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Husna Syaima, S.Si., M.Si. Irfan Ashari Hiyahara, S.Pd., M.Si.
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the principles of chemical reactions</li> <li>2. Students are able to explain the basic concepts of inorganic reactions</li> <li>3. Students are able to classify solutions and types of solvents</li> <li>4. Students are able to classify solutions and types of solvents</li> <li>5. Students are able to determine the definition and concept of non-aqueous solvents</li> <li>6. Students are able to analyze reactions in non-aqueous media</li> </ol>
<b>Content</b>	This course discusses the theory of thermodynamics; Chemical Kinetics; Principle of free energy and spontaneity of chemical reactions; Principle of entropy and chemical structure; Principle of enthalpy and strength of chemical bonds; Definition of Solution; Various Solvents Size of central atom; Solvent system; Non-water proton solvents; Non-water non-proton solvents; Acid-base reactions; Redox reactions; Reactions in HF medium; Reactions in SO <sub>2</sub> medium; and Reactions in HCN and acetic acid medium.
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p>

	<b>Interval</b>	<b>Number</b>	<b>Letter</b>
	$0 \leq FG < 40$	0.0	E
	$40 \leq FG < 50$	1.0	D
	$50 \leq FG < 60$	1.5	
	$60 \leq FG < 65$	2.0	C
	$65 \leq FG < 70$	2.5	
	$70 \leq FG < 75$	3.0	B
	$75 \leq FG < 80$	3.5	
	$80 \leq FG \leq 100$	4.0	A
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>		
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Cotton, F.A dan Wilkinson, G, 1989, <i>Kimia Anorganik Dasar</i>, UI Press, Jakarta.</li> <li>2. Nuryono, 1999, <i>Buku Ajar Kimia Koordinasi</i>, FMIPA UGM, Yogyakarta.</li> <li>3. Shriver, D.F., Atkins, P.W and Langford, C.H, 1989, <i>Inorganic Chemistry</i>, Oxford University Press, London.</li> </ol>		

## 26. Entrepreneurship

<b>Module designation</b>	<b>Entrepreneurship</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Drs. Alimuddin, M.Si Asnawati, SE., MM
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective/ specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the importance of entrepreneurship courses</li> <li>2. Students are able to describe the definition of entrepreneurship and the scope of Entrepreneurship</li> <li>3. Students are able to analyze the development of entrepreneurship and the differences between workers and entrepreneurs.</li> <li>4. Students are able to analyze the characteristics of the attitude and personality of an entrepreneur</li> <li>5. Students are able to describe the factors of business success and failure.</li> <li>6. Students are able to analyze the theory of creativity and its principles as the basis for creative thinking as the key to success and intelligence in business.</li> <li>7. Students are able to analyze the concept of business management and strategies in winning business competitions by knowing the factors of the competitive environment.</li> <li>8. Students are able to describe the differences in macro and micro entrepreneurial functions.</li> <li>9. Students are able to describe how to work effectively and efficiently</li> <li>10. Students are able to describe how to study problems, formulate problems, identify problems, and solve problems. in entrepreneurship</li> </ol>

	<ol style="list-style-type: none"> <li>11. Students are able to describe data and problem analysis using SWOT analysis method.</li> <li>12. Students are able to describe Marketing Management and Business promotion</li> <li>13. Describe Selling and Negotiation Skills in entrepreneurship.</li> <li>14. Describe how to make a business plan.</li> </ol>																								
<b>Content</b>	<p>This course discusses the concept of entrepreneurship and the scope of entrepreneurship; the development of entrepreneurship and the differences between workers and entrepreneurs; characteristics of the attitude and personality of an entrepreneur; factors for business success and failure; creativity theory and its principles; the concept of business management and strategies in winning business competition; differences between macro and micro functions of entrepreneurship; effective and efficient work; how to study problems, formulate problems, identify problems, and solve problems. in entrepreneurship; data and problem analysis using the SWOT analysis method; Marketing Management and Business Promotion; Selling and Negotiation Skills in entrepreneurship; and how to make a business plan.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Hendro,. 2011. <i>Dasar-dasar Kewirausahaan, Panduan bagi Mahasiswa untuk Mengenal, Memahami dan Memasuki Dunia Bisnis</i>. Erlangga . Jakarta.</li> <li>2. Hisrich, Robert D &amp; Peters, Michael P,. 2002. <i>Entrepreneurship</i>. McGraw Hill. New York.</li> <li>3. G. Meredith, Geoffrey. 1996. <i>Kewirausahaan Teori &amp; Praktek</i>, Penerbit : PPM. Jakarta</li> <li>4. Longenecker, Justin. G, <i>et al.</i> 2001. <i>Kewirausahaan</i>. Penerbit : Salemba Empat. Jakarta</li> </ol>																								

## 27. Environmental Chemistry

<b>Module designation</b>	<b>Environmental Chemistry</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Prof. Dr. Ir. Bohari, M.Si Prof. Dr. Aman Sentosa Panggabean, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the meaning of environmental chemistry</li> <li>2. Students are able to analyze the concept of the three wheels of the environment and environmental chemistry</li> <li>3. Students are able to describe the History of Environmental Problems</li> <li>4. Students are able to analyze the Impact of Chemistry on Environmental Pollution</li> <li>5. Students are able to describe Toxicology and Heavy Metals</li> <li>6. Students are able to analyze the mechanism of toxicity of heavy metals</li> <li>7. Students are able to analyze Chemical Pollution that affects Natural Equilibrium</li> <li>8. Students are able to analyze pollution in the air environment.</li> <li>9. Students are able to describe the concept of handling air pollution</li> <li>10. Students are able to describe Pollution in the Soil Environment</li> <li>11. Students are able to analyze the handling of pollution in the soil environment.</li> <li>12. Students are able to analyze pollution in the aquatic environment</li> <li>13. Students are able to describe radioactive pollution.</li> </ol>
<b>Content</b>	This course explains the introduction to environmental chemistry; the concept of three environmental wheels and environmental chemistry; history of environmental problems; the impact of chemistry on

	environmental pollution; toxicology and heavy metals; mechanisms of heavy metal toxicity; chemical pollution that affects the balance of nature; pollution in the air environment; the concept of handling air pollution; pollution in the soil environment; handling pollution in the soil environment; pollution in the aquatic environment; and radioactive pollution.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Palar, H. 2008. <i>Pencemaran dan Toksikologi Logam Berat</i>. Jakarta: Rineka Cipta.</li> <li>Sastrawijaya, A. T. 2009. <i>Pencemaran Lingkungan</i>. Jakarta: Rineka Cipta.</li> <li>Wardhana, W. A. 1994. <i>Teknik Analisis Radioaktivitas Lingkungan</i>. Yogyakarta: Andi Offset.</li> <li>Widyastuti, P. dan Monica E. 2005. <i>Bahaya Bahan Kimia pada Kesehatan Manusia dan Lingkungan</i>. Jakarta: EGC.</li> <li>Wright, J. 2005. <i>Environmental Chemistry</i>. London: Routledge</li> </ol>																								

## 28. Hazardous Material And Toxic Chemistry

<b>Module designation</b>	<b>Hazardous Material And Toxic Chemistry</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Prof. Dr. Ir. Bohari, M.Si Dr. Saibun Sitorus, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Advanced Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4 : Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the definition of hazardous and toxic chemicals.</li> <li>2. Students are able to analyze the source of chemicals</li> <li>3. Students are able to describe the classification of hazardous and toxic materials.</li> <li>4. Students are able to describe labeling techniques and Material Safety Data Sheet (MSDS).</li> <li>5. Students are able to analyze chemical exposure and its impact.</li> <li>6. Students are able to describe the metabolic system of B3 exposure</li> <li>7. Students are able to describe the effects of chemicals on humans.</li> <li>8. Students are able to describe the handling of gaseous chemicals.</li> <li>9. Students are able to describe Air Pollution and B3 Gas Distribution</li> <li>10. Students are able to describe the handling of solid chemicals</li> <li>11. Students are able to describe Soil Pollution and Distribution of Solid B3</li> <li>12. Students are able to describe Liquid/Solvent Chemical Handling</li> <li>13. Students are able to describe water pollution and distribution of liquid hazardous substances.</li> </ol>

	14. Students are able to describe liquid B3 waste treatment technology																								
<b>Content</b>	This course discusses the definition of hazardous and toxic chemicals; sources of chemicals; classification of hazardous and toxic materials; labeling techniques and Material Safety Data Sheet (MSDS); chemical exposure and its impacts; B3 exposure metabolism system; effects of chemicals on humans; handling of gas chemicals; Air Pollution and Distribution of B3 Gas; Handling of Solid Chemicals; Soil Pollution and Distribution of Solid B3; Handling of Liquid/Solvent Chemicals; Water pollution and distribution of liquid B3; and B3 liquid waste processing technology.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Akhavan, J. 2004. The Chemistry of Explosive. Cambridge: The Royal Society of Chemistry</li> <li>2. Patricia, P. Keselamatan dan Kesehatan Kerja dengan Bahan Kimia di Laboratorium. Jakarta : PT. Merck</li> <li>3. Widyastuti, P. dan Monica E. 2005. Bahaya Bahan Kimia pada Kesehatan Manusia dan Lingkungan. Jakarta : EGC.</li> </ol>																								

## 29. Green Chemistry

<b>Module designation</b>	<b>Green Chemistry</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Ritson Purba, S.Si., M.Si Ika Yekti Liana Sari, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Advanced Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the basic concepts of green chemistry</li> <li>2. Students are able to analyze the concept of atomic economy</li> <li>3. Students are able to describe twelve principles of green chemistry</li> <li>4. Students are able to analyze the concept of waste minimization</li> <li>5. Students are able to describe about renewable raw material</li> <li>6. Students are able to describe the application of solvent-free and solvent-less</li> <li>7. Students are able to analyze the sources and applications of new renewable energy</li> </ol>
<b>Content</b>	This course discusses the basic concepts of green chemistry; the concept of atomic economy; the twelve principles of green chemistry; the concept of waste minimization; renewable raw materials; solvent-free and solvent-less applications; and sources and applications of new renewable energy.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1383 719"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Lancaster M. <i>Green Chemistry: An Introductory Text</i>. Cambridge: Royal Society of Chemistry; 2002.</li> <li>Hanrahan Grady. <i>Key Concepts In Environmental Chemistry</i>. S.L.: Elsevier Academic Press; 2016.</li> <li>Török B, Dransfield T. <i>Green Chemistry: An Inclusive Approach</i>. Amsterdam, Netherlands: Elsevier; 2017.</li> </ol>																								

### 30. Management Industrial Chemistry

<b>Module designation</b>	<b>Management Industrial Chemistry</b>				
<b>Semester(s) in which the module is taught</b>	III				
<b>Person responsible for the module</b>	Ika Yekti Liana Sari, S.Si., M.Si Djihhan Ryn Pratiwi, S.Si., M.Si				
<b>Language</b>	Indonesian				
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>				
<b>Teaching methods</b>	Lecture, discussion, assignment, final project				
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester				
<b>Credit points</b>	2 credits / 3.18 ECTS				
<b>Required and recommended prerequisites for joining the module</b>	-				
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>Students are able to describe the definition of the Chemical Industry, important production factors in the Chemical Industry and the role of Management in the Industry.</li> <li>Students are able to describe the management system and organization</li> <li>Students are able to describe the operation management system and quality management</li> <li>Students are able to describe ISO 9000 and its derivatives.</li> <li>Students are able to describe ISO 14000 and its derivatives.</li> <li>Students are able to describe ISO 17025</li> <li>Students are able to describe human resource management</li> </ol>				
<b>Content</b>	This course discusses the introduction; management and organization; Operations Management and Quality Management; Introduction to ISO 9000 and its derivatives (ISO 9001, etc.); Introduction to ISO 14000 and its derivatives (ISO 14001, etc.); Introduction to ISO 17025, and Human Resource Management.				
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" style="width: 100%; text-align: center;"> <tr> <td><b>Interval</b></td> <td><b>Number</b></td> <td><b>Letter</b></td> </tr> </table>		<b>Interval</b>	<b>Number</b>	<b>Letter</b>
<b>Interval</b>	<b>Number</b>	<b>Letter</b>			

	0 ≤ FG < 40	0.0	E
	40 ≤ FG < 50	1.0	D
	50 ≤ FG < 60	1.5	
	60 ≤ FG < 65	2.0	C
	65 ≤ FG < 70	2.5	
	70 ≤ FG < 75	3.0	B
	75 ≤ FG < 80	3.5	
	80 ≤ FG ≤ 100	4.0	A
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>		
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Soleh Kosela. 1998. <i>Managemen Laboratorium</i>. FMIPA UI. Jakarta.</li> <li>2. Slack N. Brandon-Jones. A. Johnston R., 2010, <i>Operations management</i>, Pearson Education.</li> <li>3. Wesselingh J. A., 2007, <i>Design and Development of Biological, Chemical, Food and Pharmaceutical Products</i> / J.A, John Wiley &amp; Sons Ltd, England</li> <li>4. Ali, M,. 2013. <i>Modul Kuliah Manajemen Industri</i>. Jurusan Pendidikan Teknik Elektro Fakultas Teknik. Universitas Yogyakarta.</li> <li>5. ISO 9000 and its derivatives</li> <li>6. ISO 14000 and its derivatives</li> <li>7. ISO 17025 and its derivatives</li> </ol>		

### 31. Chemical Industry

<b>Module designation</b>	<b>Chemical Industry</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Prof. Dr. Ir. Erwin, M.Si Ritson Purba, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze the concept of Chemistry in Industrial and Environmental Processes</li> <li>2. Students are able to analyze the concept of chemical processes and quality control processes in the petroleum and natural gas processing industry.</li> <li>3. Students are able to analyze the concept of process and quality control process in water treatment</li> <li>4. Students are able to analyze the concepts of Production Process and quality control (QC) of Urea &amp; NPK Fertilizer Products PT Pupuk Kaltim</li> <li>5. Students are able to analyze the concepts of the topic of Production Process and quality control (QC) of Liquid Ammonia Products of PT Pupuk Kaltim</li> <li>6. Students are able to analyze the concepts of the topic Good Laboratory Practice: Based On ISO/IEC 17025:2017</li> <li>7. Industry Visit to PKT</li> <li>8. Students are able to analyze the concept of coal processing and the chemical processes involved in it.</li> <li>9. Students are able to analyze the concept of Soap and Detergent Processing and the quality control process in the Soap and Detergent Industry.</li> </ol>

	<p>10. Students are able to analyze the concept of paper processing and quality control processes in the paper industry.</p> <p>11. Students are able to analyze Potential Industrial Chemistry in East Kalimantan: ethanol industry</p>																								
<b>Content</b>	<p>This course discusses the concept of Chemistry in Industrial Processes and the Environment; The concept of Chemical Processes and quality control processes in the petroleum and Natural Gas processing industry, Urea &amp; NPK Fertilizer Products of PT Pupuk Kaltim, and Liquid Ammonia Products of PT Pupuk Kaltim; concepts from the topic of Good Laboratory Practice: Based On ISO/IEC 17025:2017; the concept of Coal Processing and the chemical processes involved in it; The concept of Soap and Detergent Processing and the quality control process in the Soap and Detergent Industry; the concept of Paper Processing, the quality control process in the Paper Industry; and the Potential Chemical Industry in East Kalimantan.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Research articles in national and international journals related to topics that are recent trends in the chemical industry.</li> <li>Austin G.T.,1996, Industri Proses Kimia, Erlangga, Jakarta.</li> <li>Badan Standardisasi Nasional. 2020. SNI 2803-2012 Konfirmasi 2020 (Standar Nasional Indonesia Pupuk NPK Padat). Jakarta</li> <li>Badan Standardisasi Nasional. 2010. SNI 2801-2010 (Standar Nasional Indonesia Pupuk Urea). Jakarta.</li> <li>Badan Standardisasi Nasional. 2006. SNI 06-0045-2006 (Standar Nasional Indonesia Amoniak Cair). Jakarta</li> <li>Mardiani, A. 2008. Proses Produksi PT Pupuk Kalimantan Timur. Diklat PKT. Bontang.</li> <li>Murdiono, U, 2006, Pengembangan industri etanol: prospek, dampak, kendala, dan tantangan, Workshop Nasional Bisnis Biodiesel dan Bioetanol di Indonesia, Jakarta, 80-86</li> <li>Shreve, R.N, and Brink, J. A. Jr., 1990, Chemical Process Industries, Mc Graw. Hill International Book Co, Tokyo.</li> <li>Research articles in national and international journals related to the implementation of the latest Good Laboratory Practice standards.</li> </ol>																								

## 32. Coal Chemistry

<b>Module designation</b>	<b>Coal Chemistry</b>
<b>Semester(s) in which the module is taught</b>	III
<b>Person responsible for the module</b>	Prof. Dr. Subur P Pasaribu, M.Si Dr. Saibun Sitorus, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry I
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain about Coal and Peat in general</li> <li>2. Students are able to explain the process of coal formation and its content</li> <li>3. Students are able to explain the classification of coal quality and know the reserves, production and consumption of coal</li> <li>4. Students are able to explain the concept of coal processing technology</li> <li>5. Students are able to explain the benefits of coal as a source of fuel and energy</li> <li>6. Students are able to explain the application of coal in everyday life</li> <li>7. Students are able to explain the impact of coal</li> <li>8. Students are able to explain the impact of coal use</li> <li>9. Students are able to explain the concept of coal desulfurization technology</li> <li>10. Students are able to explain coal flotation separation technology</li> <li>11. Students are able to explain the characterization of coal quality references, sampling methods and preparation of coal samples</li> </ol>

	12. Students are able to explain Proximate and Ultimate Analysis of Coal																								
<b>Content</b>	This course discusses the introduction of coal and peat in general; the process of coal formation and its content; classification of coal quality and knowing coal reserves, production and consumption; the concept of coal processing technology; the benefits of coal as a source of fuel and energy; applications of coal in everyday life; the impact of coal on the environment; the impact of coal use; the concept of coal desulfurization technology; coal flotation separation technology; characterization of coal quality references, methods of sampling and preparation of coal samples; and Proximate and Ultimate Analysis of Coal.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Aladin, A. dan Mahfud. 2011. Sumber Daya Alam Batubara. Bandung : Lubuk Agung</li> <li>2. American Society for Testing and Materials (ASTM)</li> <li>3. British Standards Institution (BS)</li> <li>4. Geoservice, PT. Kualitas Batubara</li> <li>5. International Organization for Standardization (ISO)</li> <li>6. Speight, J. G. 2005. Handbook of Coal Analysis. Canada : Wiley-Interscience</li> <li>7. Standar Nasional Indonesia (SNI)</li> </ol>																								

### 33. Geochemistry

<b>Module designation</b>	Geochemistry									
<b>Semester(s) in which the module is taught</b>	III									
<b>Person responsible for the module</b>	Irfan Ashari Hyahara, S.Pd., M.Si Moh. Syaiful Arif, S.Pd., M.Si									
<b>Language</b>	Indonesian									
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>									
<b>Teaching methods</b>	Lecture, discussion, assignment, final project									
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester									
<b>Credit points</b>	2 credits / 3.18 ECTS									
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element									
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the origin and natural abundance of chemical elements</li> <li>2. Students are able to explain the structure and composition of the earth</li> <li>3. Students are able to explain the estimated composition of the universe</li> <li>4. Students are able to explain the estimated composition of the universe</li> <li>5. Students are able to explain the thermodynamic aspects of magma crystallization</li> <li>6. Students are able to explain the basics of isotope geochemistry</li> </ol>									
<b>Content</b>	This course discusses the origin and natural abundance of chemical elements; the structure and composition of the earth; estimation of the composition of the universe; thermodynamic aspects of magma crystallization; and the basis of isotope geochemistry.									
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td>D</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D
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40 ≤ FG < 50	1.0	D								

	50 ≤ FG < 60	1.5	
	60 ≤ FG < 65	2.0	C
	65 ≤ FG < 70	2.5	
	70 ≤ FG < 75	3.0	B
	75 ≤ FG < 80	3.5	
	80 ≤ FG ≤ 100	4.0	A
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>		
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Mason B., dan Moore, C.B., 1982, Principles of Geochemistry, edisi ke-4, John Wiley &amp; Sons, New York.</li> <li>2. Misra C.K. 2012. Introduction to Geochemistry: Principle and Application, John Wiley &amp; Sons, New York.</li> </ol>		

### 34. Chemical Phase System

<b>Module designation</b>	<b>Chemical Phase System</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Dr. Rahmat Gunawan, M.Si Veliyana Londong Allo, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Kinetics
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze the concepts of molecular interactions.</li> <li>2. Students are able to describe real gases and ideal gases.</li> <li>3. Students are able to describe the basic concept of solutions.</li> <li>4. Describe the basic concept of colligative properties of solutions and non-solutions.</li> <li>5. Describe the basic concept of Phase Diagrams.</li> <li>6. Describe the concept of Osmotic Pressure.</li> </ol>
<b>Content</b>	This course discusses the concept of interactions between molecules; real gases and ideal gases; basic concepts of solutions; basic concepts of colligative properties of solutions and non-solutions; basic concepts of phase diagrams; and the concept of osmotic pressure.
<b>Examination forms</b>	Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam, FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%). The final grade (FG) for each student is calculated by the formula :

	$FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 286 1383 591"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Atkins, P.W., 1990, <i>Physical Chemistry</i>, Oxford: University Press.</li> <li>Atkins, P.W., 1999. <i>Kimia Fisika Jilid 1 Edisi Keempat</i>. Penerbit Erlangga: Jakarta.</li> <li>Dogra, S.K. dan S. Dogra. 1990. <i>Kimia Fisik dan Soal Soal</i>. UIPress: Jakarta.</li> <li>Atkins, P.W. 2010. <i>Instructor'S Solution Manual to Accompany : Physical Chemistry Ninth Edition</i>. Oxford University Press: United States</li> <li>Sukardjo. 2002. <i>Kimia Fisika</i>. Penerbit Rineka Cipta. Jakarta</li> <li>Robert G. Mortimer. 1993. <i>Physical Chemistry</i>. The Benjamin Cummings Publishing Company, Inc.</li> </ol>																								

### 35. Coordination Chemistry

<b>Module designation</b>	<b>Coordination Chemistry</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	1. Dr. Noor Hindryawati, M.Si 2. Husna Syaima, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds, Principle in Inorganic Reaction
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the Nomenclature of Metal Compounds</li> <li>2. Students are able to explain and analyze the types of ligands, central atoms, nomenclature, classical theory.</li> <li>3. Students are able to explain and analyze the theory of valence bonds in coordination compounds</li> <li>4. Students are able to explain and analyze the Crystal Field Theory in coordination compounds</li> <li>5. Students are able to explain and analyze the theory of molecular orbitals in the formation of complex compounds</li> <li>6. Students are able to explain and analyze the Jahn-Teller effect and geometry as well as the stability and reaction mechanisms of complex compounds</li> </ol>
<b>Content</b>	This course discusses Metal Compound Names; about types of ligands, central atoms, names, classical theories of complex compound formation; valence bonds in coordination compounds; Crystal field theory in coordination compounds; Molecular orbital theory in the formation of complex compounds; and about the Jahn-Teller effect and geometry as well as stability and mechanism of complex compound formation.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 450 1383 752"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Cotton, F.A dan Wilkinson, G, 1989, Kimia Anorganik Dasar, UI-Press, Jakarta.</li> <li>Nuryono, 1999, Buku Ajar Kimia Koordinasi, FMIPA UGM, Yogyakarta.</li> <li>Shriver, D.F., Atkins, P.W and Langford, C.H, 1989, Inorganic Chemistry, Oxford University Press, London</li> <li>Syaima H, Rahardjo SB, Hanifa AN, Fathonah AA, Setyaningsih R. Novel Metal Coordination Complexes Based on 4-Aminophenol: Spectroscopic Analysis and Antibacterial Test. Indonesian Journal of Chemistry. 2023;23(3):627-35.</li> </ol>																								

## 36. Analytical Chemistry II

<b>Module designation</b>	<b>Analytical Chemistry II</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Prof. Dr. Aman Sentosa Panggabean, M.Si Drs. Alimuddin, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Analytical Chemistry I
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1 : Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5 : Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe quantitative analysis and stages in qualitative analysis.</li> <li>2. Students are able to analyze the treatment of quantitative data and describe the types of errors.</li> <li>3. Students are able to analyze the gravimetric method and determine the levels of analytes gravimetrically.</li> <li>4. Students are able to analyze the volumetric method and describe the types of volumetric analysis.</li> <li>5. Students are able to analyze the concept of acid-base for quantitative analysis and describe the acid-base titration curve.</li> <li>6. Students are able to analyze the concept of precipitate formation reaction for quantitative analysis and describe the precipitate formation titration curve.</li> <li>7. Students are able to analyze the concept of redox for quantitative analysis and describe the redox titration curve.</li> </ol>

	8. Students are able to analyze the concept of complex formation reaction for quantitative analysis and describe the titration curve of complex formation.																								
<b>Content</b>	This material discusses quantitative analysis and the stages in qualitative analysis; quantitative data treatment and describing the kinds of errors; gravimetric method and gravimetric determination of analyte levels; volumetric method and types of volumetric analysis; acid-base titration; precipitate formation titration; redox titration; and complex formation titration.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) ; Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project, P (15%) ; Case Study, CS (15%) ; Practicum, Pr (20%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="3">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> <td rowspan="2">C</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> <td>B</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	65 ≤ FG < 70	2.5	C	70 ≤ FG < 75	3.0	75 ≤ FG < 80	3.5	B	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Fritz J.S., &amp; Schenk, G.H., 1979, <i>Quantitative Analytical Chemistry</i>, 4<sup>th</sup> ed., Allyn and Bacon Inc., Boston</li> <li>2. Harjadi, W., 1985, <i>Ilmu Kimia Analitik Dasar</i>, PT. Gramedia, Jakarta</li> <li>3. Khopkar, S.M., 1990, <i>Konsep Dasar Kimia Analitik</i>, UI-Press, Jakarta</li> <li>4. Skoog, D.A., West, D.M., &amp; Holler F.J., 1994, <i>Analytical Chemistry</i>, sixth edition, Saunders College Publishing, Tokyo</li> <li>5. Underwood, D., 1981, <i>Analisis Kimia Kuantitatif</i>, Erlangga, Jakarta</li> </ol>																								

### 37. Organic Chemistry Of Natural Products

<b>Module designation</b>	<b>Organic Chemistry Of Natural Products</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Prof. Dr. Ir. Erwin, M.Si Dr. Eva Marlina, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the objectives, scope, materials, strategies and evaluation of lectures (understand and agree to the lecture contract)</li> <li>2. Students are able to understand and explain the process of isolation and identification of natural compounds</li> <li>3. Students are able to understand and know the classification and biosynthesis of terpenoids</li> <li>4. Students are able to understand and explain the cyclization and rearrangement of Wagner-Meerwein</li> <li>5. Students are able to understand and explain the classification, structure and properties of steroids</li> <li>6. Students are able to understand and explain the concept of structure and activity of steroids</li> <li>7. Students are able to understand and explain the classification and origin of phenylpropanoids</li> <li>8. Students are able to understand and explain the types of structure, biosynthesis, properties and synthesis of phenyl propanoids and polyketides</li> </ol>

	<ol style="list-style-type: none"> <li>9. Students are able to understand and explain the classification and structure of flavonoids</li> <li>10. Students are able to understand and explain the interconversion and synthesis of flavonoids</li> <li>11. Students are able to understand and explain the classification and structure of alkaloids</li> <li>12. Students are able to understand and explain the rearrangement and synthesis of alkaloids</li> </ol>																								
<b>Content</b>	This course discusses the process of isolation and identification of natural compounds; knowing the classification and biosynthesis of terpenoids; cyclization and Wagner-Meerwein rearrangement; classification, structure and properties of steroids; the concept of steroid structure and activity; classification and origin of phenylpropanoids; structure, biosynthesis, properties, and synthesis of phenylpropanoids and polyketides; classification and structure of flavonoids; interconversion and synthesis of flavonoids; classification and structure of alkaloids; and rearrangement and synthesis of alkaloids.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" style="width: 100%; text-align: center;"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Achmad, Sjamsul Arifin, 1986, Kimia Organik Bahan Alam, Karunika, Jakarta.</li> <li>2. Nakanishi, Koji, et.all, 1983, Natural Products Chemistry - Vol. 1,2,3, University Science Books, California.</li> <li>3. Dewick, M., 2002, Medicinal Natural Products, Second Edition, John Wiley &amp; Sons. School of Pharmaceutical Sciences University of Nottingham.</li> <li>4. Erwin, Dari, A.K., Pratiwi, D.R., Bohari, Rahmadi, A. 2020. An anthraquinone derivative from <i>Coptosapelta tomentosa</i> (Blume) root (Merung), EurAsian Journal of BioSciences Eurasia J Biosci 14, pp. 3015-3017.</li> <li>5. Saputri, R.D., Aldin, M.F., Tjahjandarie, T.S., Marlina, E., Tanjung, M., 2023. Aktivitas Antikanker Senyawa Pterokarpan Dari Kulit Batang Aka Kalesi (<i>Spatholobus ferrugineus</i>), Jurnal Kimia Mulawarman; 20 (2), pp. 69-73.</li> </ol>																								

### 38. Physical Organic Chemistry

<b>Module designation</b>	<b>Physical Organic Chemistry</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Dr. Chairul Salah, M.Si Ritson Purba, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>Students are able to design various reactions that may occur in organic compounds</li> <li>Students are able to explain localized chemical bonds</li> <li>Students are able to explain delocalized chemical bonds and aromaticity</li> <li>Students are able to analyze the breaking and formation of bonds and the factors influencing the presence of electrons</li> <li>Students are able to explain the types of reagents and types of organic chemical reactions</li> <li>Students are able to analyze the acid-base strength of organic compounds</li> <li>Students are able to explain the energetics and kinetics of chemical reactions</li> <li>Students are able to analyze the tracing of chemical reaction mechanisms</li> <li>Students are able to analyze nucleophilic substitution reactions at saturated carbon atoms</li> <li>Students are able to explain carbocations and their reactions</li> <li>Students analyze nucleophilic and electrophilic substitution reactions in aromatic systems</li> </ol>
<b>Content</b>	This course discusses the types of reactions that may occur in organic compounds; localized chemical bonds; delocalized chemical bonds and aromaticity; bond breaking and formation and factors influencing the

	presence of electrons; types of reagents and types of organic chemical reactions; acid-base strength of organic compounds; energetics and kinetics of chemical reactions; mechanisms of chemical reactions; nucleophilic substitution reactions at saturated carbon atoms; carbocations and their reactions; and nucleophilic and electrophilic substitution reactions in aromatic systems.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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70 ≤ FG < 75	3.0	B																							
75 ≤ FG < 80	3.5																								
80 ≤ FG ≤ 100	4.0	A																							
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Peter Sykes .1985. A Guidebook to mechanism in organic chemistry, sixth edition, Cambridge.</li> <li>Ralph J. Fessenden &amp; Joan S. Fessenden. 1991. Kimia Organik. Edisi Ketiga. Jilid 1. (Terjemahan A. H. Pudjaatmaka). Jakarta: Erlangga.</li> <li>Ralph J. Fessenden &amp; Joan S. Fessenden. 1991. Kimia Organik. Edisi Ketiga. Jilid 2. (Terjemahan A. H. Pudjaatmaka). Jakarta: Erlangga.</li> <li>A. C. Knipe &amp; W. E. Watts. 2001. Organic Reaction Mechanisms. New York: John Willey &amp; Sons.</li> <li>M.B. Smith &amp; Jerry March. 2007. March's Advanced Organic Chemistry: Reaction Mechanisms and Structure. New York: John Willey &amp; Sons.</li> </ol>																								

### 39. Metabolism and Genetic Information

<b>Module designation</b>	<b>Metabolism and Genetic Information</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Dr. Rudi Kartika, M.Si Dr. Winni Astuti, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 180 minutes/week/semester
<b>Credit points</b>	4 (3-1) credits / 6.36 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and Function of Biomolecules
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students explain the concept of biotechnology, the scope and history of the development of biotechnology and classical biotechnology techniques</li> <li>2. Students are able to explain the principles of fermentation, types of organisms for fermentation and stages of the fermentation process</li> <li>3. Students are able to describe the types of fermentation, fermentation products and the development of fermentation technology</li> <li>4. Students are able to describe the concept of enzymes and the application of enzymes in the fermentation process, enzyme immobilization technology and its benefits and the application of enzyme biotechnology in industry</li> <li>5. Students are able to understand the basic principles, techniques and benefits of tissue culture</li> <li>6. Students are able to explain the benefits of types of biotechnology and various examples of biotechnology products</li> <li>7. Students are able to describe the contents of the articles presented</li> </ol>

	<ol style="list-style-type: none"> <li>8. Students are able to understand the history of genetic engineering and describe the scope of genetic engineering and the general stages for gene cloning</li> <li>9. Students are able to explain how to obtain DNA and understand PCR, genomic libraries and cDNA</li> <li>10. Students are able to describe vectors, types of vectors, requirements for cloning vectors and expression vectors and types of cloning vectors and expression vectors</li> <li>11. Students are able to explain the types of host cells, stages of making competent host cells and host cell transformation.</li> <li>12. Students are able to describe the principles of blue and white clone selection, stages of selection and characterization of transformant clones</li> <li>13. Students are able to describe the strategy of connecting genes to expression vectors, selecting the right host cells with vectors, how to transform into expression host cells and selection of transformants carrying genes</li> <li>14. Students are able to present an article</li> </ol>																								
<b>Content</b>	<p>This course discusses Bioenergetics and Introduction to Metabolism; Digestive system; Carbohydrate Metabolism; Carbohydrate Anabolism; citric acid cycle; Oxidative phosphorylation; Lipid Metabolism Amino acid metabolism and its control; replication; transcription, its stages and control; translation, its control and post-translation; and post-translation and mutation.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project, P (15%) ; Case Study, CS (15%) ; Practicum, Pr (20%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 1285 1386 1592"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Mathews C.K. &amp; Van Holde K.E. 2000. <i>Biochemistry</i>. Third Edition. The Benjamin Cumming Publishing</li> <li>2. Nelson, D.L. &amp; Cox, M. M., 2000. <i>Lehninger Principles of Biochemistry</i>, Worth Publisher Inc, New York</li> <li>3. Stryer L., Jeremy M. B., Tymoczko J. L., 1998. <i>Biochemistry</i>. Fifth Edition. WH Freeman &amp; Co. New York</li> <li>4. Devlin M.T, 1997. <i>Textbook of Biochemistry with Clinical Correlation</i>, 4th ed. John Wiley &amp; Sons INC, New York</li> <li>5. Albert, B., Bray, D., Lewis, J., Raff, M., Robert, K. And Watson, J. D. 1998. <i>Essential Cell Biology of The Cell: an Introduction to the Molecular Biology of the Cell</i>, Garland Publishing</li> </ol>																								

#### 40. Separation Chemistry and Spectroscopy

<b>Module designation</b>	<b>Separation Chemistry and Spectroscopy</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Prof. Dr. Ir. Bohari, M.Si Dr. Soerja Koesnarpadi, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Analytical Chemistry I
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 8 : Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze the basis of separation</li> <li>2. Students are able to describe the basic principles of distillation</li> <li>3. Students are able to analyze the principle of solvent extraction and describe the quantities in liquid-liquid extraction</li> <li>4. Students are able to describe solid phase extraction (EFP) techniques and their applications.</li> <li>5. Students are able to analyze the basic principles of chromatography and describe the quantities in chromatography</li> <li>6. Students are able to describe the basic principles of column chromatography</li> <li>7. Students are able to describe the basic principles of planar chromatography</li> <li>8. Students are able to analyze the basic principles of spectroscopy</li> <li>9. Students are able to analyze the basic principles of molecular spectrometry</li> <li>10. Students are able to analyze the basic principles of atomic spectrometry</li> </ol>
<b>Content</b>	This course discusses the basic principles of separation; distillation; liquid-liquid extraction; solid phase extraction; basic principles of chromatography; column chromatography; planar chromatography; basic principles of spectrophotometry; interaction of matter and energy; lambert beer law; molecular spectrometry; UV-Vis spectrophotometry; IR spectrophotometry; atomic

	spectrophotometry; atomic absorption spectrophotometry; and atomic emission spectrophotometry.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Fritz J.S., &amp; Schenk, G.H., 1979, <i>Quantitative Analytical Chemistry</i>, 4<sup>th</sup> ed., Allyn and Bacon Inc., Boston</li> <li>Harjadi, W., 1985, <i>Ilmu Kimia Analitik Dasar</i>, PT. Gramedia, Jakarta</li> <li>Khopkar, S.M., 1990, <i>Konsep Dasar Kimia Analitik</i>, UI-Press, Jakarta</li> <li>Skoog, D.A., West, D.M., &amp; Holler F.J., 1994, <i>Analytical Chemistry</i>, sixth edition, Saunders College Publishing, Tokyo</li> <li>Underwood, D., 1981, <i>Analisis Kimia Kuantitatif</i>, Erlangga, Jakarta</li> <li>Widodo, N.T., Mulyasuryani, A., dan Sabarudin, A., 2014, Recovery Cu (II) dengan Teknik Ekstraksi Fasa Padat Menggunakan Adsorben Silika dari Abu Sekam Padi Kitosan, <i>NATURAL B.</i>, 2(4), 360-365</li> <li>Wirawan, T., Supriyanto, G., dan Soegianto, A., 2019, Preparation of a New Cd(II)-Imprinted Polymer and Its Application to Preconcentration and Determination of Cd(II) Ion from Aqueous Solution by SPE-FAAS, <i>Indones. J. Chem.</i>, 19(1), 97 – 105</li> </ol>																								

#### 41. Practice: Principle In Inorganic Reaction

<b>Module designation</b>	<b>Practice: Principle In Inorganic Reaction</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Irfan Ashari Hiyahara, S.Pd., M.Si, Husna Syaima, S.Si., M.Si.
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Laboratory session: 170 minutes/week/semester
<b>Credit points</b>	1 (0-1) credits / 1.59 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Principle In Inorganic Reaction
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. After this activity ends, students are able to know the ins and outs of the practicum that will be carried out and how to assess it.</li> <li>2. Students are able to understand the types and properties of inorganic compounds and elements correctly</li> <li>3. Students are able to practice chemical reactions: cases of qualitative reactions of inorganic compounds</li> <li>4. Students are able to identify the effects of acids and bases on metals</li> <li>5. Students are able to analyze oxidation-reduction reactions in several compounds</li> <li>6. Students are able to explain about Studying the corrosion properties of several metals in gel medium</li> <li>7. Students are able to explain and understand the corrosion characteristics of metals (iron, copper and magnesium)</li> </ol>
<b>Content</b>	This course discusses the types and properties of inorganic compounds and elements; qualitative reactions of inorganic compounds; the effect of acids and bases on metals; oxidation-reduction reactions in some compounds; corrosion properties of some metals in gel medium; and corrosion characteristics of metals (iron, copper and magnesium).

<p><b>Examination forms</b></p>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1383 719"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<p><b>Study and examination requirements</b></p>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<p><b>Reading list</b></p>	<ol style="list-style-type: none"> <li>Cotton, F.A dan Wilkinson, G, 1989, <i>Kimia Anorganik Dasar</i>, UI-Press, Jakarta.</li> <li>Douglas, 1983. <i>Concept and models of inorganic chemistry</i>. New York: John Wiley&amp;Sons</li> <li>Raffaello Romeo. <i>Inorganic And Bio-Inorganic Chemistry – Vol. II - Inorganic Reaction Mechanisms</i></li> <li>D. F. Shriver, P. W. Atkins and C. H. Langford, <i>Inorganic Chemistry</i> 2nd edn. Oxford Chapter.15, p.559, (1994).</li> <li>James E. Huheey, Ellen A. Keiter, Richard L. Keiter <i>Inorganic Chemistry: Principles of Structure and Reactivity</i> Subsequent Edition. Edition 3. Harper &amp; Row. 1983 digitized 2010. ISBN 006049879. 936 pages.</li> <li>Modul Praktikum Dasar Reaksi Anorganik. Tim Dosen Kimia Anorganik 2022</li> </ol>																								

## 42. Agrochemistry

<b>Module designation</b>	Agrochemistry
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Prof. Dr. Subur P Pasaribu, M.Si Dr. Saibun Sitorus, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the meaning of agrochemicals and classification of agrochemicals</li> <li>2. Students are able to compare agrochemical fertilizers with inorganic fertilizers.</li> <li>3. Students are able to describe the adverse effects of insecticides.</li> <li>4. Students are able to explain pesticides and the adverse effects that can be caused.</li> <li>5. Students are able to explain herbicides and the adverse effects that can be caused.</li> <li>6. Students are able to explain fungicides and algaecides and the adverse effects that can be caused.</li> <li>7. Students are able to explain the advantages and adverse effects that are caused.</li> <li>8. Students are able to explain the beneficial and detrimental effects of agrochemicals on soil</li> <li>9. Students are able to explain the beneficial and detrimental effects of agrochemicals on water</li> <li>10. Students are able to explain the beneficial and detrimental effects of agrochemicals on air</li> <li>11. Students are able to explain the beneficial and detrimental effects of agrochemicals on humans</li> <li>12. Students are able to explain the prospects for agrochemical development and the challenges faced.</li> </ol>

<b>Content</b>	This course discusses Introduction to Agrochemistry; Classification of agrochemicals; Agrochemical Fertilizers; Agrochemical Insecticides; Agrochemical Pesticides; Agrochemical Herbicides; Agrochemical Fungicides; Agrochemical Algacides; Agrochemicals and their effects; Effects of Agrochemicals on soil; Effects of Agrochemicals on water; Effects of Agrochemicals on air; Effects of Agrochemicals on humans; and Prospects for the development of agrochemicals																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 651 1385 954"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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$80 \leq FG \leq 100$	4.0	A																							
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Djojsumarno, P., 2008, Pestisida dan Aplikasinya, Penerbit Agromedia, Jakarta</li> <li>2. Safety and Health in the Use of Agrochemical: A Guide, Geneva, International Labor Office, 1991</li> <li>3. Rosenfeld, P., 2011, Handbook of Pollution Prevention and Cleaner Production Vol. 3: Best Practices in the Agrochemical Industry, Elsevier</li> <li>4. Giri B., Prasad R., Wu Q.S., Varma A., 2019, Biofertilizers for Sustainable Agriculture and Environment, Springer, Switzerland</li> <li>5. Rathore, H.S., dan Nollet, L.M.L., Pesticides: Evaluation of Environmental Pollution, CRC Press, Boca Rato</li> </ol>																								

### 43. Chemical Minerals

<b>Module designation</b>	<b>Chemical Minerals</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Irfan Ashari Hiyahara, S.Pd, M.Si. Husna Syaima, S.Si, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the origin of rocks (starting from the initial elements of the universe, the solar system, the earth and plate theory),</li> <li>2. Students are able to explain the definition of the concept of minerals and rocks and their differences</li> <li>3. Students are able to explain the classification of rocks (volcanic, sedimentary, and metamorphic) and their differences</li> <li>4. Students are able to identify and explain the formation process, types of minerals, areas found and applications of rocks for sedimentary rock mining materials subgroup A</li> <li>5. Students are able to identify and explain the formation process, types of minerals, areas found and applications of rocks for sedimentary rock mining materials subgroup B</li> <li>6. Students are able to identify and explain the formation process, types of minerals, areas found and applications of rocks for volcanic rock mining materials</li> <li>7. Students are able to identify and explain the formation process, types of minerals, areas found and applications of rocks for intrusive plutonic acid and ultra basic rocks</li> <li>8. Students are able to identify and explain the formation process, types of minerals, areas found and applications of rocks for residual sediment and deposition mining materials</li> </ol>

	<p>9. Students are able to identify and explain the formation process, types of minerals, areas found and applications of rocks for materials hydrothermal alteration process excavation</p> <p>10. Students are able to identify and explain the formation process, types of minerals, areas found and applications of rocks for mining materials Metamorphic rocks</p>																								
<b>Content</b>	This course discusses the origin of rocks; definitions of minerals and rocks and their differences; classification of rocks; formation processes, types of minerals, areas found, and applications of rocks for subgroup A and B sedimentary rock excavation materials; plutonic intrusion excavation materials acidic and ultra-basic rocks; residual sediment excavation materials and sedimentary deposits; hydrothermal alteration processes; and malachite rock excavation materials.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Klein. C, Philpotts. A. 2013. Earth Material: Introduction to Mineralogy and Petrology. Cambridge University Press: New York.</li> <li>2. Sukandarrumidi. 2009. <i>Bahan Galian Industri</i>. Cetakan ketiga. Gajah Mada University Press: Yogyakarta.</li> <li>3. Nurhakim. 2015. Bahan Galian Industri. Modul BGI Teknik Kimia. Indonesia</li> <li>4. Nuryati dan Mustikawati. 2019. Statistik Pertambangan di Indonesia. Subdirektorat pertambangan dan energi. Badan Statistik Indonesia</li> </ol>																								

#### 44. Sampling Techniques

<b>Module designation</b>	<b>Sampling Techniques</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Drs. Alimuddin, M.Si Nanang Tri Widodo, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Analytical Chemistry I
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1 : Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, ; and being environmentally conscious.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the basic principles of sampling.</li> <li>2. Students are able to describe planning, preparation, types of sampling and samples, sample preservation</li> <li>3. Students are able to describe river, lake or reservoir water sampling techniques</li> <li>4. Students are able to describe the sampling techniques of estuary water, sea water, and ground water</li> <li>5. Students are able to describe the process and parts of WWTP, wastewater sampling techniques</li> <li>6. Students are able to describe the stratification of the atmosphere, air composition, and air pollution</li> <li>7. Students are able to describe ambient air sampling techniques</li> <li>8. Students are able to describe roadside air sampling techniques, and factors affecting emission air sampling</li> <li>9. Students are able to describe air sampling techniques for mobile source emissions, stationary source emissions</li> <li>10. Students are able to describe soil sampling techniques, plants</li> <li>11. Students are able to describe water and air sample preparation techniques</li> <li>12. Students are able to describe the preparation techniques of plant samples, and animal tissues</li> <li>13. Students are able to describe soil sample preparation techniques, and food ingredients</li> </ol>

	14. Students are able to practice water sampling																								
<b>Content</b>	This course discusses the basic principles of sampling, planning, preparation, types of sampling and samples, sample preservation; river, lake or reservoir water sampling techniques; estuary, sea and groundwater sampling techniques; wastewater sampling techniques; ambient air sampling techniques; roadside air sampling techniques, and factors affecting air emission sampling; air sampling techniques for mobile source emissions, stationary source emissions; soil and plant sampling techniques; water and air sample preparation techniques; plant and animal tissue sample preparation techniques; soil and food sample preparation techniques; and sampling practice.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Miroslav Radojevic, Vladimir N. Bashkin, 1998, Practical Environmental Analysis, Royal Society of Chemistry (RS.C)</li> <li>2. Neil T. Crosby, John A. Day, William A. Hardcastle, David G. Holcombe, Ric D. Treble, 1995, Quality in Analytical Chemistry Laboratory, John Willey&amp;Sons</li> <li>3. Noel De Nevers, 1995, Air Pollution Control Engineering, Mcgraw-Hill International Editions</li> <li>4. Roger Reeve, 2002, Introduction to Environmental Analysis, John Willey&amp;Sons</li> <li>5. Stanley E. Manahan, 2000, Environmental Chemistry, seventh edition, Lewis Publisher</li> <li>6. Badan Standardisasi Nasional (BSN), 2008, SNI 6989.57:2008: Air dan air limbah – Bagian 57: Metoda pengambilan contoh air permukaan.</li> <li>7. Badan Standardisasi Nasional (BSN), 2008, SNI 6989.58:2008: Air dan air limbah – Bagian 58: Metoda pengambilan contoh air tanah.</li> <li>8. Badan Standardisasi Nasional (BSN), 2008, SNI 6989.59:2008: Air dan air limbah – Bagian 59: Metoda pengambilan contoh air limbah.</li> <li>9. Badan Standardisasi Nasional (BSN), 2005, SNI 19.7117.2:2005: Emisi Gas Buang-Sumber Tidak Bergerak-Bagian 2: Penentuan Lokasi dan Titik-titik Lintas Pengambilan Contoh Uji Partikel.</li> </ol>																								

	<ol style="list-style-type: none"><li data-bbox="624 194 1380 297">10. Badan Standardisasi Nasional (BSN), 2005, SNI 19.7119.6:2005: Udara Ambien-Bagian 6: Penentuan Lokasi Pengambilan Contoh Uji Pemantauan Kualitas Udara Ambien.</li><li data-bbox="624 297 1380 409">11. Badan Standardisasi Nasional (BSN), 2005, SNI 19.7119.9:2005: Udara Ambien-Bagian 9: Penentuan Lokasi Pengambilan Contoh Uji Pemantauan Kualitas Udara Roadside.</li></ol>
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## 45. Inorganic Material

<b>Module designation</b>	<b>Inorganic Material</b>
<b>Semester(s) in which the module is taught</b>	IV
<b>Person responsible for the module</b>	Irfan Ashari Hiyahara, S.Pd., M.Si Dr. Abdul Aziz, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the concepts of inorganic materials and their classification</li> <li>2. Students are able to explain the physical and chemical properties of inorganic materials and their characterization methods</li> <li>3. Students are able to analyze the relationship between the structure and physical and chemical properties of several metal group materials and their applications</li> <li>4. Students are able to analyze the relationship between the structure and physical and chemical properties of several ceramic group materials and their applications</li> <li>5. Students are able to analyze the relationship between the structure and physical and chemical properties of several inorganic polymer group materials and their applications</li> <li>6. Students are able to analyze the relationship between the structure and physical and chemical properties of several composite group materials and their applications</li> </ol>
<b>Content</b>	This course discusses the concepts of inorganic materials and their classification; physical and chemical properties of inorganic materials and their characterization methods; the relationship between the structure and chemical physical properties of several metal group

	materials and their applications; the relationship between the structure and chemical physical properties of several ceramic group materials and their applications; the relationship between the structure and chemical physical properties of several inorganic polymer group materials and their applications; and the relationship between the structure and chemical physical properties of several composite group materials and their applications.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Housecroft, Sharpe. 2012. Inorganic Chemistry. 4th edition. Pearson Education Limited: Harlow</li> <li>2. Callister, Rethwisch. 2010. Materials Science and Engineering: An Introduction. 4th edition. John Wily and Son Inc: Hoboken</li> <li>3. Huheey J, Ellen A.K, Keither R. 2008. Inorganic Chemistry: Principles of Structure and Reactivity Subsequent Edition. ISBN-13: 978-0060429959</li> <li>4. Sangeeta D, Lagraff JR. 2004. Inorganic Materials Chemistry Desk Reference. ISBN 9780849309106. Published November 29, by CRC Press</li> </ol>																								

## 46. Chemical Bonding and Structures

<b>Module designation</b>	<b>Chemical Bonding and Structures</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Veliyana Londong Allo, S.Si., M.Si Dr. Rahmat Gunawan, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Phase System
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the history of modern physics and quantum chemistry.</li> <li>2. Students are able to analyze the Law of quantized energy.</li> <li>3. Students are able to describe quantum mechanics for electrons and atoms.</li> <li>4. Students are able to analyze the Schrödinger equation and its applications.</li> <li>5. Students are able to describe the concept of the Quantum Tunneling phenomenon effect.</li> <li>6. Students are able to analyze the concept of Orbitals and the energy of the Hydrogen Atom.</li> <li>7. Students are able to describe the orbitals and energy of non-hydrogen atoms.</li> <li>8. Students are able to describe the determination of electron configuration and the periodic table of elements.</li> <li>9. Students are able to describe the concept of molecules: Simple molecules.</li> <li>10. Students are able to describe Chemical Bonds: Conjugation and Resonance.</li> <li>11. Students are able to analyze quantized energy in Molecules: Molecular rotation.</li> <li>12. Students are able to describe quantized energy in Molecules: Molecular vibration.</li> </ol>

	<p>13. Students are able to describe the application of quantum chemistry in the development of computational chemistry.</p> <p>14. Students are able to describe Molecular Spectroscopy.</p>																								
<b>Content</b>	<p>This course discusses the history of modern physics and quantum chemistry; the law of quantized energy; quantum mechanics for electron and atomic particles; Schrödinger and its applications; the concept of the Quantum Tunneling effect phenomenon; the concept of Hydrogen Atom Orbitals and energy; non-hydrogen atomic orbitals and energy; determination of the arrangement of electron configurations and the periodic table of elements; the concept of simple molecules; conjugated chemical bonds and resonance; quantized energy in molecules; quantized energy in molecules: Molecular Vibration; Applied Quantum Chemistry in the Development of Computational Chemistry; and Molecular Spectroscopy.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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$80 \leq FG \leq 100$	4.0	A																							
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>John P. Lowe, Kirk A. Peterson, <i>Quantum Chemistry</i>, Third Edition, Elsevier, ISBN: 012457551X, 2006</li> <li>Thomas Engel, Warren Hehre, <i>Quantum Chemistry &amp; Spectroscopy</i>, Third Edition, Pearson, ISBN: 9780321766199, 2012</li> <li>J.E. Parker, <i>Advanced Maths for Chemists: Chemistry Maths 3</i>, First edition, J.E. Parker &amp; bookboon.com, ISBN 9788740303728, 2013</li> <li>Robert G. Mortimer, <i>Mathematics for Physical Chemistry</i>, Third Edition, Elsevier</li> </ol>																								

## 47. Synthesis and Characterization of Inorganic Compounds

<b>Module designation</b>	<b>Synthesis and Characterization of Inorganic Compounds</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Dr. Noor Hindryawati, M.Si Irfan Ashari Hiyahara, S.Pd., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds, Principle in Inorganic Reaction, Coordination Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the principles of synthesis</li> <li>2. Students are able to understand and explain inorganic synthesis techniques</li> <li>3. Students are able to understand and explain the synthesis of inorganic solid materials</li> <li>4. Students are able to explain the characteristics and components of molecules/structures of materials through inorganic solid materials</li> <li>5. Students are able to explain the characteristics of inorganic solid materials</li> <li>6. Students are able to explain the applications of inorganic materials resulting from synthesis</li> </ol>
<b>Content</b>	This course discusses the principles of synthesis; inorganic synthesis techniques; synthesis of inorganic solid materials; characteristics and structure of materials through inorganic solid materials; characteristics of inorganic solid materials; and applications of synthesized inorganic materials.
<b>Examination forms</b>	Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).

	<p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 320 1385 622"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Shriver, D.F., Atkins, P.W and Langford, C.H, 1989, Inorganic Chemistry, Oxford University Press, London.</li> <li>Philip P. P. Inorganic Syntheses, Volume 37, 2018 John Wiley &amp; Sons, Inc.</li> <li>Ningsih, S.W. Sintesis Anorganik. 2016. UNP Press.</li> </ol>																								

## 48. Structure Elucidation

<b>Module designation</b>	<b>Structure Elucidation</b>
<b>Semester(s) in which the module is taught</b>	VII
<b>Person responsible for the module</b>	Prof. Dr. Subur P Pasaribu, M.Si Prof. Dr. Ir. Erwin, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II, Physical Organic Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand and explain the basic concepts of spectroscopy</li> <li>2. Students are able to understand and explain the basic principles of UV-Vis Spectrophotometry</li> <li>3. Students are able to understand and identify the characteristic absorption of organic compounds against UV and Visible radiation absorption</li> <li>4. Students are able to understand and explain the interpretation of FT-IR spectra</li> <li>5. Students are able to understand and explain the interpretation of UV-Vis and FT-IR data</li> <li>6. Students are able to understand and explain the principles and interpret <sup>1</sup>H and <sup>13</sup>C-NMR data</li> <li>7. Students are able to understand and explain the principles of mass spectrometry and molecular ionization</li> <li>8. Students are able to understand and explain the arrangement of fragmentation patterns</li> <li>9. Students are able to understand and explain the determination of molecular structure based on UV, IR, NMR, and MS spectrum data</li> </ol>
<b>Content</b>	This course discusses the basic concepts of spectroscopy; basic principles of UV-Vis Spectrophotometry; characteristic absorption of organic compounds against UV and Visible radiation absorption; interpretation of FTIR spectra; interpretation of UV-Vis and FTIR data; principles and interpretation of <sup>1</sup> H and <sup>13</sup> C-NMR data, Mass Spectrometry and molecular ionization; fragmentation pattern

	preparation; and determination of molecular structure based on UV, IR, NMR, and MS spectrum data.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Elsair, R., 2012, Fundamentals of Chemistry, Romain Elsair and Ventus Publishing (free books at bookboon.com).</li> <li>Silverstein, R.M., Bassler, G, C., Morrill, T.C., 1963, Spectrometric Identification of Organic Compounds.</li> <li>Syah, Y.M., 2016, Dasar-Dasar Penentuan Struktur Molekul Berdasarkan Data Spektrum <math>^1\text{H}</math> dan <math>^{13}\text{C}</math>-NMR, Laboratorium Spektroskopi Massa dan NMR FMIPA ITB, Bandung.</li> <li>Supratman, U., 2010, Elusidasi Struktur Senyawa Organik, Widya Pajajaran.</li> <li>Gauglitz, G and Vo-Dinh, T, 2003, Handbook of Spectroscopy, Wiley-VCH GmbH &amp; Co.KGAA, Weinheim.</li> <li>Saputri, R.D., Aldin, M.F., Tjahjandarie, T.S., Marlina, E., Tanjung, M., 2023. Aktivitas Antikanker Senyawa Pterokarpan Dari Kulit Batang Aka Kalesi (<i>Spatholobus ferrugineus</i>), Jurnal Kimia Mulawarman; 20 (2), pp. 69-73.</li> </ol>																								

## 49. Chemical Instrumentation

<b>Module designation</b>	<b>Chemical Instrumentation</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Prof. Dr. Ir. Bohari, M.Si Dr. Soerja Koesnarpadi, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective/ specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Laboratory session: 170 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	3 (2-1) credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Separation chemistry and spectroscopy, Analytical Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1 : Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5 : Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8 : Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the basics of chromatography</li> <li>2. Students are able to analyze about gas chromatography</li> <li>3. Students are able to analyze liquid chromatography.</li> <li>4. Students are able to analyze the basic principles, types of electrodes and spectrometric analysis.</li> <li>5. Students are able to analyze electromagnetic radiation instruments for spectroscopy.</li> <li>6. Students are able to analyze UV-Vis spectroscopy</li> <li>7. Students are able to analyze absorption and emission spectroscopy</li> <li>8. Students are able to describe about nuclear magnetic resonance (NMR) spectroscopy</li> <li>9. Students are able to describe about Mass Spectroscopy</li> </ol>

<b>Content</b>	This course discusses the basics of chromatography, gas chromatography, liquid chromatography, potentiometry, electromagnetic radiation, instruments for spectroscopy, UV-Vis spectroscopy, absorption and emission spectroscopy (AAS-AES), nuclear magnetic resonance spectroscopy (NMR), mass spectroscopy.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project, P (15%) ; Case Study, CS (15%) ; Practicum, Pr (20%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 611 1385 913"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>D.A. Skoog, 1985, Principles of Instrumental Analysis, 3<sup>rd</sup> Ed, Saunders College Pub.</li> <li>R. L. Pecsok, L. D. Shields, t. Cairns, I. G. Mc. Williams, 1976, Modern Methods of Chemical Analysis 2<sup>nd</sup> Ed., John Wiley &amp; Sons.</li> <li>G.W. Ewing, 1981, Instrumental Methods of Chemical Analysis 4<sup>th</sup> Ed. McGraw Hill Int. Co.</li> <li>Khopkar, S.M., 1990, <i>Konsep Dasar Kimia Analitik</i>, UI-Press, Jakarta</li> <li>Underwood, D., 1981, <i>Analisis Kimia Kuantitatif</i>, Erlangga, Jakarta.</li> <li>Wang J., (1990) "Electroanalytical Chemistry" VCH Publisher, New York.</li> </ol>																								

## 50. Chemical Kinetics

<b>Module designation</b>	<b>Chemical Kinetics</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Dr. RR. Dirgarini Julia NS., M.Sc Veliyana Londong Allo, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Phase System
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the scope of chemical kinetics and kinetic quantities.</li> <li>2. Students are able to describe the law of rate integration.</li> <li>3. Students are able to describe and apply several types of methods for determining reaction rates to find the rate of reaction and the rate constant.</li> <li>4. Students are able to describe the effect of temperature on the rate constant.</li> <li>5. Students are able to describe the kinetics of complex reactions, the value of the complex reaction rate constant, and the complex reaction rate equations.</li> <li>6. Students are able to describe the processes of homogeneous catalysis and enzymatic catalysis.</li> <li>7. Students are able to describe the basic principles of heterogeneous catalysis.</li> </ol>
<b>Content</b>	This course discusses the scope of chemical kinetics limitations and kinetic quantities; integration rate laws; reaction rate determination methods to determine the value of reaction rates and reaction rate constants; the effect of temperature on reaction rate constants; complex reaction kinetics, complex reaction rate constant values and complex reaction rate equations; homogeneous catalysis and enzyme catalysis processes; and the basic principles of heterogeneous catalysis.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1385 719"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>James H. Espenson. 1995. <i>Chemical Kinetics and Reaction Mechanism</i>. McGrawHill, Inc.</li> <li>Keith J. Laidler. 1987. <i>Chemical Kinetics. Third Edition</i>. Harper Collins Publishers</li> <li>P.W. Atkins. 1999. <i>Kimia Fisika jilid 2</i>. Penerbit Erlangga. Jakarta</li> <li>S.K. Dogra. 1990. <i>Kimia Fisik dan Soal-Soal</i>. Penerbit universitas Indonesia. Jakarta</li> </ol>																								

## 51. Research Methodology

<b>Module designation</b>	<b>Research Methodology</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Dr. Saibun Sitorus, M.Si Drs. Alimuddin, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze the role of research methodology in science</li> <li>2. Students are able to describe the meaning of methodology and types of research</li> <li>3. Students are able to analyze the initial steps of conducting research and formulating problems, frameworks and research hypotheses</li> <li>4. Students are able to describe literature review and research novelty</li> <li>5. Students are able to describe research ethics and Research Misconduct</li> <li>6. Students are able to describe literature review</li> <li>7. Students are able to describe how to cite literature sources</li> <li>8. Students are able to describe research variables</li> <li>9. Students are able to describe research data</li> <li>10. Students are able to describe scientific writing techniques</li> <li>11. Students are able to describe inference techniques</li> <li>12. Students are able to describe the preparation of abstracts, objectives, outline structure and writing techniques in presentations.</li> </ol>
<b>Content</b>	This course discusses the concept of research methodology; meaning of research, types of research; initial steps in conducting research; literature review; research ethics and research misconduct; literature review; citation of literature sources; research variables, research data; scientific writing techniques, drawing conclusions, scientific ethics;

	abstract preparation, writing objectives; thought framework structure; writing techniques; and research powerpoint.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Creswell, John W., <i>Research Design: Qualitative and Quantitative Approaches</i>, London: SAGE Publication. 1994</li> <li>Jaya, S. 2015. <i>RPS Metodologi Penelitian</i>. Universitas Pembangunan Jaya.</li> <li>Sarwono dan Mekar D. A. 2013. <i>Metodologi Penelitian Kualitatif dan Kuantitatif</i>. Yogyakarta : Nuha Medika</li> </ol>																								

## 52. Organic Synthesis Chemistry

<b>Module designation</b>	<b>Organic Synthesis Chemistry</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Prof. Dr. Ir. Daniel, M.Si Prof. Dr. Subur P Pasaribu, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 150 minutes/week/semester Self learning : 180 minutes/week/semester Structured assignment: 180 minutes/week/semester
<b>Credit points</b>	3 credits / 4.77 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Physical Organic Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the uses and principles of organic chemical synthesis</li> <li>2. Students are able to describe active groups in synthesis</li> <li>3. Students are able to describe retrosynthesis analysis</li> <li>4. Students are able to describe chemoselective reactions</li> <li>5. Students are able to describe protecting groups</li> <li>6. Students are able to describe esterification and interesterification reactions</li> <li>7. Students are able to describe stereo control and ring formation</li> <li>8. Students are able to describe molecular rearrangement</li> <li>9. Students are able to describe the formation of C-C bonds through condensation reactions</li> <li>10. Students are able to describe the formation of C-C bonds through acid-catalyzed condensation reactions</li> <li>11. Students are able to describe the formation of C-C bonds using organometallic reactions.</li> </ol>
<b>Content</b>	This course discusses active groups in synthesis; retrosynthesis analysis; chemoselective reactions, protecting groups, esterification and interesterification reactions; stereo control and ring formation; molecular rearrangement; C-C bond formation through condensation reactions; C-C bond formation through acid-catalyzed condensation reactions, and C-C bond formation using organometallic reactions.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1383 719"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Gould, E.S., "Mechanism and structure in Organic Chemistry", Hold, Rinehart and Winston Inc, New York, USA, 1959.</li> <li>House, H.O., "Modern Synthetic Reactions", Second Edition, W.A. Benjamin Inc Mentro Park California, 1972.</li> <li>Isacs, N.S., "Physical Organic Chemistry Longman", Scientific &amp; Technical", New York, 1992.</li> <li>Robert, J.D. and Morjoric C.C., "Basic Principles of Organic Chemistry", 2 nd Edition., W.A Benjamin Inc, California, 1990</li> <li>Smith M.O., "Organic Chemistry", Vol 1. International edition, Mc Graw Hill, Inc, New York, 1994</li> <li>Furrhop, J. dan G., Penzillin, "Organic Synthesis", Concepts Methods, Starting Material, First editin, weinheim, 1984</li> <li>Corruthers, W., "Some Modern Methods of Orgnic Synthesis", Third Edition, Cambridge University Press, Melbourne, Sydney, 1986</li> <li>Warrens, S., "Organic Synthesis", This Connection Approach, John Wiley &amp; Sons, New York, 1986</li> <li>Norman. R.O.C., "Principles of Organic Synthesis", Second edition, London, 1978.</li> <li>Smith, M., "Organic Synthesis", International Edition, M.C Graw Hill, Inc, New York, 1994</li> <li>Robert., E.L., "Quantitative Analysis of Organic Mixture", John Willey &amp; Sons, New York, 1980</li> </ol>																								

### 53. Advanced Material Chemistry

<b>Module designation</b>	<b>Advanced Material Chemistry</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Irfan Ashari Hiyahara, S.Pd, M.Si Husna Syaima, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Phase System
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze the concept of smart materials</li> <li>2. Students are able to describe piezoelectric crystal and polymer systems</li> <li>3. Students are able to describe the principle of magnetostriction</li> <li>4. Students are able to describe about electroactive materials</li> <li>5. Students are able to describe shape memory materials, and electro and magnetorheological fluids</li> <li>6. Students are able to describe low voltage smart sensors (part 1)</li> <li>7. Students are able to describe low voltage smart sensor (part 2)</li> <li>8. Students are able to analyze the concept of intelligent actuators</li> <li>9. Students are able to describe magnetostrictive actuation</li> <li>10. Students are able to describe several types of actuators</li> <li>11. Describe several types of control on intelligent actuators</li> <li>12. Able to understand about the concept of smart composites</li> <li>13. Students are able to describe composite beams</li> <li>14. Students are able to describe advances in smart structures and materials</li> </ol>
<b>Content</b>	This course discusses the concept of smart materials; piezoelectric crystal and polymer systems; magnetostriction principles; electroactive materials; shape memory materials, and electro- and magneto-rheological fluids; low-strain smart sensors; the concept of smart actuators; magnetostrictive actuation; several types of actuators; several types of controls on smart actuators; the concept of smart

	composites; composite beams; and advances in smart structures and materials.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Brian Culshaw, 2000, <i>Smart Structures and Materials</i>, Artech House.</li> <li>Gaudenzi, P., 2009, <i>Smart Structures</i>, Wiley.</li> <li>Cady, W. G., 1964 <i>Piezoelectricity</i>, Dover Publication Inc., New York</li> </ol>																								

## 54. Colloid And Surface Chemistry

<b>Module designation</b>	<b>Colloid And Surface Chemistry</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Dr. Abdul Aziz, M.Si Dr. Rahmat Gunawan, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Phase System
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the concepts of colloid understanding.</li> <li>2. Students are able to describe several examples of colloid uses.</li> <li>3. Students are able to describe the physical properties of colloids.</li> <li>4. Students are able to describe the chemical properties of colloids.</li> <li>5. Students are able to describe the stability of colloids.</li> <li>6. Students are able to describe the reactions involved in making colloidal compounds.</li> <li>7. Students are able to analyze recent developments in colloid chemistry for the industry.</li> <li>8. Students are able to describe an introduction to surface chemistry.</li> <li>9. Students are able to describe liquid-gas surfaces and their examples.</li> <li>10. Students are able to describe gas-solid surfaces and their examples.</li> <li>11. Students are able to describe solid-liquid surfaces and their examples.</li> <li>12. Students are able to describe the concept of macromolecules.</li> <li>13. Students are able to analyze the future applications of macromolecules.</li> </ol>
<b>Content</b>	This course discusses the definition of colloids; the uses of colloids; physical properties of colloids; chemical properties of colloids; colloidal stability; reactions to make colloidal compounds; recent developments in colloidal chemistry for industry; introduction to surface chemistry; gas-liquid surfaces and their examples; liquid-liquid surfaces and their examples and applications; gas-solid surfaces and their examples;

	liquid-solid surfaces and their examples; the concept of macromolecules; and future applications of macromolecules.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Robert J. Silbey, Robert A. Alberty, Mounji G. Bawendi, <i>Physical Chemistry</i>, Fourth Edition, John Wiley &amp; Sons. Inc., 2005</li> <li>K.S. Birdi, <i>HANDBOOK OF Surface and Colloid Chemistry</i>, CRC Press, Taylor &amp; Francis Group, ISBN: 9780849373275</li> <li>Dennis Prieve, <i>Physical Chemistry of Colloids and Surfaces</i>, <a href="https://www.researchgate.net/publication/308959457">https://www.researchgate.net/publication/308959457</a></li> </ol>																								

## 55. Polymer Chemistry

<b>Module designation</b>	<b>Polymer Chemistry</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Dr. Chairul Salah, M.Si Rita Hairani, M.Sc., Ph.D
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry I
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the concept of polymers, basic concepts of polymers, and the history of the development of polymer chemistry</li> <li>2. Students are able to understand the naming of polymer compounds and polymer classification</li> <li>3. Students are able to understand the process or stages in polymerization</li> <li>4. Students are able to understand the concept of the degree of polymerization and the average molecular weight of a polymer and understand the stages of calculating or determining the average molecular weight of the number and average weight</li> <li>5. Students are able to explain the structure or morphology of polymers</li> <li>6. Students are able to explain polymer/plastic processing technology and the concept of rheology in polymer materials</li> <li>7. Students are able to explain the characterization and analysis of polymers</li> <li>8. Students are able to explain the types of polymerization reactions and polymerization reaction mechanisms</li> </ol>

	<ol style="list-style-type: none"> <li>9. Students are able to explain the mechanism of condensation polymerization reactions</li> <li>10. Students are able to explain examples of free radical vinyl polymerization</li> <li>11. Students are able to explain examples of vinyl polymerization with ion initiators and group transfers</li> <li>12. Students are able to explain polymer modifications</li> <li>13. 13. Students are able to explain examples of organic polymers and natural polymers</li> </ol>																								
<b>Content</b>	<p>This course discusses the definition of polymers, basic concepts of polymers, and the history of the development of polymer chemistry; naming of polymer compounds and classification of polymers; stages in polymerization; degree of polymerization and average molecular weight of a polymer and determination of average molecular weight, number and average weight; polymer structure; polymer/plastic processing technology and the concept of rheology in polymer materials; polymer characterization and analysis; types of polymerization reactions and polymerization reaction mechanisms; condensation polymerization reaction mechanisms; free radical vinyl polymerization; vinyl polymerization with ion initiators and group transfer; polymer modification; and organic polymers and natural polymers.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Carey, F.A., organic Chemistry, 4<sup>th</sup> edition, McGraw Hill Company, New york.</li> <li>2. Fessenden, R.J. &amp; Fessenden, J.S., 1989, Kimia Organik, Jilid 2, Erlangga, Jakarta.</li> <li>3. March, J., Advanced Organic Chemistry, Fourth Edition, John Wiley &amp; Sons, New York, 1992.</li> <li>4. Maskil, H., "The Physical Basis of Organic Chemistry", Oxford University Press, New York, 1985.</li> </ol>																								

## 56. Chemical Palm

<b>Module designation</b>	<b>Chemical Palm</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Ritson Purba, S.Si., M.Si Prof. Dr. Ir Daniel, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the Palm Oil Industry</li> <li>2. Students are able to explain about the harvesting and processing of palm oil products</li> <li>3. Students are able to explain about the quality standards of palm oil</li> <li>4. Students are able to explain about the processing of palm oil</li> <li>5. Students are able to explain about the laboratory analysis of palm oil</li> <li>6. Students are able to explain about palm oil products</li> <li>7. Students are able to explain about fatty acids from palm oil products</li> <li>8. Students are able to explain about the content of palm oil</li> <li>9. Students are able to explain about the processing of margarine from palm oil</li> <li>10. Students are able to explain about the processing of palm oil into biodiesel</li> </ol>
<b>Content</b>	This course discusses the Palm Oil Industry; harvesting and Processing of Palm Oil Products; Palm Oil Quality Standards; Palm Oil Processing; Laboratory Analysis of Palm Oil; Palm Oil Products; Fatty Acids from palm oil products; Palm Oil content; Processing of Margarine from palm oil; and Processing of palm oil into biodiesel.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1383 723"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Carey, F.A., 2001, Organic Chemistry, 4<sup>th</sup> Edition, McGraw Hill Company, New York.\</li> <li>Fessenden, R.J. &amp; Fessenden, J.S., 1989, Kimia Organik, Jilid 2, Erlangga, Jakarta.</li> <li>Darnoko, D. , dkk. Teknologi Pengolahan Kelapa Sawit dan Produk Turunannya, Medan : PPKS dan IOPRI.</li> <li>Ketaren, S. 2008. Minyak dan Lemak Pangan, Jakarta : UI-Press.</li> <li>Hartanto, H. 2011. Sukses Besar Budidaya Kelapa Sawit. Yogyakarta : Citra Media Publishing</li> </ol>																								

## 57. Radiochemistry

<b>Module designation</b>	<b>Radiochemistry</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Irfan Ashari Hiyahara, M.Si Ritbey Ruga, MP., Ph.D
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical element, Structural In Inorganic Compounds, Principle In Inorganic Reactions
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the contents of the Lecture Contract, Definition and History of the Development of Radiochemistry</li> <li>2. Students are able to analyze and explain the Basic Principles of the Atomic Nucleus</li> <li>3. Students are able to understand, analyze and explain Radioactivity in nature, Isotopes, Isobars, Isotones, and Radionuclides</li> <li>4. Students are able to explain the Processes of Radioactive Decay</li> <li>5. Students are able to explain and analyze the Equations of Radioactive Decay and Growth</li> <li>6. Students are able to explain and analyze the Types of Radiation Interactions with Matter</li> <li>7. Students are able to explain and analyze the Principles and Methods of Radiation Detection and Measurement</li> <li>8. Students are able to explain Labeling Techniques with Radioactive Elements</li> <li>9. Students are able to analyze and explain the Application of Radiochemistry in Various Fields</li> <li>10. Students are able to analyze and explain the Enrichment of Nuclear Materials and Nuclear Energy</li> <li>11. Students are able to explain the Use of Nuclear Reactors</li> <li>12. 12. Students are able to analyze and explain the Impact of Using Nuclear Reactors from Positive and Negative Aspects</li> </ol>

<b>Content</b>	This course discusses the Definition and Historical Development of Radiochemistry; Basic Principles of Atomic Nuclei; Radioactivity in Nature, Isotopes, Isobars, Isotones, and Radionuclides; Radioactive Decay Processes; Radioactive Decay and Growth Equations; Various Interactions of Radiation with Matter; Principles and Methods of Detection and Measurement of Radiation; Labeling Techniques with Radioactive Elements; Application of Radiochemistry in Various Fields; Enrichment of Nuclear Materials and Nuclear Energy; Use of Nuclear Reactors; and Impact of the Use of Nuclear Reactors from Positive and Negative Aspects.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 741 1383 1043"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Fredlander, G; Kennedy, J.W; Macias, E.S and Miller, J.M, 1981, <i>Nuclear and Radiochemistry</i>, 3<sup>rd</sup> Edition, John Wiley and Sons, New York.</li> <li>Lieser, K.H., 2001, <i>Nuclear and Radiochemistry: Fundamental and Applications</i>, 2<sup>nd</sup> Revised Edition, Wiley VCH-Verlag GmbH.</li> </ol>																								

## 58. Nanotechnology and Nanomaterial

<b>Module designation</b>	<b>Nanotechnology and Nanomaterial</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Dr. Noor Hindryawati, M.Si Husna Syaima, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical element, Structural In Inorganic Compounds, Principle In Inorganic Reactions, Coordination Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the meaning of nanoscience, nanotechnology, nanomaterials,</li> <li>2. Students are able to explain Nanostructures (nanoparticles, nanorods, nanoribbons, nanotubes, nanoporous),</li> <li>3. Students are able to analyze the structure and physical and chemical properties of Nanostructures (nanoparticles, nanorods, nanoribbons, nanotubes, nanoporous),</li> <li>4. Students are able to explain Nanomaterial Synthesis Methods and Techniques</li> <li>5. Students are able to analyze Nanostructure Material Characterization</li> <li>6. Students are able to understand Nanomaterial applications (Devices, electronics, medicine, pharmacy and environment</li> <li>7. Students are able to identify and analyze and explain the Trend of Nanomaterial Use in the Industrial Era 4.0</li> </ol>
<b>Content</b>	This course discusses the definition of nanoscience, nanotechnology, and nanomaterials; nanomaterial properties; structure and chemical physical properties of Nano structures; Nano material synthesis methods and techniques; Nanostructured material characterization;

	Nanomaterial applications; and trends in the use of nanomaterials in the Industrial 4.0 era.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>The Chemistry Of Nanomaterials: Synthesis, Properties And Applications In 2 Volumes. Originally Published: 2004.Editors: C. N. R. Rao, Anthony Cheetham, Achim Müller</li> <li>Nanomaterials, Nanotechnologies And Design. Originally Published: 2009. Author: Michael F. Ashby.Editor: Paulo J. S. G. Ferreira</li> <li>Nanostructures &amp; Nanomaterials. Guozhong Cao. World Scientific, Apr 8, 2004 - Science – 448</li> <li>Callister, Rethwisch. 2010. Materials Science and Engineering: An Introduction. 4th edition. John Wily and Son Inc: Hoboken</li> <li>Huheey J, Ellen A.K, Keither R. 2008. Inorganic Chemistry: Principles of Structure and Reactivity Subsequent Edition. ISBN-13: 978-0060429959</li> <li>Sangeeta D, Lagraff JR. 2004. Inorganic Materials Chemistry Desk Reference. ISBN 9780849309106. Published November 29, by CRC Press</li> </ol>																								

## 59. Environmental Analysis

<b>Module designation</b>	<b>Environmental Analysis</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Nanang Tri Widodo, S.Si., M.Si Ika Yekti Liana Sari, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Analytical Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe environmental pollution, the pollution cycle, and the importance of environmental analysis.</li> <li>2. Students are able to describe the function, classification, and eligibility of water.</li> <li>3. Students are able to describe water sample sampling techniques</li> <li>4. Students are able to describe water quality parameters and their analysis.</li> <li>5. Students are able to describe the definition of water pollution, sources and classifications as well as legal entities that supervise.</li> <li>6. Students are able to describe soil analysis techniques.</li> <li>7. Students are able to describe sediment analysis techniques.</li> <li>8. Students are able to describe air analysis techniques.</li> </ol>
<b>Content</b>	This course discusses environmental pollution, the pollution cycle, and the importance of environmental analysis; the function, classification, and feasibility of water; water sample sampling techniques; water quality parameters and their analysis; definition of water pollution, sources and classifications as well as supervising legal entities; soil analysis techniques; sediment analysis techniques; and air analysis techniques.
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$

	<p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 255 1385 562"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>APHA. 1994. <i>Standard Method for Wastewater</i>.</li> <li>Faust, S. D., and Aly, O. M., 1981, <i>Chemistry of Natural Waters</i>, Ann Arbor Sciences Publishers, Inc.</li> <li>Hidayat, A., 1978, <i>Methods of soil Chemical Analysis</i>, Japan International Cooperation Agency (Jica), Bogor.</li> <li>Van Reeuvick, 1992, <i>Procedures for soil Analysis International Soil Reference and Information Centre</i>, Nederland.</li> <li>Skoog, D. A., West, D. M., Holler, F. J., 1993, <i>Analytical Chemistry</i>, Edisi ke-6, Saunders College Publishing, San Francisco.</li> <li>Willard, H. H., Merritt, L. L., Dean, J. A., dan Settle, F. A., 1988, <i>Instrumental Methods of Analysis</i>, Edisi ke-7, Wadsworth Publishers Co, Belmont California.</li> </ol>																								

## 60. Plantation Crops Analysis

<b>Module designation</b>	<b>Plantation Crops Analysis</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Moh. Syaiful Arif, S.Pd., M.Si Ika Yekti Liana Sari, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Analytical Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the scope, role, and basics of plantation yield analysis.</li> <li>2. Students are able to describe the objectives of plantation product analysis as well as analysis strategies and their uses.</li> <li>3. Students are able to describe the potential of oil palm plantations in East Kalimantan and the analysis of palm oil.</li> <li>4. Students are able to work and analyze about fats and oils.</li> <li>5. Students are able to present literature studies and journal references regarding the analysis of plantation products.</li> <li>6. Students are able to describe the various procedures of plantation products in Indonesia and the basic techniques of general analysis of plantation products.</li> <li>7. Students are able to describe the differences between laboratory scale procedures and SNI.</li> <li>8. Students are able to do testing of water content and ash / mineral content</li> <li>9. Students are able to do carbohydrate, protein and vitamin testing.</li> <li>10. Students are able to test plantation product processing additives and additives such as BTM (Food Additives),</li> <li>11. Students are able to conduct literature study presentations on the analysis of plantation products based on SNI.</li> </ol>

<b>Content</b>	This course discusses the scope, role, and basics of plantation product analysis; the objectives of plantation product analysis as well as analysis strategies and their designation; the potential of oil palm plantations in East Kalimantan; palm oil analysis; basic techniques for general analysis of plantation products; differences in laboratory scale procedures with SNI; chemical - physical testing of water content; testing of vitamin carbohydrates such as vitamins A, C and E, testing of additives in plantation product processing; and testing of additives such as BTM (food additives).																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 741 1386 1043"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Harvey, D. 2000. Modern Analytical Chemistry. McGraw-Hill. New York</li> <li>Skoog, West and Holler. 1996. Fundamentals of Analytical Chemistry. 7th ed.</li> <li>Lagowski, J.J and Sorum, C.H. 1991. Introduction to Semimicro Qualitative Analysis. 7th ed. Prentice Hall. New Jersey</li> <li>Perkin, Elmer. 1996. Analytical Methods for Atomic Absorption Spectroscopy. The Perkin-Elmer Corporation. United States of America.</li> <li>SNI.</li> <li>Slamet Sudarmadji dkk, 1989. Analisa Bahan Makanan Dan Pertanian. Liberty Yogyakarta. Jogjakarta</li> <li>Winarno, FG., 1984. Kimia Pangan Dan Gizi. PT Gramedia. Jakarta</li> </ol>																								

## 61. Advance Biochemistry

<b>Module designation</b>	<b>Advance Biochemistry</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Ritbey Ruga, MP., Ph.D Djihhan Ryn Pratiwi, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and fuction of biomolecules, Motabolism and genetic information
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO-8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the contents of the lecture contract and describe biological membranes and transport</li> <li>2. Students describe the immune system</li> <li>3. Students are able to explain and understand the endocrine system (hormones)</li> <li>4. Students are able to explain the nervous system</li> <li>5. Students are able to describe the chemistry of the sensory system</li> <li>6. Students are able to explain the chemistry of the olfactory system</li> <li>7. Students are able to understand the chemistry of the auditory system</li> <li>8. Students are able to explain the chemistry of the visual system</li> <li>9. Students are able to explain and understand the chemistry of viruses</li> </ol>
<b>Content</b>	This course discusses the structure and function of membranes, membrane transport processes, antigens and antibodies, the immune system, the endocrine system, the nervous system's parts and how it works, squeezing system chemistry, olfactory system chemistry, auditory system chemistry, visual system chemistry, and viral chemistry.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) ; Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1383 719"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Kramer I, 2015, <i>Signal Transduction</i>, 3rd ed., Academic Press Limited, London</li> <li>Berg J.M, Tymoczko J.L, Strayer L, 1975 , <i>Biochemistry</i>, 5nd ed.,W.H. Freeman and Co, San Francisco</li> <li>Cotterill R, 2008, <i>The Material World</i>, Cambridge University Press, Cambridge</li> <li>Wagner, 2008, <i>Basic Virology</i>, Blackwell Publishing, Australia</li> </ol>																								

## 62. Biochemical Foodstuffs

<b>Module designation</b>	<b>Biochemical Foodstuffs</b>
<b>Semester(s) in which the module is taught</b>	V
<b>Person responsible for the module</b>	Djihhan Ryn Pratiwi, S.Si., M.Si Dr. Winni Astuti, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and Function of Biomolecules
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the structure, physicochemical properties of Macronutrients and their functions for the body</li> <li>2. Students are able to describe the structure, physicochemical properties of Micronutrients and their functions for the body</li> <li>3. Students are able to analyze the types, functions of food additives and their dangers to the body</li> <li>4. Students are able to explain the causes of food damage and their relationship to the principles of food preservation</li> <li>5. Students are able to explain: The principles of preservation by freezing and heating food ingredients</li> <li>6. Students are able to explain: The basics of preservation by drying, salting and candied and their relationship to the quality of food ingredients</li> <li>7. Students are able to understand the principles of food preservation by acidification, canning and radiation and their relationship to food quality</li> <li>8. Students are able to explain: the principles of preservation by fermentation</li> </ol>

	<p>9. Students are able to describe natural toxins in food ingredients and their processing</p> <p>10. Students are able to explain Nutrigenomics and its relationship to health</p> <p>11. Students are able to Task: Make a review of food ingredients and present the results of the review</p>																								
<b>Content</b>	<p>This course discusses nutrition including macronutrients (carbohydrates, proteins, and fats) and micronutrients (vitamins, water, and minerals), with a study of their structure, physicochemical properties, distribution in food, and benefits to the body. Food processing and preservation through temperature regulation, water activity, and radiation, as well as the use of natural and synthetic food additives, are also discussed. Packing aspects, including definitions, functions, regulations, and examples of food additives and impurities are also introduced, along with a discussion of foodborne diseases and the concept of nutrigenomics.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) ; Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Teti Estiasih. <i>Teknologi Pengolahan Pangan</i>”, Bumi Aksara, 2011.</li> <li>Desrosier, N.W. <i>Teknologi Pengawetan Pangan</i>. Penerbit Universitas Indonesia. 1988.</li> <li>Anwar, dkk. <i>Sanitasi Makanan dan Minuman Pada Institut Pendidikan Sanitasi</i>. Departemen Kesehatan RI. 1987.</li> </ol>																								

### 63. Student Service Community

<b>Module designation</b>	<b>Student Service Community</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Field work : 10880 minutes
<b>Credit points</b>	4 credits / 6.36 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to prepare for community service activities (KKN)</li> <li>2. Students are able to compile the final report of the Community Service Program</li> <li>3. Collect Work Program Outputs as Final Assignment and Final Report of Community Service Program (KKN) 3.</li> </ol>
<b>Content</b>	This course discusses the objectives, scope, and materials of Community Service Lectures; identification of problems and potentials in the village or Community Service Lecture location; program plans and potentials in the village or Community Service Lecture location; Community Service Lecture problems at the location where it is implemented; Community Service Lecture design at the location where it is implemented; application of courses in the village or Community Service Lecture location; integration of courses at the Community Service Lecture location; and finalization of Community Service Lecture outputs.
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$

	The conversion of final grades to alphabetic values is given by the table:		
	<b>Interval</b>	<b>Number</b>	<b>Letter</b>
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	$40 \leq FG < 50$	1.0	D
	$50 \leq FG < 60$	1.5	
	$60 \leq FG < 65$	2.0	C
	$65 \leq FG < 70$	2.5	
	$70 \leq FG < 75$	3.0	B
	$75 \leq FG < 80$	3.5	
	$80 \leq FG \leq 100$	4.0	A
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>		
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Buku Panduan KKN Universitas Mulawarman</li> </ol>		

## 64. Applied Chemistry

<b>Module designation</b>	<b>Applied Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Ritson Purba, S.Si., M.Si Rita Hairani, M.Sc., Ph.D
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze the outline of applied chemistry in everyday life</li> <li>2. Students are able to describe industrial process technology.</li> <li>3. Students are able to describe industrial waste and its management</li> <li>4. Students are able to describe the application of chemistry in drinking water treatment.</li> <li>5. Students are able to describe the application of chemistry in agriculture, especially related to soil, fertilizers, and pesticides.</li> <li>6. Students are able to describe the role of chemistry in the health sector, especially related to drugs and radiochemical equipment.</li> <li>7. Students are able to describe the concept of food analysis and preservation in the food processing process.</li> <li>8. Students are able to describe the utilization of natural materials chemically and the isolation process</li> </ol>

	9. Students are able to describe how to make several materials that are useful in everyday life (making soap, VCO, etc.).																								
<b>Content</b>	This course explains the outline of the application of chemistry in everyday life; industrial process technology; industrial waste processing; drinking water processing; soil chemistry, fertilizers, and pesticides; drugs and radiochemistry; food analysis and preservation; natural product chemistry; and chemical applications and manufacturing of household products.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="3">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> <td>B</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	$75 \leq FG < 80$	3.5	B	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	Based on the latest journals, articles or scientific publications according to their respective fields of expertise.																								

## 65. Waste Treatment Techniques

<b>Module designation</b>	<b>Waste Treatment Techniques</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Saibun Sitorus, M.Si Drs. Alimuddin, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective /-specialisation
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS

<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the importance of waste treatment, the relationship between waste and the process of environmental pollution and know cases related to waste.</li> <li>2. Students are able to describe the identification and characterization of waste</li> <li>3. Students are able to describe the classification of hazardous waste 3.</li> <li>4. Students are able to describe waste treatment regulations in Indonesia and in the world</li> <li>5. Students are able to describe the management of hazardous waste (labeling, storage and transportation).</li> <li>6. Students are able to describe the management of medical waste and radioactive waste</li> <li>7. Students are able to describe the principles of physical waste treatment.</li> <li>8. Students are able to describe the principles of chemical waste treatment</li> <li>9. Students are able to describe the Stabilization and Solidification process and its application in industry.</li> <li>10. Students are able to describe the principles of biological waste treatment</li> <li>11. Students are able to describe the working principles of incinerators</li> <li>12. Students are able to describe the planning of B3 waste landfills.</li> </ol>
<b>Content</b>	<p>This course explains about the introduction, Identification of B3 waste, and characterization of B3 waste, Classification of B3 waste, Regulations on B3 Waste Management in Indonesia, B3 Waste management (labeling, storage and transportation); Management of Medical Waste and radioactive waste; Soil pollution; Chemical waste treatment; Stabilization and Solidification processes and their applications in industry; Biological Waste Treatment (Composting, land treatment, soil heaping, bioremediation); Thermal waste treatment; Types of waste incinerators; and B3 waste landfills.</p>
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p>

	<p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 320 1386 622"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>LaGrega, M.D. : Hazardous waste management, McGraw-Hill Book Co, 1994</li> <li>Tchobanoglous, G.; Theisen, H.; Vigil, S.A. : Integrated solid waste management, McGraw Hill Book, 1993.</li> <li>Damanhuri, E. : (Diktat TL-3204).Teknik Lingkungan, institut Teknologi Bandung. 2010</li> <li>PP 101 thn 2014 tentang pengelolaan limbah B3</li> </ol>																								

## 66. Field Work Practice

<b>Module designation</b>	<b>Field Work Practice</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Field work : 5440 minutes
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>Students are able to understand the characteristics of the industry or research center where PKL is located and have the provision of analytical knowledge that can be applied at the PKL place.</li> <li>Students are able to apply their knowledge and analytical skills in the industry or research centers.</li> <li>Students are able to compile a report on the results of PKL</li> <li>Students are able to present a report on the results of PKL</li> </ol>
<b>Content</b>	This course discusses the profile of the internship location; Production process; Types and procedures of analysis; Practice; Reports of internship results; and Presentation.
<b>Examination forms</b>	Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%). The final grade (FG) for each student is calculated by the formula :

	$FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 286 1386 591"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	-																								

## 67. Chemistry of Drugs and Cosmetics

<b>Module designation</b>	<b>Chemistry of Drugs and Cosmetics</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Rita Hairani, M.Sc., Ph.D Ritson Purba, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry Of Natural Products
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to Explain the introduction of medicinal plants and cosmetics</li> <li>2. Students are able to Understand and explain medicinal plants in terms of ethnobotany and chemotaxonomy</li> <li>3. Students are able to know the types of medicinal product ingredients</li> <li>4. Students are able to explain phytochemical tests, extraction techniques and isolation of active compounds from natural materials</li> <li>5. Students are able to explain bioactive screening, secondary metabolite content and the relationship between the structure and activity of medicinal plants</li> <li>6. Students are able to explain the role of drugs in health services and the drug manufacturing process.</li> <li>7. Students are able to explain the basic aspects and classification of cosmetic preparation ingredients</li> <li>8. Students are able to explain instrumental and non-instrumental methods of analyzing cosmetic preparation components</li> <li>9. Students are able to explain the physicochemical properties of cosmetic preparation ingredients</li> </ol>

<b>Content</b>	This course discusses the introduction to medicinal plants and cosmetics; medicinal plants reviewed from ethnobotany and chemotaxonomy; types of medicinal product ingredients; phytochemical tests, extraction techniques and isolation of active compounds from natural materials; bioactive screening, secondary metabolite content and the relationship between structure and activity of medicinal plants; the role of drugs in health services and the drug manufacturing process; basic aspects and classification of cosmetic preparation ingredients; instrumental and non-instrumental methods of analyzing cosmetic preparation components; and physicochemical properties of cosmetic preparation ingredients.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 775 1385 1077"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="3">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> <td>B</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	75 ≤ FG < 80	3.5	B	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Dalimartha S (2001), "Atlas Tumbuhan Obat Indonesia", Jilid 1, Trubus Agriwidya, Jakarta.</li> <li>Dalimartha S (2001), "Atlas Tumbuhan Obat Indonesia", Jilid 2, Trubus Agriwidya, Jakarta.</li> <li>Dalimartha S (2001), "Atlas Tumbuhan Obat Indonesia", Jilid 3, Trubus Agriwidya, Jakarta.</li> <li>Depkes RI (1986), "Sediaan Galenik dan Uji Klinik Obat Tradisional", Dirjen POM, Jakarta.</li> <li>Tjitrosoepomo G (1994), " Taksonomi Tumbuhan Obat-Obatan, Gajah Mada, University Press, Yogyakarta.</li> <li>Wagner, H. et,all, (1984), "Plant Drug Analysis", Springer-Verlag, Berlin Heidelberg New York Tokyo.</li> <li>Widana, G.A.B., 2014, Analisis Obat, Kosmetik dan Makanan, Graha Ilmu, Yogyakarta.</li> <li>Salvador, A. and Chisvert, A., 2007, Analysis of Cosmetic Products, Elsevier, Oxford.</li> <li>Snyder, Kirkland, dan Dolan, 2010, Introduction to Modern Liquid Chromatography.</li> <li>Paye, M., Barel, M.O., and Maibach, H.I., 2001, Handbook of Cosmetics Science and Technology, Marcel Dekker, New York.</li> <li>Draelos, Z.D. dan Thaman, L.A., 2006, Cosmetics Formulation of Skin Care Products, Taylor &amp; Francis.</li> </ol>																								

## 68. Techniques for Natural Product Research

<b>Module designation</b>	<b>Techniques for Natural Product Research</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Eva Marliana, M.Si Dr. Chairul Saleh, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II and Organic Chemistry Of Natural Products
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the definition of natural materials and their characteristics chemically and biologically, the diversity of aspects of natural material chemistry, herbal medicine regulations in the world and in Indonesia, and the development of natural material chemistry research techniques</li> <li>2. Students are able to explain the role of natural materials as a source of new drugs, several major discoveries in the field of natural material chemistry, the development of methods in organic chemistry related to the development of natural material chemistry, and the development of methods in organic chemical synthesis related to the development of natural material chemistry</li> <li>3. Students are able to explain phytochemical screening and stages of natural material sample preparation</li> <li>4. Students are able to explain natural material extraction techniques</li> <li>5. Students are able to explain fractionation in natural material research</li> <li>6. Students are able to explain chromatography columns</li> <li>7. Students are able to explain vacuum, flash and gravity liquid chromatography columns; and compare the differences between the three adsorption chromatography columns</li> </ol>

	<ol style="list-style-type: none"> <li>8. Students are able to explain the combination of eluents used in liquid chromatography columns with adsorption separation mechanisms</li> <li>9. Students are able to explain the mechanism of exclusion separation, size and use of eluents in exclusion chromatography columns</li> <li>10. Students are able to explain the concept of radial chromatography and how to make chromatotron plates with various thicknesses</li> <li>11. Students are able to explain the combination of eluents used in radial chromatography, how to prepare samples in radial chromatography, and the stages carried out so that radial chromatography plates can be used repeatedly</li> <li>12. Students are able to explain the final stage of compound purification and how to ensure that the isolated compound is pure</li> <li>13. Students are able to explain the spectroscopic method in determining the structure of compounds</li> <li>14. Students are able to explain how to screen simple bioassays</li> </ol>																								
<b>Content</b>	<p>This course discusses natural materials and their chemical and biological characteristics; development of natural material chemistry research techniques; the role of natural materials as a source of new drugs; major discoveries in the field of natural material chemistry; development of methods in organic chemistry of natural materials; development of organic chemical synthesis methods of natural materials; phytochemical screening and stages of natural material sample preparation; natural material extraction techniques; fractionation in natural material research; chromatography columns; vacuum, flash and gravity liquid chromatography columns; and comparing the differences between the three adsorption chromatography columns; eluent combinations used in liquid chromatography columns with adsorption separation mechanisms; exclusion separation mechanisms; radial chromatography and how to make chromatotron plates with various thicknesses; radial chromatography; the final stage of compound purification and how to ensure that the isolated compound is pure; spectroscopic methods in determining the structure of compounds; and simple bioassay screening methods.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 1648 1385 1957"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="3">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> <td rowspan="2">C</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> <td>B</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	$65 \leq FG < 70$	2.5	C	$70 \leq FG < 75$	3.0	$75 \leq FG < 80$	3.5	B	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								

**Reading list**

1. Achmad, S.A. 1986. *Kimia Organik Bahan Alam*. Jakarta:Karunika.
2. Darwis, D. 2000. *Teknik Dasar Laboratorium dalam Penelitian Senyawa Bahan Alam Hayati*. Workshop Pengembangan Sumber Daya Manusia di dalam Bidang Kimia Organik Bahan Alam Hayati. FMIPA UNAND, Padang.
3. Harborne, J.B. 1987. *Metode Fitokimia*. Bandung: Penerbit ITB.
4. Robinson, T. 1995. *Kandungan Kimia Organik Tumbuhan tinggi*. Bandung: Penerbit ITB.
5. Rahman, A., Choudhary, M.I., Thomsen, W.J., 2005. *Bioassay Techniques for Drug Development*, harwood Academic Publisher.
6. Satyajit ,D.S, Latief, Z., Gray, A.I., *Natural Products Isolation*, 2006, Human Press, Totowa, New Jersey.
7. Silverstein, R.M., Webster, F.X., Kiemle, *Spectrometric identification of Organic Compounds*, 2005, Seventh edition, State University of New York, College of Environmental Science and Forestry.

## 69. Bioassay Techniques in Natural Product

<b>Module designation</b>	<b>Bioassay Techniques in Natural Product</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Prof. Dr. Ir. Erwin, M.Si Rita Hairani, M.Sc., Ph.D
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry Of Natural Products
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand and explain the contents of the lecture contract and the meaning of bioassay</li> <li>2. Students are able to understand and explain the types of bioassay</li> <li>3. Students are able to understand and explain the ethics of research using test animals</li> <li>4. Students are able to understand and explain the types of toxicity tests</li> <li>5. Students are able to understand and explain the antioxidant test</li> <li>6. Students are able to understand and explain the types of bioassay for mosquito repellent tests</li> <li>7. Students are able to understand and explain the types of cytotoxic tests</li> <li>8. Students are able to understand and explain antibacterial and antifungal</li> <li>9. Students are able to understand and explain anti-inflammatory</li> <li>10. Students are able to understand and explain sunscreen</li> <li>11. Students are able to understand and explain the contents of the lecture contract and the meaning of bioassay</li> </ol>
<b>Content</b>	This course discusses the definition of bioassay; types of bioassays such as in vitro, in vivo, and preclinical tests; ethics of research using test animals; acute toxicity tests, subchronic or subacute toxicity tests, chronic toxicity tests, potentiation tests, ketaragonics tests, and chemutagenic tests; definition and classification of antioxidants, types of antioxidant tests, calculation of IC50 values, definition and classification of bacteria; definition and classification of fungi, types of antibacterial and antifungal tests; types of anti-inflammatory drugs;

	types of anti-inflammatory tests; anti-inflammatory test procedures; the effect of UV rays from the sun on human skin; and the working principles of sunscreens, types of natural compounds that have the potential as sunscreens, and sunscreen test procedures.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) ; Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Pedoman dan Pengujian dan Pengembangan Fitofarmaka, 1993, Penapisan Farmakologi, Pengujian Fitokimia, dan Pengujian Klinik,</li> <li>2. Syamsudin. 2012. Teknik Bioassay: Untuk Pengembangan Obat Bahan Alam. Universitas Pancasila. Jakarta</li> <li>3. Darmita, Analisis Hayati: Uji Toksisitas, <a href="https://staff.ui.ac.id/system/files/users/harmita/material/analisi_shayatiujitoksisitassecaramikrobiologidr.harmi.pdf">https://staff.ui.ac.id/system/files/users/harmita/material/analisi_shayatiujitoksisitassecaramikrobiologidr.harmi.pdf</a>, diakses tanggal 23-2-2022.</li> <li>4. Teguh Wahyu Sardjono, T.W., Etika Penelitian Menggunakan Hewan Coba, BBT dan Rekam Medik, Komisi Etik Penelitian Kesehatan Fakultas Kedokteran Universitas Brawijaya, <a href="https://fkik.uin-malang.ac.id/wp-content/uploads/2019/02/Etika-Penelitian-Menggunakan-Hewan-Coba-BBT-dan-Rekam-Medis-1.pdf">https://fkik.uin-malang.ac.id/wp-content/uploads/2019/02/Etika-Penelitian-Menggunakan-Hewan-Coba-BBT-dan-Rekam-Medis-1.pdf</a>, diakses tanggal 23-2-2022</li> <li>5. Maesaroh, K., Kurnia, D. dan Al Anshori, J. 2018, Perbandingan Metode Uji Aktivitas Antioksidan DPPH, FRAP dan FIC Terhadap Asam Askorbat, Asam Galat dan Kuersetin, Chimica et Natura Acta, 6 (2) : 93-100</li> <li>6. Uji Boiassay, <a href="https://agus34drajat.files.wordpress.com/2011/03/bio-assay.pdf">https://agus34drajat.files.wordpress.com/2011/03/bio-assay.pdf</a>, diakses tanggal 23-2-2022</li> <li>7. <a href="#">B N Meyer</a>, <a href="#">N R Ferrigni</a>, <a href="#">J E Putnam</a>, <a href="#">L B Jacobsen</a>, <a href="#">D E Nichols</a>, <a href="#">J L McLaughlin</a>, 1982, Brine shrimp: a convenient general bioassay for active plant constituents, Planta Med, 45(5): 31-4. doi: 10.1055/s-2007-971236.</li> <li>8. Parwata, I.M.O.A., 2014, Bahan Ajar Kanker dan Antikanker, Jurusan Kimia Fakultas Matematika Dan Ilmu Pengetahuan Alam Universitas Udayan, Bali.</li> <li>9. Saputri, R.D., Aldin, M.F., Tjahjandarie, T.S., Marlina, E., Tanjung, M., 2023. Aktivitas Antikanker Senyawa Pterokarpan Dari Kulit</li> </ol>																								

	<p>Batang Aka Kalesi (<i>Spatholobus ferrugineus</i>), Jurnal Kimia Mulawarman; 20 (2), pp. 69-73.</p> <p>10. Saleh, C., Sestiani, M., Erwin., 2023. Activity of Alang-Alang (<i>Imperata cylindrica</i> (L.) P. Beauv) Leaves Methanol Extract as Anti-inflammatory, Jurnal Sains dan Kesehatan (J. Sains Kes.); 5 (3), pp. 290-296.</p>
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## 70. Pulp And Paper Chemistry

<b>Module designation</b>	<b>Pulp and Paper Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Prof. Dr. Ir. Daniel, M.Si Dr. Saibun Sitorus, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the limitations of Pulp and Paper Chemistry</li> <li>2. Students are able to explain the limitations of Pulp and Paper Chemistry</li> <li>3. Students are able to explain the Pulp and Paper industry</li> <li>4. Students are able to explain the continuation of the Pulp and Paper industry</li> <li>5. Students are able to explain the impact of pulp and paper waste</li> <li>6. Students are able to explain the continuation of the impact of the pulp and paper industry</li> <li>7. Students are able to explain the impact of the pulp and paper industry</li> <li>8. Students are able to explain the components of wood chemical compounds</li> <li>9. Students are able to explain the manufacture of pulp from softwood</li> <li>10. Students are able to explain bleaching and delignification</li> <li>11. Students are able to explain Pulp from low plants (Algae)</li> <li>12. Students are able to explain Pulping Technology I</li> <li>13. Students are able to explain Pulping Technology II</li> <li>14. 14. Students are able to explain the conventional Pulping Process</li> </ol>

<b>Content</b>	This course discusses the chemistry of pulp and paper; pulp and paper industry; impacts of pulp and paper waste; impacts of the pulp and paper industry; components of wood chemical compounds; making pulp from softwood; bleaching and delignification; pulp from low plants (algae); analysis of SO <sub>2</sub> in the air using pulping technology I; analysis of pulping technology II; and conventional pulping processes.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 611 1383 913"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Carrahe, Jr. C. E., <i>Seymour/Carraher's Polymer Chemistry</i>, Sixth Edition, Marcel Dekker, Inc., New York, 2003.</li> <li>Ebewele, R. O., <i>Polymer Science and Technology</i>, CRC Press, New York, 2000</li> <li>Fried, J. R., <i>Polymer Science and Technology</i>, Third Edition, Pearson Education, Inc., 2014.</li> <li>Sperling, L. H., <i>Introduction to Physical Polymer Science</i>, John Wiley &amp; Sons, Inc., Canada, 2006</li> </ol>																								

## 71. Petroleum Chemistry

<b>Module designation</b>	<b>Petroleum Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Saibun Sitorus, M.Si Prof. Dr. Ir Daniel, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain petroleum chemistry</li> <li>2. Students are able to distinguish between downstream and upstream industries</li> <li>3. Students are able to explain petroleum raw materials and petroleum utilization</li> <li>4. Students are able to describe the petroleum processing process I</li> <li>5. Students are able to describe the concept of the crude oil processing process and hydrocarbon production as petroleum raw materials</li> <li>6. Students are able to describe the Naphtha Cracking process</li> <li>7. Students are able to describe the petroleum conversion process I</li> <li>8. Students are able to describe the petroleum conversion process II</li> <li>9. Students are able to describe the petroleum conversion process III</li> <li>10. Students are able to describe the petroleum conversion process III</li> <li>11. Students are able to describe the petroleum conversion process IV</li> <li>12. Students are able to describe the process of forming plastic, rubber and fiber</li> <li>13. Students are able to describe the petroleum industry in East Kalimantan</li> </ol>

<b>Content</b>	This course discusses petroleum chemistry; downstream and upstream industries; petroleum raw materials and petroleum utilization; petroleum processing process; the concept of crude oil processing process and hydrocarbon production as petroleum raw materials; Naphtha Cracking process; Petroleum conversion process; Plastic, Rubber, and Fiber Formation Process; and the Petroleum Industry in East Kalimantan.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 645 1386 949"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Burdick, D. L., and William L. L. <i>Petrochemicals in Nontechnical Language</i>. USA : Pennwell.</li> <li>Chaudhuri, U. T. 2011. <i>Fundamentals of Petroleum and Petrochemical Engineering</i>. India : CRC Press.</li> <li>Matar, S. and Hatch, L. F. 2001. <i>Chemistry of Petrochemical Processes</i>. USA : Gulf Professional Publishing</li> </ol>																								

## 72. Fundamental of Oleochemistry

<b>Module designation</b>	<b>Fundamental Oleochemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Ritson Purba, S.Si., M.Si Dr. Chairul Saleh, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry II
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the basic oleochemical concept</li> <li>2. Students are able to explain unsaturated fatty acids Mono Unsaturated Fatty Acid (MUFA) and Poly Unsaturated Fatty Acid (PUFA)</li> <li>3. Students are able to explain the characterization of sources and utilization of glycerol and the conversion of glycerol through biotechnology and thermochemistry</li> <li>4. Students are able to explain the extraction techniques and extraction process of palm oil</li> <li>5. Students are able to explain fatty alcohols and fatty amines, physical and chemical properties, and their synthesis and applications</li> <li>6. Students are able to distinguish between soap and detergent</li> <li>7. Students are able to explain the definition, types, manufacture of butter, margarine and shortening</li> <li>8. Students are able to explain the definition and classification, synthesis, characterization and application of surfactants</li> <li>9. Students are able to explain fuel from petroleum and biodiesel as alternative fuels. 10. Students are able to explain the basics of polymers, biodegradable polymers and several polymers from plant oils and their applications</li> </ol>

	<p>10. Students are able to explain the basic concepts of cosmetics and their sources from nature and stem cells, as well as the use of cosmetics</p> <p>11. Students are able to explain sample preparation techniques, chemical analysis, and instrumentation</p>																								
<b>Content</b>	<p>This course discusses the basic concepts of oleochemistry; characterization of sources and utilization of glycerol and conversion of glycerol through biotechnology and thermochemistry pathways; extraction techniques and extraction processes of palm oil; fatty alcohols and fatty amines, physical and chemical properties, and their synthesis and applications; soaps and detergents; definition, types, manufacture of butter, margarine and shortening; definition and classification, synthesis, characterization and application of surfactants; petroleum fuels and biodiesel as alternative fuels; basics of polymers, biodegradable polymers and several polymers from vegetable oils and their applications; basic concepts of cosmetics and their sources from nature and stem cells, and the use of cosmetics; and sample preparation techniques, chemical analysis, and instrumentation.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Ahmad, M.U., 2017. Fatty Acids, Chemistry, Synthesis, and Applications, Academic Press, London</li> <li>Ashworth, M.R.F., 1979, Analytical Methods for Glycerol, Academic Press, London</li> <li>Austin, G.T., 1984, Shreve's Chemical Process Industries, 5th Edition, McGraw Hill, Singapore</li> <li>Behr, A. dan Seidensticker, T., 2020, Chemistry of Renewables, An Introduction, Springer, Berlin</li> <li>Barel, A.O., Paye, M., Maibach, H.I., 2009, Handbook of Cosmetic Science and Technology, 3rd Edition, New York</li> <li>Burdge, G.C., 2018, Polyunsaturated Fatty Acid Metabolism, Academic Press, London</li> <li>Byrdwell, W.C., 2005, Modern Methods for Lipid Analysis by LC-MS and Related Techniques, AOAC Press, Illinois</li> <li>Carroll, R., 2002, Making Cheese, Butter &amp; Yogurt, Storey Country Wisdom Bulletin, North Adams</li> <li>Chaudhuri, U.R., 2011, Fundamentals of Petroleum and Petrochemical Engineering, CRC Press, London</li> </ol>																								

	<ol style="list-style-type: none"> <li>10. Chow, C.K., 2008, Fatty Acids in Food and their Health Implications, 3rd Edition, CRC Press, New York</li> <li>11. Farn, R.J., 2006, Chemistry and Technology of Surfactant, Blackwell Publishing, New Delhi</li> <li>12. Gandini, A. &amp; Lacerda, T.M., 2018. Polymers from Plant Oils, 2nd Edition, Wiley, New York</li> <li>13. Gunstone, F., 1996, Fatty Acid and Lipid Chemistry, Blackie Academic, London</li> <li>14. Herman, W., 1991, Sulphonation Technology in the Detergent Industry, Springer, Berlin</li> <li>15. Inamuddin, Ahamed, M.I., Boddula, R., Rezakazemi, M., 2021, Biodiesel, Technology and Applications, Wiley, Beverly</li> <li>16. Karak, N., 2012, Vegetable Oil-Based Polymer, Properties, Processing and Application, Woodhead Publishing, Cambridge, London</li> <li>17. Khosrova, E., 2016, Butter, A Rich History, Algonquin Books of Chapel Hill, Canada</li> <li>18. Knothe, G., Krahl, J., Gerpen, J., The Biodiesel Handbook, 2nd Edition, AOCS Press, Illinois</li> <li>19. Lai, O.M. et al., 2012, Palm Oil, Production, Processing, characterization, and Uses, AOCS Press, Urbana</li> <li>20. Li, C. et al., 2020, Industrial Oil Plant, Application, Principles and Green Technologies, Springer, Singapore</li> <li>21. Madbouly, S.A., Zhang, C., Kessler, M.R., 2016, Bio-Based Plant Oil Polymers and Composites, Elsevier, New York</li> <li>22. Maroa, S., &amp; Inambao, F., 2020, Biodiesel Combustion, Performance and Emission Characteristics, Springer, Gewerbestrasse</li> <li>23. Mota, C.J.A., Pinto, B.P., Lima, A.L., 2017, Glycerol, A Versatile Renewable Feedstock for the Chemical Industry, Springer, Switzerland</li> <li>24. Montero, G. &amp; Staytcheva, M., 2016, Biodiesel, Quality, Emmisions and By-Products, 2nd Edition, InTech, London</li> <li>25. Mudge, S.M., Belanger, S.E., Deleo, P.C., 2019, Fatty Alcohols, Anthropogenic and Natural Occurrence in the Environment, 2nd Edition, RSC Press, London</li> <li>26. Mulligan, C.N., Sharma, S.K., Mudhoo, A., 2014, Biosurfactants, Research Trends and Applications, CRC Press, New York</li> <li>27. Myers, D., 2020, Surfactant Science and Technology, 4th Edition, Wiley, New York</li> <li>28. Pagliaro, M. dan Rossi, M., 2010, The Future of Glycerol, 2nd Edition, RSC Publishing, New York</li> <li>29. Salvador, A. dan Chrisvert, A., 2007, Analysis of Cosmetic Products, Elsevier, Amsterdam</li> <li>30. Sarma, H. &amp; Prasad, M.N.V., 2021, Biosurfactants for a Sustainable Future, Wiley, New York</li> <li>31. Sarin, A., 2012, Biodiesel, Production and Properties, RSC Publishing, Cambridge</li> <li>32. Schmitt, T.M., 2001, Analysis of Surfactants, 2nd Edition, Marcel Dekker, New York</li> <li>33. Spitz, L., 2016, Soap Manufacturing Technology, Elsevier, San Francisco</li> <li>34. Tadros, T.F., 2005, Applied Surfactants, Principles and Applications, Wiley-VCH Verlag, Berlin</li> </ol>
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### 73. Capita Selecta in Organic Chemistry

<b>Module designation</b>	<b>Capita Selecta in Organic Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Ritson Purba, S.Si., M.Si Rita Hairani, M.Sc., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand and explain the contents of the lecture contract, the scope of selected chapters, basic concepts of organic chemistry development</li> <li>2. Students are able to understand and explain specific topics 1</li> <li>3. Students are able to understand and explain specific topics 2</li> <li>4. Students are able to understand and explain the basic theory of organic chemistry and organic chemistry research techniques in the journals presented</li> <li>5. Students are able to understand and explain specific topics 3</li> <li>6. Students are able to understand and explain types of specific topics 3</li> <li>7. Students are able to design simple organic chemistry research</li> <li>8. Students are able to understand and explain the basic theory of organic chemistry and organic chemistry research techniques in the research design made in the previous meeting</li> </ol>

<b>Content</b>	This course discusses the scope of selected chapters, basic concepts of the development of organic chemistry, aspects of organic chemistry, and current research on several specific topics in organic chemistry.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Achmad, S.A. 1986. Kimia Organik Bahan Alam. Jakarta: Karunika.</li> <li>2. Harborne, J.B. 1987. Metode Fitokimia. Bandung: Penerbit ITB.</li> <li>3. Robinson, T. 1995. Kandungan Kimia Organik Tumbuhan tinggi. Bandung: Penerbit ITB.</li> <li>4. Rahman, A., Choudhary, M.I., Thomsen, W.J., 2005. Bioassay Techniques for Drug Development, Harwood Academic Publisher.</li> <li>5. Satyajit, D.S, Latief, Z., Gray, A.I., Natural Products Isolation, 2006, Human Press, Totowa, New Jersey.</li> <li>6. Silverstein, R.M., Webster, F.X., Kiemle, Spectrometric identification of Organic Compounds, 2005, Seventh edition, State University of New York, College of Environmental Science and Forestry.</li> <li>7. Parashar R, K, 2009, Reaction mechanism in organic synthesis, Reader Chemistry department, Kirori Mal College, University of Delhi, India.</li> <li>8. Other organic chemistry journals</li> </ol>																								

## 74. Essential of Chemistry

<b>Module designation</b>	<b>Chemistry of Essential Oil</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Rita Hairani, M.Sc., Ph.D Ritson Purba, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minuter/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Organic Chemistry Of Natural Products
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the chemistry of essential oils</li> <li>2. Students are able to describe the types and classifications of essential oils</li> <li>3. Students are able to describe the method of isolating the chemical components of essential oils and the techniques of distilling essential oils</li> <li>4. Students are able to describe the physical properties and chemical composition of essential oils</li> <li>5. Students are able to describe the production, isolation and modification of the main components of fennel oil</li> <li>6. Students are able to describe the production, isolation and modification of the main components of clove oil</li> <li>7. Students are able to describe the production, isolation and modification of the main components of patchouli oil</li> <li>8. Students are able to describe the production, isolation and modification of the main components of citronella oil</li> <li>9. Students are able to describe the production, isolation and modification of the main components of turpentine oil</li> <li>10. Students are able to describe the production, isolation and modification of the main components of star anise oil</li> </ol>

	<ol style="list-style-type: none"> <li>11. Students are able to describe the production, isolation and modification of the main components of peppermint oil</li> <li>12. Students are able to describe the production, isolation and modification of the main components of nutmeg oil</li> <li>13. Students are able to describe production, isolation and modification of the main components of eucalyptus oil and cinnamon oil.</li> <li>14. Students are able to Describe the production, isolation and modification of the main components of agarwood oil</li> </ol>																								
<b>Content</b>	This course discusses the chemistry of essential oils; Types and Classification of Essential Oils; methods of isolating chemical components of essential oils and techniques of essential oil distillation; physical properties and chemical composition of essential oils; and production, isolation and modification of the main components of fennel oil, clove oil, patchouli oil, production, citronella oil, turpentine oil, star anise oil, piperment oil, nutmeg oil, eucalyptus oil, cinnamon oil, and agarwood oil.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. De Silva, K, T. 1995. <i>A Manual on The Essential Oil Industry</i>. Austria: United Nations Industrial Development Organization Vienna.</li> <li>2. Parry, E.J. 1921. <i>The Chemistry of Essential Oils and Artificial Perfumes, Volume I</i>. London: Scott, Greenwood and Son.</li> <li>3. Parry, E.J. 1922. <i>The Chemistry of Essential Oils and Artificial Perfumes, Volume II</i>. London: Scott, Greenwood and Son.</li> <li>4. Oyen, L.P.A., and Dung, N.X. (editor), (1999), <i>Plant Resources of South-East Asia No. 19. Essential-oil plants</i>. Leiden: Backhuys Publishers.</li> <li>5. Sastrohamidjojo, H., (2004), <i>Kimia Minyak Atsiri</i>, Yogyakarta: Gajah Mada University Press</li> </ol>																								

## 75. Astrochemistry

<b>Module designation</b>	<b>Astrochemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Rahmat Gunawan, M.Si Nanang Tri Widodo, S.Si, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Fundamental of Physic
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the basic concepts of astrochemistry.</li> <li>2. Students are able to analyze the concept of chemical evolution.</li> <li>3. Students are able to describe fusion reactions in supernovae and black holes.</li> <li>4. Students are able to describe chemistry in planetary nebulae and supernova nebulae.</li> <li>5. Students are able to analyze the chemistry of the Earth's atmosphere.</li> <li>6. Students are able to describe the ionization reactions of the Earth's atmosphere.</li> <li>7. Students are able to analyze ozone chemistry.</li> <li>8. Students are able to describe the chemistry of the atmospheres of the planets in the solar system.</li> </ol>
<b>Content</b>	This course discusses the basic concepts of astrochemistry; the concept of chemical evolution; fusion reactions in supernovae and black holes; the chemistry of the Planetary Nebula and Supernova Nebula; the chemistry of the earth's atmosphere; ionization reactions of the earth's atmosphere; ozone chemistry; and the chemistry of the atmospheres of the planets of the solar system.
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p>

	<b>Interval</b>	<b>Number</b>	<b>Letter</b>
	$0 \leq FG < 40$	0.0	E
	$40 \leq FG < 50$	1.0	D
	$50 \leq FG < 60$	1.5	
	$60 \leq FG < 65$	2.0	C
	$65 \leq FG < 70$	2.5	
	$70 \leq FG < 75$	3.0	B
	$75 \leq FG < 80$	3.5	
	$80 \leq FG \leq 100$	4.0	A
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>		
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Nancy E. Carpenter, 2104, Chemistry of Sustainable Energy, CRC Press</li> <li>2. Nivaldo J. Tro, 2019, Chemistry A Molecular Approach, Pearson</li> <li>3. Atkins, 2010. Atkins Inorganic Chemistry, Oxford University Press, New York</li> </ol>		

## 76. Electrochemistry

<b>Module designation</b>	<b>Electrochemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Abdul Aziz, M.Si Dr. Rahmad Gunawan, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Energetics
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the concept of oxidation and reduction Osmotic Pressure.</li> <li>2. Students are able to describe the concept of oxidation numbers.</li> <li>3. Students are able to describe electrochemical cells.</li> <li>4. Students are able to describe the types of electrochemical cells.</li> <li>5. Students are able to describe the concept of electrochemical cell measurement.</li> <li>6. Students are able to describe the concept of batteries.</li> <li>7. Students are able to analyze the application of fuel cells.</li> <li>8. Students are able to describe the concept of reference electrodes.</li> <li>9. Students are able to describe the thermodynamics of electrochemical cells.</li> <li>10. Students are able to describe standard electrode potential.</li> <li>11. Students are able to describe electromotive force (EMF).</li> <li>12. Students are able to describe the dependence of EMF on concentration and temperature.</li> <li>13. Students are able to describe the concept of electrolysis.</li> <li>14. Students are able to analyze the applications of electrolysis.</li> </ol>
<b>Content</b>	This course discusses the concepts of oxidation and reduction; the concept of oxidation state; electrochemical cells; types of electrochemical cells; the concept of electrochemical cell measurement; the concept of batteries; applied fuel cells; the concept of comparison electrodes; thermodynamics of electrochemical cells; single electrode potential; electromotive force (EMF); dependence of EMF on concentration and temperature; the concept of electrolysis; and electrolysis applications.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1385 719"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Robert J. Silbey, Robert A. Alberty, Mounji G. Bawendi, <i>Physical Chemistry</i>, Fourth Edition, John Wiley &amp; Sons. Inc., 2005</li> <li>Andrzej Lasia, <i>Advanced Electrochemistry. Interfaces, thermodynamics, and electrochemistry. Interfaces thermodynamics</i>  <a href="https://www.researchgate.net/publication/305681545">https://www.researchgate.net/publication/305681545</a> </li> </ol>																								

## 77. Catalyst Chemistry

<b>Module designation</b>	<b>Catalyst Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. RR. Dirgarini Julis NS., M.Sc Veliyana Londong Allo, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Phase System, Coordination Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze the definition of catalysts and the background of the use of catalysts in research and industry.</li> <li>2. Students are able to describe the types of catalysts.</li> <li>3. Students are able to describe the requirements for a material to be a catalyst.</li> <li>4. Students are able to describe heterogeneous catalysts.</li> <li>5. Students are able to describe acid sites and the acidity of catalysts.</li> <li>6. Students are able to describe homogeneous catalysts.</li> <li>7. Students are able to describe the reaction principles in acid-base catalysts.</li> <li>8. Students are able to analyze the reaction principles in initiator radical and metal ion catalysts.</li> <li>9. Students are able to describe the reaction principles in enzymes as homogeneous catalysts.</li> </ol>
<b>Content</b>	This course discusses the definition of catalysts and the background of the use of catalysts in research and industry; types of catalysts; the requirements of a material as a catalyst; heterogeneous catalysts; acid sites and catalyst acidity; homogeneous catalysts; reaction principles on acid-base catalysts; reaction principles on radical initiator and metal

	ion catalysts; and reaction principles on enzymes as homogeneous catalysts.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Julian R.H. Ross. 2012. Heterogeneous Catalysis: Fundamentals and Applications. Elsevier</li> <li>S.K. Dogra.1990. Kimia Fisik dan Soal-Soal. Penerbit universitas Indonesia. Jakarta</li> <li>Sukardjo. 2002. Kimia Fisika. Penerbit Rineka Cipta. Jakarta</li> <li>Triyono. 2000. Kimia Katalis. Jurusan Kimia FMIPA UGM. Yogyakarta</li> <li>Atkins, 2010. Atkins Inorganic Chemistry, Oxford University Press, New York</li> </ol>																								

## 78. Renewable Energy

<b>Module designation</b>	<b>Renewable Energy</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Rahmat Gunawan, M.Si Dr. RR. Dirgarini Julia NS., M.Sc
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Phase System
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to analyze the basic concepts of energy and conventional energy sources (fossil fuels).</li> <li>2. Students are able to describe the basic concepts of the laws of thermodynamics.</li> <li>3. Students are able to recognize and understand the description of hydrogen production and storage and its catalytic processes.</li> <li>4. Students are able to recognize and understand the description of Fuel Cells</li> <li>5. Students are able to recognize and understand to analyze the use of solar energy, solar cells, and various components used in energy production related to its applications.</li> <li>6. Students are able to recognize and understand the description of biomass energy sources, thermochemical processes, and biochemical processes to produce energy. Analyzing the use of solar energy, solar cells, and various components used in energy production related to applications of nuclear energy.</li> <li>7. Students are able to recognize and understand nuclear energy.</li> </ol>
<b>Content</b>	This course discusses the basic concepts of energy and conventional energy sources (fossil fuels); basic concepts about the laws of thermodynamics; hydrogen production and storage and its catalytic

	process; Fuel Cells; the use of solar energy, solar cells and various components used in energy production in connection with their applications; the concept of biomass energy sources, thermochemical processes and biochemical processes to produce energy; and nuclear energy.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Indonesian Journal of Science and Technology</li> <li>Environment Technology Monitoring Management</li> <li>American Chemical Society</li> <li>Subagyono, R.R.D.J.N, Masdalifa, W, Aminah, S., Nugroho, R.A., Mollah, M., Allo, V.A., Gunawan, R., 2021, Kinetic Study of Copyrolysis of the Green Microalgae Botryococcus braunii and Victorian Brown Coal by Thermogravimetric Analysis, ACS Omega, 6, 32032–32042.</li> </ol>																								

## 79. Solid State Chemistry

<b>Module designation</b>	<b>Solid State Chemistry</b>							
<b>Semester(s) in which the module is taught</b>	VI							
<b>Person responsible for the module</b>	Dr. RR. Dirgarini Julia NS., M.Sc Veliyana Londong Allo, S.Si., M.Si							
<b>Language</b>	Indonesian							
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>							
<b>Teaching methods</b>	Lecture, discussion, assignment, final project							
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester							
<b>Credit points</b>	2 credits / 3.18 ECTS							
<b>Required and recommended prerequisites for joining the module</b>	Chemical Phase System							
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the basic concepts of astrochemistry.</li> <li>2. Students are able to analyze the concept of chemical evolution.</li> <li>3. Students are able to describe fusion reactions in supernovae and black holes.</li> <li>4. Students are able to describe the chemistry in planetary nebulae and supernova nebulae.</li> <li>5. Students are able to analyze the chemistry of Earth's atmosphere.</li> <li>6. Students are able to describe ionization reactions in Earth's atmosphere.</li> <li>7. Students are able to analyze ozone chemistry.</li> <li>8. Students are able to describe the atmospheric chemistry of planets in the solar system.</li> </ol>							
<b>Content</b>	This course discusses the basic concepts of solids; Molecular Interactions in Solids; the concept of Simple Crystal Structures; Crystalline Solids; the concept of X-ray Diffraction; Crystal Damage; solid solutions; the concept of Phase Diagrams and Thermal Analysis; solid preparation methods; Solid Characterization Techniques; Optical Properties of Solids; and Magnetic Properties of Solids.							
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> </tbody> </table>		Interval	Number	Letter	$0 \leq FG < 40$	0.0	E
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	$50 \leq FG < 60$	1.5	
	$60 \leq FG < 65$	2.0	C
	$65 \leq FG < 70$	2.5	
	$70 \leq FG < 75$	3.0	B
	$75 \leq FG < 80$	3.5	
	$80 \leq FG \leq 100$	4.0	A
<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>		
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. A.R. West. 1989. Solid State Chemistry and Its Application. John Wiley and Sons. New York</li> <li>2. D.R. Askeland. 2006. The Science and Engineering of Material. Thomson. Toronto</li> <li>3. Henri Alloul. 2011. Introduction to the Physics of Electron in Solids. Springer. New York</li> <li>4. James E. Brady.2011. Chemistry. John Wiley and Sons. New York</li> </ol>		

## 80. Capita Selecta in Physical Chemistry

<b>Module designation</b>	<b>Capita Selecta in Physical Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Veliyana Londong Allo, S.Si., M.Si Dr. RR. Dirgarini Julia NS., M.Sc
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the scope of physical chemistry capstone and basic concepts of physical chemistry in the development of physical chemistry research.</li> <li>2. Students are able to describe Specific Topic 1.</li> <li>3. Students are able to describe Specific Topic 2.</li> <li>4. Students are able to analyze the basic theory of physical chemistry and research techniques in physical chemistry based on the journal presented.</li> <li>5. Students are able to describe Specific Topic 3.</li> <li>6. Students are able to describe Specific Topic 4.</li> <li>7. Students are able to design simple physical chemistry research.</li> <li>8. Students are able to describe the basic theory of physical chemistry and biochemistry research techniques in the research design created in the previous meeting.</li> </ol>

<b>Content</b>	This course discusses the scope of the capita selecta of physical chemistry and the basic concepts of Physical Chemistry in the development of Physical Chemistry research; theoretical basis of Physical Chemistry and Physical Chemistry research techniques in journals; simple Physical Chemistry research design; and theoretical basis of Physical Chemistry and Biochemistry research techniques in research design.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 645 1385 949"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Indonesian Journal of Science and Technology</li> <li>2. Environment Technology Monitoring Management</li> <li>3. American Chemical Society</li> <li>4. Subagyono, R.R.D.J.N, Masdalifa, W, Aminah, S., Nugroho, R.A., Mollah, M., Allo, V.A., Gunawan, R., 2021, Kinetic Study of Copyrolysis of the Green Microalgae Botryococcus braunii and Victorian Brown Coal by Thermogravimetric Analysis, ACS Omega, 6, 32032–32042.</li> </ol>																								

## 81. Computational Chemistry

<b>Module designation</b>	<b>Computational Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Rahmat Gunawan, M.Si Veliyana Londong Allo, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Bonding and Structures
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the history and applications of computational chemistry.</li> <li>2. Students are able to analyze the application of the Schrödinger equation computed by a computer.</li> <li>3. Students are able to describe the level of accuracy of calculations (level of theory): Molecular mechanics.</li> <li>4. Students are able to describe the level of accuracy of calculations (level of theory): Semi-empiric.</li> <li>5. Students are able to describe the concept of the level of accuracy of calculations (level of theory): ab initio.</li> <li>6. Students are able to describe the concept of the level of accuracy of calculations (level of theory): density functional theory.</li> <li>7. Students are able to describe applications of computational chemistry: chemical reaction mechanisms.</li> <li>8. Students are able to describe the calculation of potential energy surfaces.</li> <li>9. Students are able to describe the calculation of potential energy surfaces.</li> <li>10. Students are able to describe the calculations related to drug design and QSAR.</li> <li>11. Students are able to analyze molecular docking.</li> <li>12. Students are able to describe the scanning tunneling effect.</li> <li>13. Students are able to describe nano molecules.</li> <li>14. Students are able to describe interactions between molecules.</li> </ol>
<b>Content</b>	This course discusses the History and Applications of computational chemistry; applications of the Schrodinger equation calculated by computer; levels of calculation accuracy (level of theory): Molecular

	mechanics, Semi empirical, ab initio, and density functional theory; applications of computational chemistry: chemical reaction mechanisms; potential energy surface calculations; surface reaction calculations; drug design and QSAR calculations; molecular docking; scanning tunneling effect; nano molecules; and interactions between molecules.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Ralph A. Wheeler, <i>Annual Reports in Computational Chemistry</i>. ISBN: 9780444626721, Elsevier, Amsterdam, 2013</li> <li>David A. Dixon, <i>Annual Report in Computational Chemistry</i>, ISBN: 9780444637147, Elsevier, Amsterdam, 2016</li> <li>Jerzy Leszczynski, <i>Challenges and Advances in Computational Chemistry and Physics</i>, ISBN 9783319290201, Springer, 2017</li> <li>Allo,V.L., Farhanah, G.E., Gunawan, R., 2022. In silico analysis of flavonol compounds against Mpro COVID19, <i>AIP Conf. Proc.</i> 2668, 030005.</li> </ol>																								

## 82. Molecular Reaction Dynamics

<b>Module designation</b>	<b>Molecular Reaction Dynamics</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Rahmat Gunawan, M.Si Dr. Abdul Aziz, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Kinetics
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the definition and introduction to Molecular Reaction Dynamics.</li> <li>2. Students are able to describe Microscopic to Macroscopic.</li> <li>3. Students are able to analyze potential energy surfaces.</li> <li>4. Students are able to describe bimolecular reactions and the dynamics of Reactive collisions.</li> <li>5. Students are able to describe reaction rate constants and reactive flux.</li> <li>6. Students are able to analyze transition state theory.</li> <li>7. Students are able to analyze unimolecular reactions.</li> <li>8. Students are able to describe Arrhenius parameters in microscopic interpretation.</li> <li>9. Students are able to describe the introduction to condensed phase dynamics.</li> <li>10. Students are able to describe the introduction to condensed phase dynamics.</li> <li>11. Students are able to describe static solvent effects, transition state theory.</li> <li>12. Students are able to describe dynamic solvent effects</li> <li>13. Students are able to describe Kramers theory.</li> </ol>
<b>Content</b>	This course discusses the definition and introduction of Molecular Reaction dynamics; Microscopic to Macroscopic; potential energy surfaces; bimolecular reactions and Reactive collision dynamics; reaction rate constants and reactive fluxes; transition state theory; unimolecular reactions; Arrhenius parameters on microscopic interpretations; introduction to condensed phase dynamics: transition state theory; dynamic solvent effects; and Kramers theory.

<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1385 723"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Theories of Molecular Reaction Dynamics (Niels E. Henriksen and Flemming Y. Hansen)</li> <li>Molecular Reaction Dynamics (Raphael D. Levine)</li> <li>Molecular Reaction Dynamics in Gases, Liquids and Interfaces (Royal Society of Chemistry )</li> </ol>																								

### 83. Inorganic Reaction Mechanisms

<b>Module designation</b>	<b>Inorganic Reaction Mechanisms</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Husna Syaima, S.Si., M.Si Irfan Ashari Hiyahara, S.Pd., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds, Principle In Inorganic Reaction, Coordination Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the nomenclature of complex compounds</li> <li>2. Students are able to understand and explain the stereochemistry of transition metals</li> <li>3. Students are able to understand and explain the structural isomers of transition/complex compounds</li> <li>4. Students are able to explain the reactions of complex compounds</li> <li>5. Students are able to explain and understand substitution reactions and reaction kinetics</li> <li>6. Students are able to explain the determination of oxidation reactions of complex compounds</li> <li>7. Students are able to explain Redox Processes and Reactions between Two Complexes Electron-Transfer Reactions</li> </ol>
<b>Content</b>	This course discusses the nomenclature of complex compounds; stereochemistry of transition metals; structural isomers of transition/complex compounds; reactions of complex compounds; substitution reactions and reaction kinetics; oxidation reactions of complex compounds; and Redox Processes and Reactions between Two Complexes Electron-Transfer Reactions.
<b>Examination forms</b>	Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%). The final grade (FG) for each student is calculated by the formula :

	$FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 286 1385 591"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Stephen J. Inorganic Reaction Mechanisms Progress In Inorganic Chemistry Volume 13. Department Of Chemistry, Columbia University, New York, New York. Interscience Publishers A Division Of John Wiley &amp; Sons</li> <li>Douglas, 1983. Concept and models of inorganic chemistry. New York: John Wiley&amp;Sons</li> <li>Raffaello Romeo. INORGANIC AND BIO-INORGANIC CHEMISTRY – Vol. II - Inorganic Reaction Mechanisms –</li> <li>D. F. Shriver, P. W. Atkins and C. H. Langford, Inorganic Chemistry 2nd edn. Oxford Chapter.15, p.559, (1994).</li> <li>D. Benson Mechanism of Inorganic Reactions in Solution – An Introduction, McGraw – Hill Chapter.15, p.465, (1968).</li> </ol>																								

## 84. Inorganic Chemistry: Structure and reactivity

<b>Module designation</b>	<b>Inorganic Chemistry: Structure and reactivity</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Irfan Ashari Hiyahara, S.Pd., M.Si Husna Syaima, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds, Principle In Inorganic Reaction, Coordination Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain and understand Molecular symmetry and group theory</li> <li>2. Students are able to explain the determination of point groups of molecules, using symmetry studies in chemistry</li> <li>3. Students are able to understand and explain the structure of coordination compounds with certain coordination numbers and the factors that cause them</li> <li>4. Students are able to explain back bonds and their identification based on infrared spectroscopy evidence</li> <li>5. Students are able to explain back bonds and their identification based on crystallographic evidence,</li> <li>6. Students are able to understand and explain infrared spectroscopy of coordination compounds</li> <li>7. Students are able to understand and explain the synthesis and reactions of coordination compounds</li> <li>8. Students are able to understand and explain the kinetics of coordination compounds</li> <li>9. Students are able to understand and explain the uses of coordination compounds</li> </ol>
<b>Content</b>	This course discusses Molecular symmetry, group theory, determination of molecular point groups, symmetry studies in chemistry, the structure of coordination compounds with certain coordination numbers and their causal factors, reverse bonding and its

	identification based on infrared spectroscopic evidence, reverse bonding and its identification based on crystallographic evidence, infrared spectroscopy of coordination compounds, synthesis and reactions of coordination compounds, kinetics of coordination compounds, and uses of coordination compounds.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Cotton, F.A dan Wilkinson, G, 1989, <i>Kimia Anorganik Dasar</i>, UI-Press, Jakarta.</li> <li>Douglas, 1983. <i>Concept and models of inorganic chemistry</i>. New York: John Wiley&amp;SONs</li> <li>Shriver, D.F., Atkins, P.W and Langford, C.H, 1989, <i>Inorganic Chemistry</i>, Oxford University Press, London.</li> <li>Huheey, J.E., J.E, Keiter, E.A., &amp;Keiter, K.L. 1994. <i>Inorganic Chemistry, Principles of Structure and Reactivity, 4<sup>th</sup> Ed</i>. New York: Harper Collins College Publisher.</li> <li>Kettle, S.F.A. 1996. <i>Physical Inorganic Chemistry, A Coordination Approach</i>. Oxford: Spektrum Academic Publishers.</li> <li>Lee, J.D. 1991. <i>Concise Inorganic Chemistry, 4<sup>th</sup> Ed</i>. London: Chapman and Hall.</li> <li>Miessler, G. L., Fischer, P. J., &amp; Tarr, D.A. 2014. <i>Inorganic Chemistry 5<sup>th</sup> Ed</i>. New Jersey: Pearson Education, Inc.</li> <li>Wells, A.F. 1975. <i>Structural Inorganic Chemistry, 4<sup>th</sup> Ed</i>. London: Oxford University Press.</li> </ol>																								

## 85. Capita Selecta in Inorganic Chemistry

<b>Module designation</b>	<b>Capita Selecta in Inorganic Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Noor Hindryawati, M.Si Irfan Ashari Hiyahara, S.Pd., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds, Principle In Inorganic Reaction, Coordination Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 6: Able to collaborate in building professional networks in chemistry, across disciplines, and entrepreneurship, as well as demonstrating leadership attitude and a sense of responsibility.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the concepts of porous material research topics (Metal-Organic Frameworks (MOF) and PCPs (Porous Coordination Polymers), zeolites, graphene, carbon nanotubes,</li> <li>2. Students are able to explain the concepts of Metalloenzymes and Medical Inorganic Chemistry research topics</li> <li>3. Students are able to explain the concepts of Coordination Chemistry research topics (Ligand controlled structure, spectroscopy and oxidation reactions)</li> <li>4. Students are able to explain the concepts of Ionic liquid research topics</li> <li>5. Students are able to explain the concepts of Green Chemistry research topics in the formation of nanoparticles</li> <li>6. Students are able to explain the concepts of Composite Material research topics</li> <li>7. Students are able to explain the concepts of Industrial Inorganic Chemistry research topics (material development, energy production, energy storage or consumer products and applications in modern electronic devices such as solar cells and batteries)</li> </ol>

	8. Students are able to explain the concepts of Crystal Structure and Superconductor Properties research topics																								
<b>Content</b>	This course discusses porous materials research topics; Metalloenzymes and Medical Inorganic Chemistry; Coordination Chemistry; Ionic liquids; Green chemistry in nanoparticle formation; Composite Materials; Industrial Inorganic Chemistry; and Crystal structure and superconductive properties.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam, FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="3">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> <td>B</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	$75 \leq FG < 80$	3.5	B	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<p>National and international journals related to topics that are recent trends in inorganic chemistry research</p> <ol style="list-style-type: none"> <li>Porous materials (Metal-Organic Frameworks (MOF) and PCPs (Porous Coordination Polymers), zeolites, graphene, carbon nanotubes)</li> <li>Metalloenzymes and Medical Inorganic Chemistry</li> <li>Coordination Chemistry (Ligand controlled structure, spectroscopy and oxidation reactions)</li> <li>Ionic liquid</li> <li>Green chemistry in the formation of nanoparticles,</li> <li>Composite Materials</li> <li>Industrial Inorganic Chemistry (material development, energy generation, energy storage or consumer products and applications in modern electronic devices such as solar cells, batteries, dyes)</li> <li>Crystal structure and properties of superconductors.</li> </ol>																								

## 86. Bio-Inorganic Chemistry

<b>Module designation</b>	<b>Bioinorganic Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	1. Husna Syaima, S.Si, M.Si 2. Rita Hairani, M.S., Ph.D
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds, Principle In Inorganic Reaction, Coordination Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the contents of the lecture contract and explain the definition and history of the development of Bioinorganic Chemistry</li> <li>2. Students are able to describe the various elements found in living things</li> <li>3. Students are able to understand and describe the central atom, the stability of complex ions/compounds and crystal field theory and the formation of phi bonds</li> <li>4. Students are able to describe molecular metabolism</li> <li>5. Students are able to explain the transformation of cell membranes and transition metals</li> <li>6. Students are able to describe Proteins (Enzymes) and reduction-oxidation reactions</li> </ol>
<b>Content</b>	This course discusses the history of the development of bioanorganic chemistry; elements present in the bodies of living things; central atoms, stability of ions/complex compounds and crystal field theory as well as the formation of phi bonds; molecular metabolism; cell membrane transformation and transition metals; and proteins (enzymes) and oxidation-reduction reactions.
<b>Examination forms</b>	Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).

	<p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 320 1385 622"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Cotton, F.A dan Wilkinson, G, 1989, <i>Kimia Anorganik Dasar</i>, UI-Press, Jakarta.</li> <li>Kaim, Wolfgang and Schwederski, B, 1994, <i>Bio Inorganic Chemistry: Inorganic Element in the Chemistry of Life</i>, John Wiley &amp; Sons, Chichester</li> </ol>																								

## 87. Organometal

<b>Module designation</b>	<b>Organometal</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	1. Irfan Ashari Hiyahara M.Si 2. Rita Hairani, M.Sc., Ph.D
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Element, Structural In Inorganic Compounds, Principle In Inorganic Reactions, Coordination Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the definition, history and scope of organometallics and analyze their relationship to other fields of science</li> <li>2. Students are able to analyze and explain the structure and tendency of the types of bonds formed in Organometallic compounds</li> <li>3. Students are able to explain and analyze the basic concepts of ligands involved in the formation of organometallic compounds</li> <li>4. Students are able to analyze and explain the structure and bonds in alkene complexes: case studies</li> <li>5. Students are able to explain and analyze the concept of reactivity of organic compounds versus organometallics.</li> <li>6. Students are able to analyze and explain the types of reactions for organometallic compounds and their reaction mechanisms.</li> <li>7. Students are able to explain the types of organometallic compounds</li> </ol>
<b>Content</b>	This course discusses the definition, history and scope of organometallic and its relationship with other fields of science; structure and tendency of bond types formed in Organometallic compounds; basic concepts of ligands involved in the formation of organometallic compounds; structure and bonding in alkene complexes; the concept of reactivity of organic compounds versus organometallic; reaction types for organometallic compounds and their reaction mechanisms; and types of organometallic compounds.

<p><b>Examination forms</b></p>	<p>Assessment is carried out based on Quiz, Q (10%); Mid Exam, ME (10%); Final Exam , FE (20%); Project (25%); Case Study, CS (25%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1383 723"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<p><b>Study and examination requirements</b></p>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<p><b>Reading list</b></p>	<ol style="list-style-type: none"> <li>Robert H. Crabtree. 2014. The Organometallic Chemistry of the Transition Metal, 6<sup>th</sup> Ed.</li> <li>Gupta BD, Elias AJ. 2013. Basic Organometallic Chemistry. 2<sup>nd</sup> Ed. University Press.</li> <li>Collman JP, Hegedus LS, Norton JR, and Finke RG. 1987. Principles and Applications of Organotransition Metal Chemistry. USA: University Science Books.</li> <li>Cotton and Wilkinson. 1989. Kimia Anorganik Dasar. Jakarta: Penerbit UI Press.</li> <li>Sukardjo. 1985. Kimia Koordinasi. Jakarta: Penerbit PT. Bina Aksara.</li> </ol>																								

## 88. Trace Analysis

<b>Module designation</b>	<b>Trace Analysis</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Soerja Koesnarpadi, M.Si Nanang Tri Widodo, S.Si, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Instrumentation Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8 : Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Able to describe trace element analysis</li> <li>2. Able to describe the process of sample preparation, deconstruction, and preconcentration techniques</li> <li>3. Able to analyze the process of separation and detection to measurement with instrumentation tools.</li> <li>4. Able to describe Trace elemental in soil, water and air</li> <li>5. Able to analyze literature studies and journal references related to the analysis of trace compounds.</li> <li>6. Able to describe trace compound analysis techniques</li> <li>7. Able to describe FIA (Flow injection analysis).</li> <li>8. Able to explain the development of hydride generation method for the analysis of Hg, As, Se, Sb, Cr and Sn ions.</li> <li>9. Able to analyze literature and reference studies related to the analysis of runut compounds using FIA or hydride generation method.</li> </ol>
<b>Content</b>	This course discusses the importance of trace element analysis; differences in trace speciation analysis; sample preparation process; preconcentration techniques; instrumentation tools used for separation; instrumentation tools used for detection to measurement; Tandem technique and Hypend technique; heavy metal trace analysis techniques; pesticide runoff analysis techniques; runoff analysis

	techniques for other organic contaminants such as preservatives and colorants; runoff analysis techniques that include the use of HPLC instrumentation, gas chromatography, AAS, UV-Vis spectro, preconcentration techniques for metal ions based on flow injection analysis (FIA); hydride generation methods; and development of generation methods for the analysis of Hg, As, Se, Sb, Cr, and Sn.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Fritz J.S., &amp; Schenk, G.H., 1979, <i>Quantitative Analytical Chemistry</i>, 4<sup>th</sup> ed., Allyn and Bacon Inc., Boston</li> <li>Harjadi, W., 1985, <i>Ilmu Kimia Analitik Dasar</i>, PT. Gramedia, Jakarta</li> <li>Khopkar, S.M., 1990, <i>Konsep Dasar Kimia Analitik</i>, UI-Press, Jakarta</li> <li>Skoog, D.A., West, D.M., &amp; Holler F.J., 1994, <i>Analytical Chemistry</i>, sixth edition, Saunders College Publishing, Tokyo</li> <li>Underwood, D., 1981, <i>Analisis Kimia Kuantitatif</i>, Erlangga, Jakarta</li> </ol>																								

## 89. Specific Analysis

<b>Module designation</b>	<b>Specific Analysis</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Drs. Alimuddin, M.Si Ika Yekti Liana Sari, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Instrumentation chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8 : Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the limitations, special analysis and environmental problems and identification of pollutants.</li> <li>2. Students are able to describe the special analysis of Hg using CV-AAS.</li> <li>3. Students are able to describe the speciation analysis of Hg using GC-CVAAS,</li> <li>4. Students are able to describe the special analysis of Arsenic using HGAAS,</li> <li>5. Students are able to describe arsenic speciation analysis using GC-HGAAS</li> <li>6. Students are able to describe the special analysis of Selenium using Fi-MW-HGAAS</li> <li>7. Students are able to describe particulate Pb and Cd in air FAAS</li> <li>8. Students are able to describe the analysis of CO<sub>2</sub>, O<sub>2</sub>, CO using the Orsat method.</li> <li>9. Students are able to describe the analysis of air contaminants using near IR.</li> <li>10. Students are able to describe the analysis using GC with a special detector.</li> <li>11. Students are able to describe the analysis of organic compounds using GC with FID and FPD detectors.</li> </ol>

	<p>12. Students are able to describe the analysis of SO<sub>2</sub> in air using Coulometric Titration</p> <p>13. Students are able to describe the analysis of electrochemical sensors based on potentiometry</p> <p>14. Students are able to describe particle analysis using PSA and microscopy</p>																								
<b>Content</b>	<p>This course discusses the identification of pollutants; Hg analysis using CV-AAS; Hg speciation analysis using GC-CVAAS; Arsenic analysis using HGAAS; Arsenic speciation analysis using GC-HGAAS; Selenium analysis using Fi-MW-HGAAS; analysis of particulate Pb and Cd in FAAS air; Analysis of air contaminants using near IR; Analysis using GC with special detectors and analysis of organic compounds using GC ECD detectors; Analysis of organic compounds using GC FTD and FPD detectors; analysis of SO<sub>2</sub> in air using Coulometric Titration; potentiometry-based electrochemical sensor analysis; and particle analysis using PSA and microscopy.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Skoog, D.A., 1984, Principles of Instrumental Analysis, Sounders Golden Sunburst Series, Philadelphia</li> <li>Gallay, W., Egan, H., Monkman, J.L., Truhuat, R., West, P.W., Widmark. G., 1975. Environmental Pollutants-Selected Analytical Methods, SCOPE (Scientific Commite on Problems of The Enviroment). Butterworth-London.</li> <li>Donald A. Burns and Emil W. Ciurczak, 2008, Handbook of Near-Infrared Analysis, Third Edition, CRC Press, Taylor &amp; Francis Group, Boca Raton-London-New York</li> </ol>																								

## 90. Analysis of Pollution Control

<b>Module designation</b>	<b>Pollution Analysis and Control</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Prof. Dr. Ir. Bohari, M.Si Dr. Soerja Koesnarpadi, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / elective / specialisation
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Chemical Instrumentation
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 4 : Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the limits, problems, types, and sources of environmental pollution.</li> <li>2. Students are able to describe the main types and classifications of pollutants, as well as the routes of pollutants into the environment,</li> <li>3. Students are able to describe the emission and transport of pollutants, interaction and fate of pollutants in the environment,</li> <li>4. Students are able to describe the limits, types, and characteristics of bioindicators and biomarkers.</li> <li>5. Students are able to analyze the effects of pollutants on organisms, as well as the criteria and potential, use of bioindicators.</li> <li>6. Students are able to describe water pollution and the transfer of pollutants through the food chain</li> <li>7. Students are able to describe the purpose and methods of physical, chemical, and biological water quality measurements</li> <li>8. Students are able to describe soil pollution and transfer of contaminants in the food chain.</li> <li>9. Students are able to analyze air pollution and global atmospheric changes.</li> <li>10. Students are able to describe toxicity testing of contaminants.</li> </ol>

	<ol style="list-style-type: none"> <li>11. Students are able to analyze the pollution index.</li> <li>12. Students are able to describe various efforts to control and mitigate the effects of water pollution.</li> <li>13. Students are able to describe various efforts to control and mitigate the effects of soil pollution.</li> <li>14. Students are able to describe various efforts to control and overcome the effects of air pollution.</li> </ol>																								
<b>Content</b>	This course discusses the classification and routes of pollutants; emission, transport, and interaction of pollutants; bioindicators and biomarkers; effects of pollutants on organisms; criteria and applications of bioindicators; water pollution (definition, types and fate of pollutants in ecosystems, and transfer of pollutants through the food chain); water quality testing; soil pollution and transfer of pollutants in the food chain; air pollution and global atmospheric changes; pollution index (limitations, uses, calculations); water pollution control; soil pollution control; and air pollution control.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Machdar I. 2018. Pengantar Pengendalian Pencemaran. Deepublish.</li> <li>2. Hocking, M.B. 2005. Handbook of Chemical Technology and Pollution Control. Academic Press.</li> <li>3. Peirce, J.J., P.A. Vesilind and R. Weiner. 1997. Environmental Pollution and Control. Butterworth-Heinemann.</li> <li>4. Connell, D.W., dan G.J. Miller, 1995, Kimia dan Ekotoksikologi Pencemaran (terjemahan), Jakarta, Penerbit UI Press.</li> </ol>																								

## 91. Validation Methods

<b>Module designation</b>	<b>Validation Methods</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Drs. Alimuddin, M.Si Moh. Syaiful Arif, S.Pd., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Instrumentation Chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8 : Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe Data Analysis and Data Classification in Method Validation</li> <li>2. Students are able to describe Correlation Analysis and Anova Analysis</li> <li>3. Students are able to describe F Test and t Test.</li> <li>4. Students are able to describe Regression Analysis on Spectrophotometric Data Collection</li> <li>5. Students are able to describe Regression Analysis on Chromatography Data Retrieval</li> <li>6. Students are able to describe Regression Analysis in Electrometry Data Retrieval</li> <li>7. Students are able to analyze Calibration curves</li> <li>8. Students are able to compare validation and Verification</li> <li>9. Students are able to describe the difference between Precision and Accuracy</li> <li>10. Students are able to describe Linearity and Working Area</li> <li>11. Students are able to analyze Limit of Detection (LOD) and Limit of Quantization (LOQ)</li> <li>12. Students are able to describe Ruggedness and Robustness of Test Methods</li> </ol>

	13. Students are able to analyze Estimation of Measurement Uncertainty																								
<b>Content</b>	This course discusses Data Analysis and Data Classification in Method Validation; Correlation Analysis and Anova Analysis; F Test and t Test; Regression Analysis on Spectrophotometric Data Collection; Regression Analysis on Chromatographic Data Collection; Regression Analysis on Electrometric Data Collection; Calibration Curves; Validation and Verification; Precision and Accuracy; Linearity and Working Area; Limit of Detection (LOD) and Limit of Quantization (LOQ); Ruggedness and Robustness of Test Methods; and Measurement Uncertainty.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) ; Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="3">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> <td>B</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	$75 \leq FG < 80$	3.5	B	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Data Analysis for The Chemical Sciences, Edited: Richard C Graham. Penerbit VCH. New York, 1993.</li> <li>2. Statistik Untuk Kimia Analitik, Miller dan Miller. Penerbit ITB Bandung.</li> <li>3. Validasi Metode untuk Kimia, Penulis: Gunawan Indrayanto, Penerbit: Airlangga University Press, 2000.</li> <li>4. Validasi dan Verifikasi Metode Uji, Riyanto, Penerbit Deepublish, Yogyakarta, 2014.</li> </ol>																								

## 92. Capita Selecta in Analytical Chemistry

<b>Module designation</b>	<b>Capita Selecta in Analytical Chemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Ika Yekti Liana Sari, S.Si., M.Si Moh. Syaiful Arif, S.Pd., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5 : Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8 : Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the lectures on analytical chemistry capita selecta</li> <li>2. Students are able to describe the synthesis process and properties of silver and gold nanoparticles</li> <li>3. Students are able to analyze the properties of gold and silver nanoparticles as colorimetric detection</li> <li>4. Students are able to analyze the properties of gold and silver nanoparticles as drug delivery 4.</li> <li>5. Students are able to describe the modification of nanoparticle synthesis as a crosslink agent in histamine and antibiotic detection 6.</li> <li>6. Students are able to analyze the use of complexing agents as detection by UV-Vis spectrophotometry</li> <li>7. Students are able to describe the principles of Molecular Imprinted polymer (MIP), the function of MIP, and how to make it</li> </ol>

	<p>8. Students are able to describe the electrochemical detection of uric acid (potentiometry), the manufacture of ion selective electrodes</p> <p>9. Students are able to analyze the use of modern instruments as analysis.</p> <p>10. Students are able to describe flue gas analysis using ORSAT instrument</p>																								
<b>Content</b>	<p>This course discusses the Synthesis of silver and gold, Properties of silver and gold nanoparticles, Gold and silver nanoparticles as colorimetric detection, Gold and silver nanoparticles as drug delivery, Nanoparticle modification, Complexing agents as UV-Vis spectrophotometric detection, Molecular Imprinted polymer (MIP), Electrochemical uric acid detection (potentiometry), manufacture of ion selective electrodes, Use of modern instruments as analysis, and Exhaust gas analysis using ORSAT instruments.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	-																								

### 93. Advanced Chemical Instrumentation

<b>Module designation</b>	<b>Advanced Chemical Instrumentation</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Prof. Dr. Bohari, M.Si Prof. Dr. Aman Sentosa Panggabean, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Instrumentation chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8 : Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the basic principles of tandem/hyphen technique instruments.</li> <li>2. Students are able to describe the basic principles of flow injection analysis instruments.</li> <li>3. Students are able to describe hydride generation instrument techniques</li> <li>4. Students are able to describe the basic concepts of membrane-based electro ionic separation</li> <li>5. Students are able to analyze the application of chemical instruments.</li> <li>6. Students are able to describe the basic principles of ICP-AES spectrometry</li> <li>7. Students are able to describe the basic principles of ICP-MS Spectrometry</li> <li>8. Students are able to describe the basic principles of XRD spectrometry</li> <li>9. Students are able to describe the basic principles of fluorescence spectroscopy</li> </ol>

	<p>10. Students are able to describe the basic principles of scanning electron microscope (SEM) and transmission electron microscope (TEM).</p> <p>11. Students are able to describe the basic principles of raman spectroscopy</p>																								
<b>Content</b>	<p>This course discusses the basic principles of tandem/hyphen technique instruments; basic principles of flow injection analysis instruments; hydride generation instrument techniques; basic concepts of membrane-based electro ionic separation; application of chemical instrument applications; basic principles of ICP-AES spectrometry; basic principles of ICP-MS Spectrometry; basic principles of XRD spectrometry; basic principles of fluorescence spectroscopy; basic principles of SEM and TEM; and basic principles of raman spectroscopy.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Skoog, D.A., 1985, Principle of Instrumental Analysis, 3<sup>rd</sup>Ed., Philadelphia: Saunders Golden Sunburst Series</li> <li>Christian, G.D., 1994, Analytical Chemistry, 5<sup>th</sup> Ed., New York: John Wiley&amp; Sons.</li> <li>Pecsok R.L., and Shields, L.D., 1976, Modern Methods of Chemical Analysis, New York: John Wiley &amp; Sons.</li> </ol>																								

## 94. Electroanalysis

<b>Module designation</b>	<b>Electroanalysis</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Drs. Alimuddin, M.Si Ika Yekti Liana Sari, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Instrumentation chemistry
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2 : Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 7 : Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8 : Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to describe the meaning of electroanalysis</li> <li>2. Students are able to analyze the basic principles of electroanalysis</li> <li>3. Students are able to describe electrodes</li> <li>4. Students are able to describe the basic principles and applications of pH meters</li> <li>5. Students are able to describe the basic principles and applications of Potentiometry</li> <li>6. Students are able to analyze Potentiometry Literature and Reference Studies</li> <li>7. Students are able to describe the basic principles of Volumetry.</li> <li>8. Students are able to describe Electrogravimetry.</li> <li>9. Students are able to describe the basic principles of Voltammetry</li> <li>10. Students are able to describe the basic principles of Amperometric Titration</li> <li>11. Students are able to describe the basic principles of Electrode Selective Ion (ESI)</li> <li>12. Students are able to describe the basic principles of Membranes and sensors</li> </ol>

	13. Students are able to analyze the literature study on ESI and Membrane																								
<b>Content</b>	This course discusses the definition of electroanalysis, basic principles of electroanalysis, Electrodes, basic principles and applications of pH meters, basic principles and applications of Potentiometry, basic principles of Coulometry, Electrogravimetry, basic principles of Voltammetry, basic principles of Amperometric Titration, basic principles of Ion Selective Electrodes (ESI), and basic principles of Membranes and sensors.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) ; Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Bockris, I. O. M., 2008, <i>Electrochemical Sciences</i>, Taylor &amp; Francis Ltd, London.</li> <li>Edmonds. 1995. <i>Chemical Sensor</i>. John Willey and Sons. New York.</li> <li>Harris, D. 1986. <i>Quantitative Chemical Analysis Second Edition</i>. International Student Edition. China.</li> </ol>																								

## 95. Medicinal Biochemistry

<b>Module designation</b>	<b>Medicinal Biochemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	1. Ritbey Ruga, M.P., Ph.D 2. Djihan Ryn Pratiwi, S.Si, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and fuction of biomolecules, Motabolism and genetic information
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO-8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to understand the contents of the lecture contract and an introduction to the history and scope of medicinal biochemistry and its relationship to the field of science</li> <li>2. Students are able to understand the character of the atoms that make up drug compounds, physical and chemical properties, electronegativity, polarity, dipole moments and their relationship to the reactivity of drug compounds</li> <li>3. Students are able to understand the chemical bonds involved in drug interactions and the role of these bonds in biological activity</li> <li>4. Students are able to understand the relationship between structure, solubility and biological activity</li> <li>5. Students are able to understand drug-cell membrane interactions</li> <li>6. Students are able to understand a review of the anatomy and physiology of neuron cells</li> <li>7. Students are able to understand acetylcholine as a messenger in cholinergic nerves and receptors.</li> </ol>

	<ol style="list-style-type: none"> <li>8. Students are able to understand the activity of cholinergic nervous system inhibitor compounds and their use in pathological conditions, glaucoma, myasthenia gravis and Alzheimer's disease</li> <li>9. Students are able to explain the mechanism of action of antibiotic drugs</li> <li>10. Students are able to explain the mechanism of action of antidiabetic drugs</li> <li>11. Students are able to explain the mechanism of action of anticancer drugs</li> <li>12. Students are able to explain the processes of bioactivation, bioactivation and biotransformation in drug metabolism</li> <li>13. Students are able to explain the metabolic changes of drugs due to oxidation, reduction and hydrolysis reactions of drug groups</li> <li>14. Students are able to explain the conjugation, acetylation and methylation reactions of drug functional groups associated with biological activity and drug design</li> <li>15. Students are able to explain drug design</li> </ol>																								
<b>Content</b>	<p>This course discusses the history of medicinal chemistry and its relationship with other fields of science; The character of the atoms that make up the drug compound and its relationship with the chemical physical properties of the drug compound; Drug interaction with receptors through chemical bonds; Relationship between structure, solubility and biological activity Drug-cell membrane interaction; Review of neuron cell anatomy and physiology; Acetylcholine as a messenger in the cholinergic nervous system; Activity of cholinergic nervous system blocking compounds and their use in pathological conditions, glaucoma, myasthenia gravis and Alzheimer's disease; Types of antibiotics; Mechanisms of action of antibiotic, antidiabetic, and anticancer drugs; Bioactivation and biotransformation processes in drug metabolism; Drug metabolic changes due to oxidation; reduction and hydrolysis reactions of drug moieties; Conjugated, acetylation, and methylation reactions of drug moieties associated with biological activity; and Drug design.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Nogrady T, Weaver D. F, 2005, Medicinal ChemistryA Biochemical Approach, 3rd ed., Oxford University Press, New York</li> </ol>																								

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## 96. Biochemistry Research Method

<b>Module designation</b>	<b>Biochemistry Research Method</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Djihana Ryn Pratiwi, S.Si., M.Si Ritbey Ruga, M.P., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and function of biomolecules, Metabolism and genetic information
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO-8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the basic principles of biochemical research</li> <li>2. Students are able to explain the centrifugation technique</li> <li>3. Students are able to explain the spectroscopy technique</li> <li>4. Students are able to explain the separation method in biochemistry</li> <li>5. Students are able to explain the protein purification technique by adsorption and partition chromatography</li> <li>6. Students are able to explain the protein purification technique by FPLC chromatography</li> <li>7. Students are able to analyze the journal of biochemical research technique applications</li> <li>8. Students are able to explain the protein purification technique by ion exchange and affinity chromatography</li> <li>9. M Students are able to explain DNA isolation and purification</li> <li>10. Students are able to explain DNA electrophoresis</li> <li>11. Students are able to explain protein electrophoresis and zymogram</li> </ol>

	<p>12. Students are able to explain Polymerase Chain Reaction (PCR)</p> <p>13. Students are able to explain the determination of DNA sequences</p> <p>14. Analyze the journal of biochemical research technique applications</p>																								
<b>Content</b>	<p>This course discusses the basic principles of biochemical research; Centrifugation techniques; spectroscopic techniques; separation methods in biochemistry; protein purification techniques by adsorption and partition chromatography; protein purification techniques by FPLC chromatography; protein purification techniques by ion exchange and affinity chromatography; isolation and purification of DNA; DNA electrophoresis; Protein electrophoresis and Zymogram; Polymerase Chain Reaction (PCR); and; DNA sequence determination.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Brant, M., 2002, Biotechnology Laboratory Manual, 2nd ed, Department Chemistry and Biochemistry, Cal State, Fullerton</li> <li>2. Ausubel, F. M., Brent, R., Kingston, R.E., Moore, D. D., Seidman, J.G., Smith, JA., Struhl K., 2003, Current Protocols in Molecular Biology, John Wiley &amp; Sons, Inc. New York</li> <li>3. Bintang, M., 2010, Biokimia Teknik Penelitian, Penerbit Erlangga Jakarta</li> </ol>																								

## 97. Biotechnology

<b>Module designation</b>	<b>Biotechnology</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Ritbey Ruga, M.P., Ph.D Dr. Winni Astuti, M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and fuction of biomolecules, Motabolism and genetic information
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students explain the concept of biotechnology, scope and history of biotechnology development and classical biotechnology techniques</li> <li>2. Students are able to explain the principles of fermentation, types of organisms for fermentation and stages of the fermentation process</li> <li>3. Students are able to describe the types of fermentation, fermentation products and the development of fermentation technology</li> <li>4. Students are able to describe the concept of enzymes and the application of enzymes in the fermentation process, enzyme immobilization technology and its benefits and the application of enzyme biotechnology in industry</li> <li>5. Students are able to understand the basic principles, techniques and benefits of tissue culture</li> <li>6. Students are able to explain the benefits of types of biotechnology and various examples of biotechnology products</li> <li>7. Students are able to describe the contents of the presented article</li> </ol>

	<ol style="list-style-type: none"> <li>8. Students are able to understand the history of genetic engineering and describe the scope of genetic engineering and the general stages for gene cloning</li> <li>9. Students are able to explain how to obtain DNA and understand PCR, genomic libraries and cDNA</li> <li>10. Students are able to describe vectors, types of vectors, requirements for cloning vectors and expression vectors and types of cloning vectors and expression vectors</li> <li>11. Students are able to explain the types of host cells, stages of making competent host cells and host cell transformation.</li> <li>12. Students are able to describe the principles of blue and white clone selection, stages of selection and characterization of transformant clones</li> <li>13. Students are able to describe the strategy of connecting genes to expression vectors, selecting the right host cells with vectors, how to transform into expression host cells and selection of transformants carrying genes</li> </ol>																								
<b>Content</b>	<p>This course discusses Introduction to Biotechnology; Fermentation Biotechnology; Types of Fermentation and its development; Enzyme Biotechnology; Plant Biotechnology; Applications of various types of biotechnology; Introduction to Genetic Engineering; Gene Cloning; Techniques for obtaining insert DNA; Vectors; Transformation; Characterization of clones; and Gene expression.</p>																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 1245 1385 1552"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>1. Sambrook &amp; Russell. 2001. <i>Molecular Cloning: A Laboratory Manual</i>. Third Edition. Cold Spring Harbor Laboratory Press, New York</li> <li>2. Ausubel, F. M., Brent, R., Kingston, R.E., Moore, D. D., Seidman, J.G., Smith, JA., Struhl K., 2003, <i>Current Protocols in Molecular Biology</i>, John Wiley &amp; Sons, Inc. New York</li> <li>3. Dale, J. W., &amp; Park S. F., 2010, <i>Molecular Genetics of Bacteria</i>, 5th edition. John Wiley &amp; Sons, Ltd., Publication, New York</li> <li>4. Nicholl D. S. T., 2002, <i>An Introduction to Genetic Engineering</i>, 2nd Edition, Cambridge University Press, New York</li> </ol>																								

## 98. Analysis Foodstuffs

<b>Module designation</b>	<b>Analysis Foodstuffs</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Rudi Kartika, M.Si Djihhan Ryn Pratiwi, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and Function of Biomolecules
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>(PLO-3): Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>(PIO 5): Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>(PLO-8): Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the Scope of Selected Chapters in Biochemistry and Basic Concepts of Biochemistry and Development of Biochemistry</li> <li>2. Students are able to explain Specific Topic 1</li> <li>3. Students are able to explain Specific Topic 2</li> <li>4. Students are able to explain the basic theory of Biochemistry and Biochemical research techniques in the journals presented</li> <li>5. Students are able to explain Specific Topic 3</li> <li>6. Students are able to explain Specific Topic 4</li> <li>7. Students are able to design simple Biochemical research</li> <li>8. Students are able to explain the basic theory of Biochemistry and Biochemical research techniques in the research design made in the previous meeting</li> </ol>
<b>Content</b>	This course discusses how to take food samples; analyze of water content in food; analysis of ash and mineral content; analysis of carbohydrate content; analysis of protein content and nitrogenous compounds; analysis of fat/oil content; analysis of vitamin content and analysis of food additive content (BTM); and errors that may occur in each analysis.
<b>Examination forms</b>	Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%). The final grade (FG) for each student is calculated by the formula :

	$FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 286 1385 591"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Bintang M. 2010. Biokimia: Teknik Penelitian. Erlangga</li> <li>Brant, M., 2002, Biotechnology Laboratory Manual, 2nd ed, Department Chemistry and Biochemistry, Cal State, Fullerton</li> <li>Ausubel, F. M., Brent, R., Kingston, R.E., Moore, D. D., Seidman, J.G., Smith, JA., Struhl K., 2003, Current Protocols in Molecular Biology, John Wiley &amp; Sons, Inc. New York</li> <li>Jurnal-jurnal bidang biokimia</li> </ol>																								

## 99. Capita Selecta in Biochemistry

<b>Module designation</b>	<b>Capita Selecta in Biochemistry</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Ritbey Ruga, M.P., Ph.D Djihhan Ryn Pratiwi, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and fuction of biomolecules, Motabolism and genetic information
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO-8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to define and understand the method of food analysis, both in terms of physical, chemical, characteristics, microbiology, and sensory aspects of food materials. The use of qualitative &amp; quantitative analysis</li> <li>2. Students are able to explain: Food sampling techniques</li> <li>3. Students are able to explain: Proximate analysis</li> <li>4. Students are able to explain Water Analysis in food materials.</li> <li>5. Students are able to understand and explain Lipid analysis</li> <li>6. Students are able to understand and explain: Protein analysis</li> <li>7. Students are able to understand and explain: Carbohydrate analysis</li> <li>8. Students are able to understand and explain:</li> <li>9. Students are able to Analyze Ash and Minerals</li> <li>10. Students are able to understand and explain: Vitamin analysis</li> <li>11. Students are able to Assignment to make a review of food materials and present the results of the review</li> </ol>
<b>Content</b>	This course discusses the basic concepts of Biochemistry in the development of current Biochemistry research, discussion of scientific literature, case studies, and presentation of current research results.

<p><b>Examination forms</b></p>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 416 1383 723"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<p><b>Study and examination requirements</b></p>	<ol style="list-style-type: none"> <li>1. Students have a minimum attendance rate of 80%.</li> <li>2. Students have a minimum FG score of 40</li> </ol>																								
<p><b>Reading list</b></p>	<ol style="list-style-type: none"> <li>1. Anton Apriyantono, Dedi F, Ni Luh Puspitasari, Sedarnawati dan Selamat B. 1989. Analisis Makanan. Makanan dan Gizi IPB. IPB Press. Bogor.</li> <li>2. Slamet Sudarmadji, Bambang, H dan Suhardi. 1989. Analisis Bahan Makanan dan Pertanian. PAU Makanan dan Gizi. Universitas Gadjah Mada. Yogyakarta.</li> <li>3. Yeshayahu and Clayton EIU. 1987. Food Analysis : Theory and Practice 2nd edition. AVI book. Published by Van Nostrand Reinhold Co. New York.</li> </ol>																								

## 100. Biochemical of Enzyme

<b>Module designation</b>	<b>Biochemical of Enzyme</b>
<b>Semester(s) in which the module is taught</b>	VI
<b>Person responsible for the module</b>	Dr. Winni Astuti, M.Si Djihhan Ryn Pratiwi, S.Si., M.Si
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	<del>Compulsory</del> / elective / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	Lecture : 100 minutes/week/semester Self learning : 120 minutes/week/semester Structured assignment: 120 minutes/week/semester
<b>Credit points</b>	2 credits / 3.18 ECTS
<b>Required and recommended prerequisites for joining the module</b>	Structure and fuction of biomolecules
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 2: Understanding the basic concepts and theories in the field of chemistry, including physical chemistry, analytical chemistry, organic chemistry, inorganic chemistry, and biochemistry, as well as the principles of other related sciences.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO-8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to explain the History of Enzymes and Their Development</li> <li>2. Students are able to explain the Structure of Enzyme Proteins</li> <li>3. Students are able to explain the Mechanism of Enzymes</li> <li>4. Students are able to explain the Factors that affect Enzyme activity</li> <li>5. Students are able to explain Allosteric Enzymes</li> <li>6. Students are able to explain the basic concept of Enzymes and especially Allosteric enzymes in the presented journal</li> <li>7. Students are able to explain Enzyme Kinetics</li> <li>8. Students are able to Explain Enzyme Inhibition</li> <li>9. Students are able to explain Metabolic Control by Enzymes</li> <li>10. Students are able to Explain the Mechanism of Coenzymes and Cofactors</li> <li>11. Students are able to explain Various types of Enzymes in Industry and their development</li> <li>12. Students are able to explain Various types of Enzymes in Health and their development</li> <li>13. Students are able to explain the basic concept of Enzymes and their role in the presented journal</li> </ol>

<b>Content</b>	This course discusses the definition and history of enzymes; the development of enzyme research; the protein structure of enzymes; the mechanism of enzyme action; factors affecting enzyme activity; allosteric enzymes; reaction equations in enzymes; definition and types of inhibitors; the relationship between enzyme inhibition and metabolism; control of metabolism by enzyme action; allosteric; covalent modification; coenzyme and cofactor mechanisms; enzymes in industry and their development; and several examples of enzymes in industry and health.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%) ; Final Exam , FE (20%) ; Project (25%) ; Case Study, CS (25%) ; and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.25P + 0.25CS + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 707 1383 1010"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td>0 ≤ FG &lt; 40</td> <td>0.0</td> <td>E</td> </tr> <tr> <td>40 ≤ FG &lt; 50</td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td>50 ≤ FG &lt; 60</td> <td>1.5</td> </tr> <tr> <td>60 ≤ FG &lt; 65</td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td>65 ≤ FG &lt; 70</td> <td>2.5</td> </tr> <tr> <td>70 ≤ FG &lt; 75</td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td>75 ≤ FG &lt; 80</td> <td>3.5</td> </tr> <tr> <td>80 ≤ FG ≤ 100</td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	0 ≤ FG < 40	0.0	E	40 ≤ FG < 50	1.0	D	50 ≤ FG < 60	1.5	60 ≤ FG < 65	2.0	C	65 ≤ FG < 70	2.5	70 ≤ FG < 75	3.0	B	75 ≤ FG < 80	3.5	80 ≤ FG ≤ 100	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	<ol style="list-style-type: none"> <li>Mathews C.K. &amp; Van Holde K.E. 2000. <i>Biochemistry</i>. Third Edition. The Benjamin Cumming Publishing</li> <li>Devlin M.T, 1997. <i>Textbook of Biochemistry with Clinical Correlation</i>, 4th ed. John Wiley &amp; Sons INC, New York</li> <li>Lehninger, 1982, Dasar-dasar Biokimia, Jilid 1, Penerbit Erlangga, Jakarta</li> <li>Yohanis Ngili, 2019, Enzimologi: Sifat, Mekanisme, Katalisis dan Kinetika Enzim, Penerbit Rekayasa Sains, Bandung</li> <li>Nursanti, O.W., Astuti, W., Ruga, R., 2022. Skrining Amilase, Lipase dan Protease dari bakteri Endofit daun Ciplukan (<i>Physalis angulata</i> L.), Jurnal Atomik, 7 (2), pp. 1-5.</li> </ol>																								

## 101. Thesis

<b>Module designation</b>	Thesis
<b>Semester(s) in which the module is taught</b>	VII
<b>Person responsible for the module</b>	
<b>Language</b>	Indonesian
<b>Relation to curriculum</b>	Compulsory / <del>elective</del> / <del>specialisation</del>
<b>Teaching methods</b>	Lecture, discussion, assignment, final project
<b>Workload (incl. contact hours, self-study hours)</b>	
<b>Credit points</b>	6 credits / 9.54 ECTS
<b>Required and recommended prerequisites for joining the module</b>	-
<b>Module objectives/intended learning outcomes</b>	<p><b>Program Learning Outcomes (PLO)</b></p> <p>PLO 1: Demonstrating a lifelong learning attitude, taking responsibility for the work by applying ethics, discipline, professionalism, adhering to regulations, and being environmentally conscious.</p> <p>PLO 3: Following recent advancements in chemistry, including the development of chemical products, management of natural resources, and innovations in the chemical sector.</p> <p>PLO 4: Understanding and integrating concepts from various other disciplines, both directly and indirectly related to chemistry.</p> <p>PLO 5: Able to communicate effectively, both orally and in writing, in conveying ideas, research findings, and solutions to problems related to chemistry.</p> <p>PLO 7: Able to design and conduct experiments and research systematically, considering occupational safety and health aspects, as well as analyzing the data.</p> <p>PLO 8: Able to interpret data generated from modern instruments in chemical analysis, such as chromatography, spectroscopy, and other analytical techniques.</p> <p>PLO 9: Able to conduct fundamental research related to chemical-based products, such as pharmaceuticals, cosmetics, or industrial raw materials, using compounds from tropical rainforests innovatively and efficiently.</p> <p><b>Course Learning Objective (CLO)</b></p> <ol style="list-style-type: none"> <li>1. Students are able to determine the thesis topic</li> <li>2. Students are able to find literature sources for research design</li> <li>3. Students are able to describe the background, problem formulation, objectives, and benefits of research.</li> <li>4. Students are able to describe literature review.</li> <li>5. Students are able to describe research methods.</li> <li>6. Students are able to conduct research</li> <li>7. Students are able to interpret research data</li> <li>8. Students are able to describe research results, discussions, conclusions, and attachments</li> <li>9. Students are able to revise the thesis draft</li> </ol>

<b>Content</b>	This course contains Determination of thesis topic, search for scientific literature as a theoretical basis; background, formulation of the problem, objectives, and benefits of the research; preparation of a literature review; preparation of research methods; implementation of proposal seminars; implementation of research; interpretation of research data; research results; discussion; conclusions and suggestions; attachments; implementation of results seminars; revision of thesis drafts; and final thesis seminar.																								
<b>Examination forms</b>	<p>Assessment is carried out based on Quiz, Q (10%) : Mid Exam, ME (10%); Final Exam , FE (20%); Project, P (15%); Case Study, CS (15%); Practicum, Pr (20%); and Affective A (10%).</p> <p>The final grade (FG) for each student is calculated by the formula :</p> $FG = \frac{0.1Q + 0.1ME + 0.2FE + 0.15P + 0.15CS + 0.2Pr + 0.1A}{10}$ <p>The conversion of final grades to alphabetic values is given by the table:</p> <table border="1" data-bbox="624 678 1390 981"> <thead> <tr> <th>Interval</th> <th>Number</th> <th>Letter</th> </tr> </thead> <tbody> <tr> <td><math>0 \leq FG &lt; 40</math></td> <td>0.0</td> <td>E</td> </tr> <tr> <td><math>40 \leq FG &lt; 50</math></td> <td>1.0</td> <td rowspan="2">D</td> </tr> <tr> <td><math>50 \leq FG &lt; 60</math></td> <td>1.5</td> </tr> <tr> <td><math>60 \leq FG &lt; 65</math></td> <td>2.0</td> <td rowspan="2">C</td> </tr> <tr> <td><math>65 \leq FG &lt; 70</math></td> <td>2.5</td> </tr> <tr> <td><math>70 \leq FG &lt; 75</math></td> <td>3.0</td> <td rowspan="2">B</td> </tr> <tr> <td><math>75 \leq FG &lt; 80</math></td> <td>3.5</td> </tr> <tr> <td><math>80 \leq FG \leq 100</math></td> <td>4.0</td> <td>A</td> </tr> </tbody> </table>	Interval	Number	Letter	$0 \leq FG < 40$	0.0	E	$40 \leq FG < 50$	1.0	D	$50 \leq FG < 60$	1.5	$60 \leq FG < 65$	2.0	C	$65 \leq FG < 70$	2.5	$70 \leq FG < 75$	3.0	B	$75 \leq FG < 80$	3.5	$80 \leq FG \leq 100$	4.0	A
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<b>Study and examination requirements</b>	<ol style="list-style-type: none"> <li>Students have a minimum attendance rate of 80%.</li> <li>Students have a minimum FG score of 40</li> </ol>																								
<b>Reading list</b>	-																								