



**Diponegoro University**  
**Faculty of Science and Mathematics**  
**Undergraduate Program Of Chemistry**

Module designation	<b>Biomass and Bioenergy (BMBE)</b>
Semester(s) in which the module is taught	4
Person responsible for the module	Dr. M. Asy'ari, M.Si, Dr. Agustina LN Aminin, M.Si
Language	Indonesian
Relation to curriculum	<del>Compulsory</del> /elective/ <del>specialisation</del>
Teaching methods	Lecture
Workload (incl. contact hours, self-study hours)	Face to face: 1 x (2 x 50 min); Structured study: 1 x (2 x 60 min); Self study: 1 x (2 x 60 min)
Credit points	2
Required and recommended prerequisites for joining the module	Organic Chemistry 2 (KO2)

Module objectives/intended learning outcomes	<p>(S9) Demonstrate a responsible attitude towards work in their field of expertise independently</p> <p>(KU1) Able to apply logical, critical, systematic, and innovative thinking in the development or implementation of science and technology that pays attention to and uses humanities values by their field of expertise</p> <p>(KK2) Able to solve science and technology problems in general and straightforward chemical fields such as identification, analysis, isolation, transformation, and synthesis of micro-molecules through the application of knowledge of structure, properties, kinetics, and energetics of molecules and chemical systems, with analytical methods and synthesis in specific chemical fields, as well as the application of relevant technologies</p> <p>(KK3) Able to analyze several alternative solutions in identification, analysis, isolation, transformation, and synthesis of available chemicals and present analysis conclusions for appropriate decision making</p> <p>(PP1) Mastering the theoretical concepts of structure, properties, changes, kinetics, and energetics of molecules and chemical systems, identification, separation, characterization, transformation, synthesis of micromolecular chemicals, and their application</p>
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Content	<ol style="list-style-type: none"> <li>1. Introduction: Current energy needs, the importance of renewable energy sources (bioenergy), understanding of biomass and bioenergy</li> <li>2. Solar energy and its conversion through photosynthesis</li> <li>3. Source of Biomass (plants, animals, and microorganisms) and Conversion of Biomass into Bioenergy</li> <li>4. Characteristics of Biomass: structure and composition of cells and tissues of biomass sources</li> <li>5. Characteristics of Biomass: structure and properties of biomolecules that make up biomass (amylose, amylopectin, cellulose, hemicellulose, lignocellulose)</li> <li>6. Biomass Decomposing Enzymatic Reactions: sources and reaction mechanisms of decomposing biomass enzymes</li> <li>7. Compound Reaction (BK7) Enzymatic Reaction of Biomass Decomposers: plant pathogenic microorganisms as a source of biomass-decomposing enzymes and reaction mechanisms of complex carbohydrates-decomposing enzymes in biomass: ligninase, hemicellulase, xylanase, etc</li> <li>8. Biomass Pretreatment: <ol style="list-style-type: none"> <li>a. Chemical pretreatment</li> <li>b. Physical pretreatment</li> </ol> </li> <li>9. Biomass Pretreatment: <ol style="list-style-type: none"> <li>a. Microbiological pretreatment</li> <li>b. Enzymatic pretreatment</li> </ol> </li> <li>10. Conversion of Biomass into biofuel and its impacts <ol style="list-style-type: none"> <li>a. Thermochemical conversion, syngas fermentation</li> <li>b. Biochemical conversion to ethanol: biomass pretreatment</li> </ol> </li> <li>11. Conversion of Biomass into biofuel and its impacts <ol style="list-style-type: none"> <li>a. Combinations of different enzymes, hydrolytic enzymes, and applications in ethanol production</li> </ol> </li> <li>12. Conversion of Biomass into biofuel and its impacts <ol style="list-style-type: none"> <li>a. Biodiesel produced from oilseeds, waste oil, and algae</li> </ol> </li> <li>13. Conversion of Biomass into biofuel and its impacts <ol style="list-style-type: none"> <li>a. Environmental impacts of conversion to biofuels</li> </ol> </li> <li>14. Particular topic: Discussing the latest developments related to bioenergy such as MFC, MEC, etc</li> </ol>
Exams and assessment formats	Mid-Semester Exam and Final Exam
Study and examination requirements	Participatory Activities -15% Project Results -15% Cognitive/Task Knowledge -10% Quiz -10% Mid-semester -25% Final exams -25%

Reading list

1. National Biodiesel Board, U. Bioenergy, Biomass to Biofuels; 2015
2. Pecha, B.; Garcia-Perez, M. Chapter 26 – Pyrolysis of Lignocellulosic Biomass: Oil, Char, and Gas. In Bioenergy; 2015
3. Knothe, G.; Van Gerpen, J. H.; Krahl, J. J.; Gerpen, J. H. Van. The Biodiesel Handbook; 2005; Vol. 2