Course Module

Advanced Biochar

Faculty of Forestry

Mulawarman University

Module name	Advanced Biochar
Modul level, if applicable	Graduates Programme
Code, if applicable	220401803P029
Subtitle, if applicable	
Courses, if applicable	Regular
Semester(s) in which the module is taught	II (two)
Person responsible for the module	Dr. Ir. Syahrinudin, M. Sc.
Lecturer	Dr. Ir. Syahrinudin, M. Sc. Dr. Ir. Wahjuni Hartati, M. P.
Language	Indonesia
Relation to curriculum	Programme, mandatory
Type of teaching, contact hours	Lecture, 2 lecture contact hours
Workload	Number of meetings per semester: 16 meetings (14 meetings for learning activity, 1 meeting for mid semester, 1 meeting for final examination) 3 x 50 minutes lectures, 3 x 60 minutes structure activity, 3 x 60 minutes individual activity, with a total of 7,140 minutes or equivalent to a total of 119 hours in 14 weeks per semester
Credit points	3 SKS (4.8 ECTS) Details: 1 Credit = 170 min/week 1 Credit = 170 min x 14 week = 2,380 min/semester 1 ECTS = 25 h / semester 1 Credit = 2,380 / 60 / 25 = 1.59 = 1.6 ECTS 3 Credit = 1.6 x 3 = 4.8 ECTS
Requirements according to the examination regulations	Have attended not less than 80% class meetings
Recommended prerequisites	
Module objectives/intended learning outcomes	**Intended Learning Outcomes** **Knowledge and Understanding** **ILO-1 :** Applying scientific ethics, norms, and values of professionalism **Investigation**

	ILO-3 : Able to analyze current problems and issues, and assess the ecological, social, and economic impacts of implementing programs in the forestry and tropical environmental sectors. **Engineering Design and Practice** **ILO-4 :** Develop research schemes based on inter or multidisciplinary approaches to tropical forestry and the environment, and communicate the results to the public. **Social Competences** **ILO-5 :** Lead, work in a team, and be responsible for achieving group work results. **Course Learning Outcomes** **Knowledge and Understanding** **CLO-2 :** able to explain the basic concepts of biochar, including definition, history, carbon cycle, and the role of biochar in climate change mitigation and natural resource management. **Investigation** **CLO-3 :** Able to choose and initiate efforts to utilize insect biodiversity by taking into account the principle of sustainability.
Content	This course discusses in depth the concept, production process, and application of biochar in various fields, including soil management, climate change mitigation, environmental remediation, sustainable agriculture, forestry, and renewable energy. Students will learn the characterization of biochar, its interaction with soil and microorganisms, and its role in the carbon cycle. In addition, the course also covers economic aspects, policies, and the latest innovations in biochar research. Through theoretical and practical approaches, students are expected to be able to design and present an applicable biochar project to address environmental or agricultural problems. After attending this course, students have the ability to: 1. Students are able to explain the definition, history, and role of biochar in climate change mitigation and natural resource management and understand the carbon cycle related to biochar. **(CLO- 2)** 2. Students are able to identify feedstock for biochar and pyrolysis technology and parameters that affect biochar quality. **(CLO- 2)** 3. Students are able to analyze the physical properties of biochar, such as porosity and surface area and understand the chemical properties, such as pH, cation exchange capacity (CEC), and fixed carbon content. **(CLO- 2)** 4. Students are able to explain the mechanism of biochar in improving soil fertility and the effect of biochar on water retention and nutrients in the soil. **(CLO- 2**)

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5. Students are able to analyze the effect of biochar on soil microbial activity and the relationship between biochar and biological nutrient cycles. (CLO- 4)
6. Students are able to explain the role of biochar in carbon sequestration and the impact of biochar in reducing greenhouse gas (GHG) emissions. (CLO- 2)
7. Students are able to explain the use of biochar in the remediation of heavy metals and organic pollutants in soil and the potential of biochar in wastewater treatment. (CLO- 2)
8. Students are able to identify the benefits of biochar in integrated agricultural systems and the impact of biochar on crop productivity. (CLO-4)
9. Students are able to explain the benefits of biochar in forest management and agroforestry and the use of biochar for degraded land restoration.(CLO-2)
10. Students are able to analyze the use of biochar as an alternative fuel and energy conversion from biochar in bioenergy systems. (CLO-2)
11. Students are able to evaluate the economic aspects of biochar production and application and understand local, national, and international policies related to biochar. (CLO-4)
12. Students are able to identify the latest developments in biochar research and understand the opportunities for biochar technology innovation in the future. (CLO-4)
13. Students are able to design biochar application projects for environmental or agricultural problems. (CLO-4)
14. Students are able to present project results systematically and scientifically. (CLO-4)
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<tr><td>Study and examination requirements and forms of examination</td><td>
Evaluation and assessment of the learning process are following scheme 5 in the Academic Regulations of Mulawarman University:
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<tr><th>No.</th><th>Objects of Assessment</th><th>Forms of Assessment</th><th>Quantity (%)</th></tr>
<tr><td>1</td><td>Affective</td><td>Participation</td><td>10</td></tr>
<tr><td>2</td><td>Laboratory Practice/Fieldwork</td><td>Participation, Group Project Report</td><td>20</td></tr>
<tr><td>3</td><td>Assignment/Case study</td><td>Group presentation</td><td>15</td></tr>
<tr><td>4</td><td>Project</td><td>Report</td><td>15</td></tr>
<tr><td>5</td><td>Mid-semester test</td><td>Written test</td><td>15</td></tr>
<tr><td>6</td><td>Final semester test</td><td>Written test</td><td>25</td></tr>
<tr><td colspan="3">TOTAL</td><td>100</td></tr>
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<tr><td>Media employed</td><td>Laptop, LCD</td></tr>
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Reading list	1. Lehmann, J., & Joseph, S. (2015). *Biochar for Environmental Management: Science, Technology and Implementation.* 2. Bridgwater, A. V., & Peacocke, C. L. (2000). *Fast Pyrolysis of Biomass for Energy and Chemicals.* 3. Novak, J. M., et al. (2009). *Characterization of Designer Biochars Produced at Different Temperatures and Their Effects on Soil Properties.* 4. Steiner, C., et al. (2007). *Biochar and its Effects on Plant Growth.* 5. Warnock, D. D., et al. (2007). *Mycorrhizal Responses to Biochar in Temperate Soils: Implications for Soil Fertility and Carbon Sequestration.* 6. Joseph, S., et al. (2015). *Biochar and Climate Change Mitigation: A Review.* 7. Xu, Y., et al. (2014). *Biochar for Remediation of Polluted Soils.* 8. Rondon, M. A., et al. (2007). *Biological Approaches to Sustainable Agriculture.* 9. Gaunt, J. L., & Lehmann, J. (2008). *Energy Balance and Emissions Associated with Biochar Sequestration and Pyrolysis Bioenergy Production.* 10. Mullen, C. A., et al. (2010). *Biochar and Bioenergy: New Applications for an Ancient Technology.* 11. Campbell, S. R., et al. (2015). *Economic Feasibility of Biochar Production and Use in Agriculture.* 12. Sohi, S. P., et al. (2010). *A Review of Biochar as a Soil Amendment: Its Effects on Soil Properties and Processes.* *13*. Riebeek, H. (2014). *Scientific Communication in Environmental Sciences: Presenting Projects and Proposals.*