| General information | |
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| Academic subject | Sustainable Biomass Management |
| Degree course | INNOVATION DEVELOPMENT IN AGRIFOOD SYSTEMS (LM-69) |
| ECTS credits | 6 ECTS (4 ECTS of Lectures + 2 ECTS of laboratory or field classes) |
| Compulsory attendance | No |
| Teaching language | English |

| Subject teacher | Name Surname | Mail address |
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| | Elisabetta Loffredo | elisabetta.loffredo@uniba.it |

| ECTS credits details | | |
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| | 4 ECTS Lectures | 2 ECTS Laboratory or field classes |

| Class schedule | |
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| Period | 2nd Semester |
| Course year | 1st Year |
| Type of class | Lectures, laboratory activities, working groups, didactic visits |

| Time management | |
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| Hours | 150 |
| In-class study hours | 60 |
| Out-of-class study hours | 90 |

| Academic calendar | |
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| Class begins | March 1st, 2021 |
| Class ends | June 11th, 2021 |

| Syllabus | |
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| Prerequisites/requirements | Basic knowledge of biology, chemistry, biochemistry, microbiology |
| Expected learning outcomes | *Knowledge and understanding*<br>o. Knowledge and understanding of the most innovative aspects concerning both agri-food biomass and other waste and non-waste biomass and their correct use, recycling and valorization for improving food production, obtaining new amendments, biofuel and added-value substances in the perspective of circular economy.<br>*Applying knowledge and understanding*<br>o. Knowledge and understanding to select and use appropriate innovative techniques of biomass management to solve problems of global concern.<br>o. Knowledge and understanding to perform correctly innovative use, recycling and valorization of biomasses aiming to maintain and improve soil quality.<br>*Making informed judgements and choices*<br>o. Ability to select appropriate procedures to manage biomass with an eco-friendly approach to maintain and improve soil quality and fertility and to remediate contaminated soils.<br>o. Ability to select appropriate raw and processed |

|  | biomasses for a sustainable management and improvement of agri-food systems with a view to the economic sustainability and the environmental safeguard.<br><br>*Communicating knowledge and understanding*<br>o. Ability to communicate and discuss with appropriate disciplinary lexicon the main types of raw and processed biomasses, their chemical and physical properties, and the current processes of transformation and utilization of biomass with a view to environmental sustainability and circular economy.<br><br>*Capacities to continue learning*<br>o. Ability to deepen and update the knowledge of innovative methodology for the eco-compatible and cost-effective management of waste and non-waste biomasses.<br><br>The expected learning outcomes, in terms of knowledge and skills, are listed in Annex A of the Master Degree Course Regulation (expressed through the European Descriptors of Degree qualification). |
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| Contents | The course aims to provide students with theoretical and applicative knowledge, as well as essential insights, for the correct use, recycling and valorization of biomass, especially of agri-food origin, through appropriate innovative processes and technologies. The knowledge acquired by students will allow them to make choices and operate with a view to the sustainability and circular economy of agri-food systems, through the improvement of soil quality and fertility, carbon sequestration and the contrast to climate change. The evaluation of case-studies will allow students to deepen the knowledge of the agronomic and environmental effects of the use of certain processes and products concerning biomass. Furthermore, knowledge necessary for the choice of soils suitable to receive the different types of biomass will be acquired by students in order to achieve economic benefits and also the conservation and protection of the soil as a resource. |

| **Course program** | Introduction to the course. Classification and properties of biomass. Types of residues and wastes from crop production, animal farms and the agri-food industry. Organic fraction of the municipal solid waste and civil and industrial sewage sludge. Biomass production for bioenergy.<br><br>Fate of biomass in soil. Carbon sequestration in soil and actions to counteract the greenhouse effect and global warming.<br><br>Production and recycling of untreated biomass to improve soil quality and fertility.<br><br>Bio-oxidative decomposition of waste biomass under controlled conditions. Properties of the biomass to be composted. Innovative home, farm and industrial composting processes. Composting process and management of the |
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| | physical, chemical and biological aspects of the process. Evaluation of the degree of maturation of the compost with physico-chemical and biological methods. Properties and quality of green and mixed compost. Vermicomposting process. |
| | Anaerobic digestion process: types of digestion and related processes. Properties and treatments of digestates. Use of the solid and liquid fraction originating from biogas production. |
| | Use of agro-industrial and civil sewage sludge. Biosulfate production process from civil sludge and its use as soil amendment and conditioner. Chemical and biological aspects of biosulfate. |
| | Hydrothermal carbonization process. Feedstock properties. Process parameters. Physical, chemical and biological properties of hydrochar. Potential applications of hydrochar. |
| | Pyrolysis process. Choice of the feedstock. Process parameters and syngas production, fuel oils and biochar. Characteristics and potential of use of biochar. |
| | Innovation in biofuel production from waste biomass. Bio-hydrogen and bio-ethanol production. |
| | Innovative biostimulants: production and use in agriculture. |
| | Main biomass contaminants: organic xenobiotics and heavy metals. Interaction between organic and inorganic soil contaminants and treated biomass. |
| | Evaluation of the properties of the soil suitable for receiving treated biomass. Chemical, biological and environmental aspects of soil amendment with various types of treated biomass. Immobilization of contaminants. Competition/synergy of biomass in biodecontamination and phytodecontamination processes. |
| | Notes on regulatory aspects concerning treated biomass. |
| | Case studies: visits to plants producing soil organic amendments, biofuel and energy. |
| Reference books | • Slides of the lectures will be available on EDMODO Platform at: https://new.edmodo.com/home.<br>• Scientific articles will be provided or suggested during the course<br>• Waste Biomass Management – A Holistic Approach. Editors: Singh, Lakhveer, Kalia, Vipin Chandra (Eds.) Springer 2017 (Suggested)<br>• Lecture notes |
| Notes | Sitography |

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| | https://www.ieabioenergy.com/wp-content/uploads/2013/10/ExCo68-Workshop-Environmental-Sustainability-of-Biomass.pdf<br>Interesting web sites will be indicated during the course |
| Teaching methods | Lectures will be presented through PC assisted tools (PowerPoint, Adobe Acrobat, etc.).<br>Photos and video will be also showed during the course with the aim of presenting relevant case studies |
| Evaluation methods | Students enrolled in the year in which the lectures are given (students in course) can make an ongoing examination. The exam will be oral and the mark will be expressed in thirtieths. The result of this test will be valid for one academic year and will contribute to the evaluation of the final examination.<br>The exam consists of an oral test on the topics covered during the theoretical and theoretical-practical lectures of the course, as reported in the Academic Regulations for the Master's Degree Program in "Innovation Development in Agri-Food Systems" and in the study plan (Annex A).<br>The evaluation of the student's knowledge will respect the established criteria, as detailed in Annex A of the Academic Regulation for the Master's Degree "Innovation Development in Agri-Food Systems".<br>The evaluation of the final exam of the course will be expressed in thirtieths. |
| Evaluation criteria | ***Knowledge and understanding***<br>o.  Ability to describe the properties of the main types of row and processed biomasses, the technological processes adopted to obtain them and their applications in the agrifood systems to improve the efficiency of the use of resources<br><br>***Applying knowledge and understanding***<br>o.  Ability to select and use appropriate traditional and innovative, raw and processed biomass to solve specific problems in agri-food and environmental systems<br>o. Ability to select and perform correctly the management of biomasses aiming to recycle wastes and valorise them from a circular economy perspective<br><br>***Making informed judgements and choices***<br>o. Ability to elaborate knowledge for selecting appropriate procedures to preserve and improve biomass utilization<br>o. Ability to elaborate and select appropriate procedures of biomass transformation with a view to environmental safeguard<br><br>***Communicating knowledge and understanding***<br>o.  Ability to describe and discuss with appropriate lexicon the most important aspects concerning biomass use and recycle with a view to the sustainability, presented as a case study<br><br>***Capacities to continue learning*** |

| | o. Ability to develop new approaches for choosing and applying appropriate traditional and innovative methods for the eco-compatible management of soils. |
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| Receiving times | From Monday to Tuesday, 9.00-12.00 by appointment. |