COURSE OUTLINE

BIOMASS ENERGY UTILIZATION TECHNOLOGIES

(1) GENERAL

SCHOOL	TECHNOLOGY		
DEPARTMENT	FORESTRY, WOOD SCIENCES & DESIGN		
LEVEL	POSTGRADUATE		
COURSE CODE	**MB129**	**SEMESTER**	**2nd**
COURSE TITLE	BIOMASS ENERGY UTILIZATION TECHNOLOGIES		

ACTIVITIES	**WEEKLY HOURS**	**ECTS**
Lectures	2	6
TOTAL	2	6

TYPE OF COURSE	ELECTIVE
PREREQUISITES	NO
LANGUAGE OF TEACHING AND EXAMINATION	GREEK
THE COURSE IS OFFERED TO ERASMUS STUDENTS	NO
WEBPAGE COURSE (URL)	

(2) LEARNING OUTCOMES

Learning Outcomes

The purpose of the course is the development of the students' technological and scientific background in biomass energy utilization technologies. They will get to know all categories of biomass, emphasizing that based on wood and agricultural residues based on lignin-cellulose. Methods of collection and permitted sizes and origin thereof. Analysis of the advantages and disadvantages of each method based on the type of biomass and applications by type of residue to maximize the use of these by-products. At the same time, the technology is being developed for each different production with detailed reports on each one separately in order to be able to choose the most suitable solution for Wood industries both in Greece and on a wider scale (Europe). Energy utilization of biomass in domestic and industrial use.
Upon completion of the course the student is able to know:

- What is biomass? What are the types of biomass and based on what criteria is it separated and is categorized.
- Limits and limitations in the utilization of different types of biomass.
- The technologies of utilization and production of different products from it.
- The possibilities of waste management in relation to the cost of converting them into new energy products per period (seasonal) and region, both in Europe and in Greece.
- To utilize energy from some materials producing additional profits for some production or processing units.
- To understand the different biomass utilization technologies, knowing the advantages and disadvantages of each.
- To apply the optimal utilization technique depending on the type of biomass available and the characteristics of the area (materials, available industries of each region), in order to propose a sustainable investment based on the selection criteria that has been taught.
- To evaluate the biomass and be able to choose the right way to collect it with the best economic and environmentally beneficial approach.
- To be able to suggest the best way of energy utilization of biomass, both for domestic and industrial use or its use in greenhouses.

• To be able to choose the optimal technology for electricity production or thermal-electric co-production
General Skills

(3) COURSE CONTENT

In the theoretical part of the course the student is taught and learns about:

- Introduction to biomass and understanding the behavior of different materials for their exploitation potential. Biomass, photosynthesis, presentation and understanding of the four main types of biomass.
- Bio-energy products, advantages and disadvantages. Energy crops, assessment of biomass potential at local and wider level. Energy requirements and available quantities of biomass. Periodicity, search for the creation of regional centers of harvesting and exploitation.
- Biomass management. Biomass management methods based on international practices. Applications and examples on a Greek, European and global scale.
- Biofuels. Detailed presentation of biofuels, technologies, application results and their problems.
- Presentation of energy utilization technologies. Thermochemical processes, gasification, combustion, pyrolysis. Power generation methods.
- Sustainability criteria in biomass management. Case studies on the effectiveness of applying biomass utilization and exploitation methods. European legislation and objectives.
- Educational visit to 2 companies that use biomass for electricity production.
- Biomass collection and quality assessment methods. Analysis of collection machinery. Legislation governing its use. Progress in the course.
- Production of heat and electricity from biomass. Production of electricity by production of steam-hot oils - pyrolysis. Cogeneration of electricity and thermal energy.
- Utilization of biomass for the production of thermal energy for domestic use. Small-scale combustion technologies in stoves - boilers.
- Utilization of biomass for thermal energy production in industrial use – greenhouses. Combustion technology with moving bottom boilers for lower quality biomass.
- Production of pellets and briquettes – Production of high energy efficiency products. Visit to a pellet production unit.
- Case-by-case application examples of all materials. Exercises in the application of the various materials with scenarios for an optimal understanding of the properties of each material. Presentation of work.

From the 1st lesson, a suggested list of assignments is given that the student should undertake and prepare (individually) until the end of the MSc semester.
The relevant directions are given, while rich material and instructions will be posted on the E-class.
The final assignment includes, in addition to paper and electronic submission, a public oral presentation on the chosen topic, on a set date (usually the 12th or 13th week of classes). The presentation lasts 15 minutes and is followed by 5 minutes of questions from the students present. The teacher intervenes - if necessary - for comments, observations, corrections.
Students are graded on the overall performance of their final paper: 70% on the content and editorial specifications and 30% on the preparation of the online presentation and its oral support.
These grades count for a total of 40% of the overall grade that students will receive after the final written theory exam.

(4) TEACHING AND LEARNING METHODS - EVALUATION

COURSE DELIVERY METHOD	In class and remotely

<table>
<tr><td>USE OF INFORMATION AND COMMUNICATION TECHNOLOGIES</td><td>• Use of PCs, ppt slides, projector.
• Support of the learning process through the e-class electronic platform</td></tr>
<tr><td>MANAGEMENT OF TEACHING</td><td>
<table>
<tr><th>Activity</th><th>Semester Workload</th></tr>
<tr><td>Lectures</td><td>26</td></tr>
<tr><td>Individual work on the properties and applications of biomass energy utilization technologies</td><td>44</td></tr>
<tr><td>Educational excursion / Small individual practice tasks</td><td>20</td></tr>
<tr><td>Independent Study</td><td>60</td></tr>
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<tr><td>Course Total (25 workload hours per credit unit)</td><td>150</td></tr>
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<tr><td>STUDENT EVALUATION</td><td>I. Written final exam (60%) including:
• Short answer questions from all the material of the book and lectures.
• Assignments and solving exercises related to the subject of the course.
II. Course progress during the 8th week of classes.
III. Presentation of Individual Work (40%).</td></tr>
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(5) RECOMMENDED-BIBLIOGRAPHY

- Suggested Bibliography:

- Bajpai P. Biomass to Energy Conversion Technologies. 1st Edition. The Road to Commercialization. ISBN: 9780128184004.
- Bouchard J., T.S. Nguyen, E. Chornet and R.P. Overend. Analytical methodology for biomass pretreatment — part 1: Solid residues (https://doi.org/10.1016/0144-4565(90)90035-I).
- Coombs J., D.O. Hall, W.H. Smith, C.P. Mitchell, L. Zsuffa, S. Andersson and D.J. Stevens. Forestry, Forest Biomass, and Biomass Conversion: The IEA Bioenergy Agreement (1986-1989) Summary Reports, 22(1–4).
- Debajit P. and M. Sanjay. 2007. Biomass Gasifier Systems for Thermal Applications in Rural Areas. Boiling Point No 53 2007.
- Fisher G. and L. Schrattenholzer. 2001. Global Bio-energy Potentials. Biomass and Bioenergy, 20(3):151-159.
- Goldenberg J. and Coelho S. 2004. Renewable energy - traditional biomass vs. modern biomass. Energy Policy, 32(6):711-714.
- Goldenberg J. and P. Guardabassi. 2009. Are biofuels a feasible option? Energy Policy, 37(1):10-14.
- IEA. 1998. World Energy Outlook; Paris: Inter-national Energy Agency.
- IEA. 2003. Energy Balances of non-OECD countries 2000-2001. Paris: International Energy.

- Kaltschmitt M. Energy from Organic Materials (Biomass) A Volume in the Encyclopedia of Sustainability Science and Technology, Second Edition. https://doi.org/10.1007/978-1-4939-7813-7.
- Mande S, Kumar A. and V.V.N. Kishore. 1999. A study of large cardamom curing chambers in Sikkim. Biomass and Bioenergy, 16(6):463-473.
- Tasinski K.J.P. Efficiency of biomass energy: An exergy approach to biofuels, power, and bio-refineries. 1st edition, ISBN-13: 978-1118702109 ISBN-10: 1118702107