

**JEE 659 Energy from biomass**  
(Course coordinator: Assoc.Prof.Dr. Nakorn Worasuwanarak)

**1. Course Description**

This course aims to give students an understanding of the processes to produce the energy from biomass. The advantages of bio-energy production and various technologies for biomass conversion for heat and power are reviewed. The thermochemical conversion of biomass includes combustion, gasification, and pyrolysis. Biogas, biofuel and bio-refinery are also included. Finally, the economic assessment of biomass utilization system, the impact on environmental and the policy framework for biomass utilization will be discussed.

**2. Target Knowledge, Skills, and Abilities (KSA)**

*Indicate what KSA this course will provide the students with.*

This course provides students with knowledge of biomass conversion technologies for energy production and their impact on environment. The skills to analyze the bio-energy systems from various types of biomasses in the critical thinking manner will be provided.

**3. Target group of students**

*Indicate if the course is opened for all students, including non-degree ones.*

This course is opened to Master and PhD students with a background in science or engineering.

**4. Pre-requisites**

*Indicate if the course requires some pre-requisites.*

No pre-requisites are required.

**5. Course Learning Outcomes**

*Indicate the alignment of CLOs with the PLOs.*

CLO 1: Able to define the concept of sustainable development.

CLO 2: Able to explain the challenges and potentials for development of various energy technologies.

CLO 3: Able to analyze the environmental impacts of conventional and alternative energy technologies.

**6. Method of Teaching and Learning**

*Specify if it would be 1/ Online; 2/ On-site; 3/ Hybrid; 4/ Online for lectures and On-site in small groups for discussions and workshops; 5/ Others.*

This course will be delivered in a hybrid format, i.e. a combination of online and on-site lectures and presentations.

**7. Course Outline and Organization**

*Following KMUTT's recommendations, a course should be organized based on the OBEM approach. A course can, therefore, be split over the semester, but also organized in consecutive weeks as before. A module can contain from 2 up to a maximum of 5 lectures depending on the target LOs. A 3 credits course*

can be composed of 3 to a maximum of 5 modules. In addition, indicate if **the course is opened every Semester or a specific Semester**.

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This course is opened every Semester. For the Semester 1/2024 (2567), this course is scheduled every Monday afternoon (1.30 p.m. – 4.30 p.m.) from 5 August to 9 December 2024.

<b>MODULE 1: BIOMASS POTENTIAL ASSESSMENT, BIOMASS CHARACTERIZATION, BASIC COMBUSTION CALCULATION</b>		
<b>MLO 1:</b> Understand the important of biomass and bio-energy system.		
<b>MLO 2:</b> Understand the fuel characteristics of various types of biomasses.		
<b>MLO 3:</b> Understand the fuel characteristics of various types of biomasses.		
<b>MLO 4:</b> Understand the basic calculation of biomass combustion.		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
<b>LECTURE 1: Overview of biomass and bio-energy</b>	Dr. Nakorn Worasuwannarak	5 Aug 2024
<b>LECTURE 2: Biomass fuel characterization I</b>	Dr. Nakorn Worasuwannarak	19 Aug 2024
<b>LECTURE 3: Biomass fuel characterization II</b>	Dr. Nakorn Worasuwannarak	26 Aug 2024
<b>LECTURE 4: Basic calculation of biomass combustion</b>	Dr. Nakorn Worasuwannarak	2 Sep 2024
<b>EVALUATION: Exam papers</b>		<b>7 Oct 2024</b>

<b>MODULE 2: THERMOCHEMICAL CONVERSION OF BIOMASS</b>		
<b>MLO 1:</b> Gain knowledge on biomass pretreatment		
<b>MLO 2:</b> Gain knowledge on biomass combustion technologies		
<b>MLO 3:</b> Gain knowledge on pyrolysis & bio-oil production		
<b>MLO 4:</b> Gain knowledge on biomass gasification		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
<b>LECTURE 1: Biomass pretreatment</b>	Dr. Nakorn Worasuwannarak	9 Sep 2024
<b>LECTURE 2: Biomass combustion technologies &amp; CHP application</b>	Dr. Nakorn Worasuwannarak	16 Sep 2024
<b>LECTURE 3: Pyrolysis &amp; bio-oil production</b>	Dr. Supachita Krerkkaiwan	23 Sep 2024
<b>LECTURE 4: Biomass gasification &amp; other advanced uses</b>	Dr. Supachita Krerkkaiwan	30 Sep 2024
<b>EVALUATION: Exam papers</b>		<b>7 Oct 2024</b>

<b>MODULE 3: BIOFUELS, BIOGAS, AND OTHER ADVANCED BIOMASS TO LIQUID</b>		
<b>MLO 1:</b> Gain knowledge on other advanced biomass to liquid		
<b>MLO 2:</b> Gain knowledge on bio-ethanol production		
<b>MLO 3:</b> Gain knowledge on bio-diesel production		
<b>MLO 4:</b> Gain knowledge on biogas production		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
<b>LECTURE 1: Other advanced biomass to liquid</b>	Dr. Nakorn Worasuwannarak	21 Oct 2024
<b>LECTURE 2: Bio-ethanol</b>	Dr. Boonrod Sajjakulnukij	28 Oct 2024
<b>LECTURE 3: Bio-diesel</b>	Dr. Boonrod Sajjakulnukij	4 Nov 2024
<b>LECTURE 4: Biogas production and utilization</b>	Dr. Warinthorn Songkasiri	11 Nov 2024
<b>EVALUATION: Exam papers</b>		<b>9 Dec 2024</b>

<b>MODULE 4: ECONOMIC ASSESSMENT, POLICY FRAMEWORK, AND ENVIRONMENTAL ASSESSMENT</b>		
<b>MLO 1:</b> Understand how to assess the economic of biomass utilization system		
<b>MLO 2:</b> Understand the policy framework for biomass utilization		
<b>MLO 3:</b> Can assess the environment and sustainability of biomass utilization system		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
<b>LECTURE 1: Economic assessment of biomass utilization system</b>	Dr. Boonrod Sajjakulnukij	18 Nov 2024
<b>LECTURE 2: Policy framework for biomass utilization</b>	Dr. Boonrod Sajjakulnukij	25 Nov 2024
<b>LECTURE 3: Environment and sustainability assessment of biomass utilization system</b>	Prof. Shabbir Gheewala	2 Dec 2024
<b>EVALUATION: Exam papers</b>		<b>9 Dec 2024</b>

***Note:** You may modify this template (number of modules, lectures and MLOs) as appropriate for your course.*

## 8. Evaluation Methods

*Indicate the methods used to evaluate the LOs, e.g. online or on-site exams, assignments, take-home exams, projects, etc. Following KMUTT's recommendations, the LOs evaluation should be organized at the end of each module.*

Dr. Nakorn	47%
Dr. Supachita	13%
Dr. Boonrod	26%
Dr. Warinthorn	7%
Dr. Shabbir	7%

## 9. References/Resources

*Indicate the references/resources students are recommended to consult for the modules/course.*

1. Sims, R. (2002) *The Brilliance of Bioenergy in Business and Practice*, Routledge
2. Bhatt, B. (2010) *Stoichiometry*, Fifth edition, Tata McGraw Hill Education Private Limited
3. Capareda, S. (2013) *Introduction to Biomass Energy Conversions*, CRC Press
4. Szubel, M. (2019) *Biomass in Small-Scale Energy Applications: Theory and Practice*, CRC Press
5. Castro, F.I.G., et al. (2022) *Biofuels and Biorefining: Volume 1: Current Technologies for Biomass Conversion*, Elsevier