JEE 659 Energy from biomass

(Course coordinator: Assoc.Prof.Dr. Nakorn Worasuwannarak)

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 1/2025 (2568), this course is scheduled every Monday afternoon (1.30 p.m. – 4.30 p.m.) from 4 August to 8 December 2025.

MODULE 1: BIOMASS POTENTIAL ASSESSMENT, BIOMASS CHARACTERIZATION, BASIC COMBUSTION CALCULATION **MLO 1:** Understand the important of biomass and bio-energy system. **MLO 2:** Understand the fuel characteristics of various types of biomasses. **MLO 3:** Understand the fuel characteristics of various types of biomasses. **MLO 4:** Understand the basic calculation of biomass combustion.		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Overview of biomass and bio-energy	Dr. Nakorn Worasuwannarak	4 Aug 2025
LECTURE 2: Biomass fuel characterization I	Dr. Nakorn Worasuwannarak	18 Aug 2025
LECTURE 3: Biomass fuel characterization II	Dr. Nakorn Worasuwannarak	25 Aug 2025
LECTURE 4: Basic calculation of biomass combustion	Dr. Nakorn Worasuwannarak	1 Sep 2025
EVALUATION: Exam papers		**6 Oct 2025**

MODULE 2: THERMOCHEMICAL CONVERSION OF BIOMASS **MLO 1:** Gain knowledge on biomass pretreatment **MLO 2:** Gain knowledge on biomass combustion technologies **MLO 3:** Gain knowledge on pyrolysis & bio-oil production **MLO 4:** Gain knowledge on biomass gasification		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Biomass pretreatment	Dr. Nakorn Worasuwannarak	8 Sep 2025
LECTURE 2: Biomass combustion technologies & CHP application	Dr. Nakorn Worasuwannarak	15Sep 2025
LECTURE 3: Pyrolysis & bio-oil production	Dr. Nakorn Worasuwannarak	22 Sep 2025
LECTURE 4: Biomass gasification & other advanced uses	Dr. Nakorn Worasuwannarak	29 Sep 2025
EVALUATION: Exam papers		**6 Oct 2025**

MODULE 3: BIOFUELS, BIOGAS, AND OTHER ADVANCED BIOMASS TO LIQUID **MLO 1:** Gain knowledge on other advanced biomass to liquid **MLO 2:** Gain knowledge on biogas production **MLO 3:** Gain knowledge on bio-ethanol production **MLO 4:** Gain knowledge on bio-diesel production		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Other advanced biomass to liquid	Dr. Nakorn Worasuwannarak	20 Oct 2025
LECTURE 2: Biogas production and utilization	Dr. Warinthorn Songkasiri	27 Oct 2025
LECTURE 3: Bio-ethanol	Dr. Boonrod Sajjakulnukij	3 Nov 2025
LECTURE 4: Bio-diesel	Dr. Boonrod Sajjakulnukij	10 Nov 2025
EVALUATION: Exam papers		**8 Dec 2025**

MODULE 4: ECONOMIC ASSESSMENT, POLICY FRAMEWORK, AND ENVIRONMENTAL ASSESSMENT **MLO 1:** Understand how to assess the economic of biomass utilization system **MLO 2:** Understand the policy framework for biomass utilization **MLO 3:** Can assess the environment and sustainability of biomass utilization system		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Economic assessment of biomass utilization system	Dr. Boonrod Sajjakulnukij	17 Nov 2025
LECTURE 2: Policy framework for biomass utilization	Dr. Boonrod Sajjakulnukij	24 Nov 2025
LECTURE 3: Environment and sustainability assessment of biomass utilization system	Prof. Shabbir Gheewala	1 Dec 2025
EVALUATION: Exam papers		**8 Dec 2025**

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	60%
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