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***.

addition, indicate if ***the course is opened every Semester or a specific Semester***].

This course is opened every Semester. For the Semester 1/2026 (2569), this course is scheduled every Monday afternoon (1.30 p.m. – 4.30 p.m.) from 10 August to 30 November 2026.

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 bioenergy	Dr. Nakorn Worasuwannarak	10 Aug 2026
LECTURE 2: Biomass fuel characterization I	Dr. Nakorn Worasuwannarak	17 Aug 2026
LECTURE 3: Biomass fuel characterization II	Dr. Nakorn Worasuwannarak	24 Aug 2026
LECTURE 4: Basic calculation of biomass combustion	Dr. Nakorn Worasuwannarak	31 Aug 2026
EVALUATION: Exam papers		**5 Oct 2026**

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	7 Sep 2026
LECTURE 2: Biomass combustion technologies & CHP application	Dr. Nakorn Worasuwannarak	14 Sep 2026
LECTURE 3: Pyrolysis & bio-oil production	Dr. Nakorn Worasuwannarak	21 Sep 2026
LECTURE 4: Biomass gasification & other advanced uses	Dr. Nakorn Worasuwannarak	28 Sep 2026
EVALUATION: Exam papers		**5 Oct 2026**

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 bio-ethanol production **MLO 3:** Gain knowledge on bio-diesel production **MLO 4:** Understand how to assess the economics of biomass utilization system		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Other advanced biomass to liquid	Dr. Nakorn Worasuwannarak	12 Oct 2026
LECTURE 2: Bio-ethanol	Assoc. Prof. Dr. Suneerat Fukuda	19 Oct 2026
LECTURE 3: Bio-diesel	Assoc. Prof. Dr. Suneerat Fukuda	26 Oct 2026
LECTURE 4: Economic assessment of biomass utilization system	Assoc. Prof. Dr. Suneerat Fukuda	2 Nov 2026

EVALUATION: Exam papers	**30 Nov 2026**

MODULE 4: ECONOMIC ASSESSMENT, POLICY FRAMEWORK, AND ENVIRONMENTAL ASSESSMENT **MLO 1:** Understand the policy framework for biomass utilization **MLO 2:** Gain knowledge on biogas production **MLO 3:** Can assess the environment and sustainability of biomass utilization system		
Lecture No.: Title	Name of Instructor (Affiliation)	Teaching Period
LECTURE 1: Policy framework for biomass utilization	Assoc. Prof. Dr. Suneerat Fukuda	9 Nov 2026
LECTURE 2: Biogas production and utilization	Dr. Warinthorn Songkasiri	16 Nov 2026
LECTURE 3: Environment and sustainability assessment of biomass utilization system	Prof. Shabbir Gheewala	23 Nov 2026
EVALUATION: Exam papers		**30 Nov 2026**

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. Suneerat	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