	Universitas Negeri Surabaya Faculty of Engineering, Mechanical Engineering Education Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Combustion and Fuel Engineering	8320302175		T=2	P=0	ECTS=3.18	5	July 18, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	.....	.....	Ir. Wahyu Dwi Kurniawan, S.Pd., M.Pd.

Learning model	**Project Based Learning**
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**
	Program Objectives (PO)
	PLO-PO Matrix

	P.O

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

Short Course Description	Introduction to combustion and fuel techniques explains the phenomenon of changing chemical energy in fuel into heat energy, explains various types of fuel both conventional and alternative fuels, discusses combustion events starting from types of fuel, combustion reactions, calculation analysis and tools &ndash tools used for the combustion process
References	**Main :**

1. [1.] Michael Liberman. 2008. Introduction to Physics and Chemistry of Combustion. Springer-Verlag Berlin Heidelberg
2. [2.] Amit Sarin. 2012. Biodiesel: Production and Properties.Published by The Royal Society of Chemistry, Cambridge, UK
3. [3.] Graeme M. Walker & Ventus.2010. Bioethanol: Science and technology of fuel alcohol.Publishing ApS
4. [4.] Pratima Bajpai. 2013.Advances in Bioethanol. Springer New Delhi Heidelberg New York Dordrecht, London.
5. [5.] Tasneem Abbasi, S.M. Tauseef, S.A. Abbasi. 2012. Biogas Energy. Springer New York Dordrecht Heidelberg London
6. [6.] Ir. Dwi Heru Sutjahjo, MT. Buku Ajar Teknik Pembakaran dan Bahan Bakar. Jurusan Teknik Mesin, Fakultas Teknik, UNESA

Supporters:	
Supporting lecturer	Prof. Dr. Ir. I Wayan Susila, M.T. Prof. Dr. Muhaji, S.T., M.T.

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (*offline*)	Online (*online*)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1							0%

2	Understanding coal fuel	• Explain the coal mining and processing process • Explain the structure of coal • Explain several types of coal • Analyze coal, both proximate and ultimate analysis • Explain coal quality parameters	**Criteria:** According to the Rubric	Lectures, discussions, questions and answers, research journal analysis presentation assignments 100 minutes			0%
3	Understanding coal conversion	• Explain the basic concept of coal conversion • Explain the gasification process • Explain the coal liquefaction process • Explain several types of coal liquefaction methods	**Criteria:** According to the Rubric	Lectures, discussions, questions and answers, research journal analysis presentation assignments 100 minutes			0%
4	Understanding petroleum fuels	• Explain the structure and components of petroleum fuel • Explain the petroleum processing process • Explain the quality parameters of liquid fuel	**Criteria:** According to the Rubric	Lectures, discussions, questions and answers, research journal analysis presentation assignments 100 minutes			0%
5	Understanding gas fuel	• explain several types of gas fuel • Explain the process of processing gas fuel • Explain the components of gas fuel • Explain the quality parameters of gas fuel	**Criteria:** According to the Rubric	Lectures, discussions, questions and answers, research journal analysis presentation assignments 100 minutes			0%
6	Understanding biodiesel alternative fuels	• Explain the meaning of biodiesel fuel and vegetable oil • Explain several methods for reducing the viscosity of vegetable oil, including liquefaction or blending, micro-emulsification, pyrolysis (thermal cracking), and transesterification. • Explain the parameters and specifications of bodysel fuel • Explain examples of biodiesel production from various vegetable oil sources	**Criteria:** According to the Rubric	Lectures, discussions, questions and answers, research journal analysis presentation assignments 100 minutes			0%
7	Understanding bioethanol alternative fuels	• Explain the chemical structure, types and sources of ethanol • Explain the stages of the bioethanol production process • Explain the characteristics of ethanol fuel • Explain the advantages and disadvantages of using ethanol fuel • Explain examples of bioethanol production from various waste sources	**Criteria:** According to the Rubric	Lectures, discussions, questions and answers, research journal analysis presentation assignments 100 minutes			0%

8	Biogas alternative fuel	• Explain the meaning of biogas fuel • Explain the stages of the fermentation process which refer to the breakdown of complex organic compounds • Explain the factors that influence the process of anaerobic decomposition of organic compounds • Explain examples of biogas production processes, both from animal waste, water waste and solid waste other	**Criteria:** According to the Rubric	Lectures, discussions, questions and answers, research journal analysis presentation assignments 100 minutes			0%
9	U.S.S	U.S.S	**Criteria:** According to the Rubric	USS USS			0%
10	Understand the concept of combustion from a physics perspective	• Explains the basic thermodynamic concepts of entropy, enthalpy • Explains the concept of the first law of thermodynamics, • Explains the concepts of temperature, pressure, free energy and thermodynamic potential, • Explains Nernst‘s theory, the Carnot cycle, Le Chatelier‘s principle, the relationship between thermodynamic quantities and the number of particles, the concept of ideal gas.	**Criteria:** According to the Rubric	Lecture, Discussion, Question and Answer 100 Minutes			0%
11	Understand the concept of combustion from a chemical perspective	• Explain the heat of reaction and heat of formation, • Explain the origin of the heat of combustion based on molecular bonds • Explain the adiabatic flame temperature • Explain the equilibrium constant • Explain the chemical reaction process of compounds.	**Criteria:** According to the Rubric	Lecture, Discussion, Question and Answer 100 Minutes			0%

12	Understand external and internal combustion systems	• Explain the meaning of the external combustion system • Explain the combustion of gas fuel • Explain the process of burning liquid fuel, • Explain the combustion of solid fuel • Explain the meaning of the internal combustion system and its types • Explain the combustion system for petrol motors • Explain the components and their functions in the combustion of petrol motors	**Criteria:** According to the Rubric	Lecture, Discussion, Question and Answer 100 Minutes			0%
13	Able to carry out combustion air analysis	• State the objectives and aspects of combustion calculations • Explain and carry out calculations of theoretical air, excess air using the mass method (gravimetric method) • Explain and carry out calculations of theoretical air, excess air using the mole method • Understand the meaning and purpose of the air-fuel ratio (water-fuel ratio) or a/f ratio • Calculate the A/F combustion ratio	**Criteria:** According to the Rubric	Lecture, Discussion, Question and Answer 100 Minutes			0%
14	Able to carry out calorific value analysis	• Explain the meaning of the calorific value of combustion • Explain the types of calorific value of combustion • Explain the method of analyzing the calorific value experimentally • Explain how a bomb calorimeter works • Analyze the theoretical calorific value of fuel	**Criteria:** According to the Rubric	Lecture, Discussion, Question and Answer 100 Minutes			0%
15	Understand and be able to carry out exhaust gas analysis in the combustion process	• Explain the meaning of flue gas in the combustion process • Explain the composition of flue gas • Analyze theoretical flue gas values • Analyze actual flue gas	**Criteria:** According to the Rubric	Lecture, Discussion, Question and Answer 100 Minutes			0%
16	UAS	UAS	**Criteria:** According to the Rubric	UAS UAS			0%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
		0%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.