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

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight	SEMESTER	Compilation Date
Life Sciences	2120103111		T=3 P=0 ECTS=4.77	1	July 16, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Handini Novita Sari, S.Pd., M.T. Ika Nurjannah, S.Pd., M.T., Aris Ansori, S.Pd., M.T., Saiful Anwar, S.Pd., M.T.	Handini Novita Sari, S.Pd., M.T.	Ir. Priyo Heru Adiwibowo, S.T., M.T.

Learning model: Case Studies

Program Learning Outcomes (PLO)

PLO study program that is charged to the course

PLO-11	Design and development of solutions that take into account the environment and sustainability
PLO-14	Science and engineering knowledge

Program Objectives (PO)

PO - 1	Knowledge of science and engineering
PO - 2	Experimentation and data analysis
PO - 3	Problem analysis

PLO-PO Matrix

P.O	PLO-11	PLO-14
PO-1		
PO-2		
PO-3		

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
PO-1																
PO-2																
PO-3																

Short Course Description: This course is an understanding of the basic concepts of earth/life sciences which contains an introduction to life sciences which is an intersection with mechanical engineering which is related to mechanical systems in animals and humans. The discussion begins with understanding the concept of life science structure, an introduction to cells from chemical and biological aspects, then continues with a discussion of bioenergy and metabolism. The discussion of life sciences is deepened by discussing material on mechanical systems in animals which includes: animal control systems, thermoregulation, homeostasis, biomechanics, animal locomotion, and scale effects. Then regarding the natural environment which discusses food and agriculture, environmental conservation, air and water. The next discussion discusses mechanical systems in humans, namely anatomy and physiology, human biomechanics, biomaterials, bioinstrumentation and biosensors.

References

Main :

1. Alexander, R. McNeill. Principles of animal locomotion. Princeton University Press, 2003.
2. Karp, G. Cell and Molecular Biology, 5th ed., John Wiley and Sons, Inc.
3. Berger, S. et al. Introduction to Bioengineering, Oxford University Press
4. Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.
5. Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011
6. Klein, Bradley G. Cunninghams textbook of veterinary physiology. Elsevier Health Sciences, 2013.
7. Enderle, John Denis, and Joseph D. Bronzino. Introduction to biomedical engineering. Academic press, 2012.
8. Rizal Alamsyah. Inovasi Teknologi Pemrosesan Biomassa Menjadi Biofuel untuk Mendukung Penerapan Energi Baru dan Terbarukan (EBT). Badan Riset dan Inovasi Nasional,2022. ISBN-13 (15) 978-623-8052-09-7
9. Arief Budiman. Biomassa: Anugerah dan Berkah yang Belum Terjamah. UGM Press, 2019. ISBN: 978-602-386-244-3
10. M. Daud. Bioenergi dari Bahan Non Pangan: Memanen Bensin dari Hutan untuk Ketahanan Energi Indonesia. Publisher: Philosophia Press, Makassar, 2014. ISBN: 978-602-18177-9-7
11. Bhaskar Singh, Abhishek Guldhe. Waste and Biodiesel: Feedstocks and Precursors for Catalystsbooks. Elsevier, 2022.
12. Gerhard Knothe, Jürgen Krahl, Jon Van Gerpen. The Biodiesel Handbook 2nd edition . Elsevier, 2015.
13. Charles Wyman. Handbook on Bioethanol: Production and Utilizationbooks.google.com › books. Taylor & Francis, 1996.

Supporters:

	1. Sebaiknya Konsumen Tahu Tentang PLTS Dan Biodisel. https://energiterbarukan.org/assets/2020/10/BUKU-PLTS-DAN-BIODISEL.pdf 2. Arief Budiman, dkk. Biodiesel: Bahan Baku, Proses, dan Teknologi. UGM Press, 2018. ISBN: 979-420-959-71404064-B5E. 3. Baskar Gurunathan, Renganathan Sahadevan, Zainul Akmar Zakaria. Biofuels and Bioenergy: Opportunities and Challenges. Elsevier. 2021. 4. Umar, Jaka.Biomekanika Olahraga. Sukabina Press, 2018. ISBN: 978–623–7018– 02–5. 5. Sukmana, Irza. Ilmu dan Teknologi Biomaterial. Teknosain, 2017. ISBN : 978-602-6324-73-3. 6. Wibisono, Yusuf. Biomaterial & Bioproduk. UB Press, 2017. ISBN 978-602-432-181-9.
Supporting lecturer	Saiful Anwar, S.Pd., M.T. Dr. Aris Ansori, S.Pd., M.T. Ika Nurjannah, S.Pd., M.T. Handini Novita Sari, S.Pd., 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	Students are able to communicate their understanding of definitions, concepts and the relationship between life sciences and engineering sciences.	1.Students are able to explain the definitions and concepts of Life Sciences 2.Students are able to understand the intersection of mechanical engineering knowledge 3.Convey ideas/questions	**Criteria:** Student activity during lectures **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 3 X 50		**Material:** Introduction to life sciences **References:** *Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.*	5%
2	Students are able to communicate their understanding of structural materials and the role of life sciences in life	Students are able to understand, explain and analyze chemical aspects in biology which include: acids, bases, carbohydrates, lipids, proteins, nucleic acids	**Criteria:** 1.Student activity during lectures/discussions 2.Completeness of the report on the results of the introductory cell analysis task **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 3 X 50		**Material:** Structure and role of life sciences in life. **Bibliography:** *Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.*	5%
3	Students are able to communicate their understanding of introductory cell material	Students are able to understand, explain and analyze chemical aspects in biology which include: acids, bases, carbohydrates, lipids, proteins, nucleic acids	**Criteria:** 1.Student activity during lectures/discussions 2.Completeness of the report on the results of the introductory cell analysis task **Form of Assessment** : Participatory Activities	Lectures, discussions and questions and answers 3 X 50		**Material:** Introduction to cells **Bibliography:** *Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011*	5%
4	Students are able to communicate their understanding of metabolism	1.Students understand the principles of metabolism 2.Students are able to understand, differentiate and explain aerobic and anaerobic respiration, photosynthesis	**Criteria:** 1.Student activity 2.Completeness of the report on the results of the metabolic analysis task **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Metabolism **Bibliography:** *Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.*	5%
5	Students are able to communicate their understanding of mechanical systems in animals (1)	1.Students understand the mechanical systems in animals 2.Students understand animal control systems, thermoregulation and homeostasis	**Criteria:** 1.Activeness during discussions 2.Completeness of the report on the results of the mechanical system analysis task in animals (1) **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Mechanical systems in animals **References:** *Alexander, R. McNeill. Principles of animal locomotion. Princeton University Press, 2003.* **Material:** Mechanical systems in animals. **Reference:** *Klein, Bradley G. Cunningham's textbook of veterinary physiology. Elsevier Health Sciences, 2013.*	5%
6	Students are able to communicate their understanding of mechanical systems in animals (2)	1.Students understand the principles of biomechanics in animals 2.Students understand the concept of animal locomotion and the methods used 3.Students are able to analyze scale effects in animals	**Criteria:** 1.Activeness during discussions 2.Completeness of the report on the results of the mechanical system analysis task in animals (2) **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Mechanical systems in animals **References:** *Alexander, R. McNeill. Principles of animal locomotion. Princeton University Press, 2003.* **Material:** Mechanical systems in animals. **Reference:** *Klein, Bradley G. Cunningham's textbook of veterinary physiology. Elsevier Health Sciences, 2013.*	5%

7	Students are able to communicate their understanding of bioenergy	1. Students are able to explain the basic definitions and concepts of bioenergy 2. Students are able to explain the current energy conditions 3. Students are able to explain the development of new renewable energy 4. Students are able to understand and explain the potential of EBT in Indonesia 5. Students are able to explain bioenergy producing materials 6. Convey ideas/questions	**Criteria:** 1. Student activity during lectures 2. Full marks are obtained if you are able to answer all questions/questions correctly **Form of Assessment** : Participatory Activities, Tests	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Bioenergy **Bibliography:** *Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.* **Material:** Bioenergy **References:** *Berger, S. et al. Introduction to Bioengineering, Oxford University Press*	10%
8	UTS	Students are able to answer all questions correctly	**Criteria:** Full marks are obtained if you are able to answer all questions correctly	Close book 3 X 50		**Material:** 1-7 **Bibliography:** *Alexander, R. McNeill. Principles of animal locomotion. Princeton University Press, 2003.* **Material:** 1-7 **References:** *Karp, G. Cell and Molecular Biology, 5th ed., John Wiley and Sons, Inc.* **Material:** 1-7 **Bibliography:** *Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.* **Material:** 1-7 **Bibliography:** *Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011* **Material:** 1-7 **Bibliography:** *Klein, Bradley G. Cunninghams textbook of veterinary physiology. Elsevier Health Sciences, 2013.*	10%
9	Understand the concept of the natural environment (1)	1. Students are able to explain the basic definitions and concepts of biomass, biobriquettes and biogas 2. Students are able to explain the types of raw materials for biobriquettes and biogas, the process of developing biobriquettes and biogas 3. Students are able to explain the process of developing biobriquettes and biogas 4. Students are able to understand and explain the chemical reactions in the formation of biogas 5. Students are able to explain the implementation of biogas utilization for electricity development 6. Convey ideas/questions	**Criteria:** 1. Student activity during discussions 2. Completeness of reports on the results of biomass, biobriquette and biogas analysis tasks **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Biomass, biobriquettes and biogas **References:** *Cunningham, William P., and Mary Ann Cunningham. Principles of environmental science: inquiry & applications. McGraw-Hill, 2011.* **Material:** Biomass, biobriquettes and biogas **Reader:** *Rizal Alamsyah. Biomass Processing Technology Innovation into Biofuel to Support the Application of New and Renewable Energy (EBT). National Research and Innovation Agency, 2022. ISBN-13 (15) 978-623-8052-09-7* **Material:** Biomass, biobriquettes and biogas **Reader:** *Arief Budiman. Biomass: An Unexplored Gift and Blessing. UGM Press, 2019. ISBN: 978-602-386-244-3* **Material:** Biomass, biobriquettes and biogas **Reader:** *M. Daud. Bioenergy from Non-Food Materials: Harvesting Gasoline from Forests for Indonesia's Energy Security. Publisher: Philosophia Press, Makassar, 2014. ISBN: 978-602-18177-9-7*	5%

10	Understand the concept of the natural environment (2)	1.Students are able to explain the basic definitions and concepts of biodiesel 2.Students are able to explain the types of biodiesel raw materials 3.Students are able to explain the process of developing biodiesel 4.Students are able to understand and explain the use and advantages of using biodiesel 5.Students are able to explain the quality parameters of biodiesel 6.Convey ideas/questions	**Criteria:** 1.Student activity during discussions 2.Completeness of the report on the results of the biodiesel analysis task **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Biodiesel **Bibliography:** *Bhaskar Singh, Abhishek Guldhe. Waste and Biodiesel: Feedstocks and Precursors for Catalystsbooks. Elsevier, 2022.* **Material:** Biodiesel **References:** *Gerhard Knothe, Jürgen Krahl, Jon Van Gerpen. The Biodiesel Handbook 2nd edition. Elsevier, 2015.* **Material:** Biodiesel **Literature:** *Consumers Should Know About PLTS and Biodiesel. https://energiterbarukan.org/...* **Material:** Biodiesel **Reference:** *Arief Budiman, et al. Biodiesel: Raw Materials, Processes, and Technology. UGM Press, 2018. ISBN: 979-420-959-71404064-B5E.*	5%
11	Understand the concept of the natural environment (3)	1.Students are able to explain the definition and basic concepts of bioethanol 2.Students are able to explain the types of bioethanol raw materials 3.Students are able to explain the process of developing bioethanol 4.Students are able to understand and explain the use and advantages of using bioethanol 5.Students are able to explain the quality parameters of bioethanol 6.Convey ideas/questions	**Criteria:** 1.Student activity during discussions 2.Completeness of the report on the results of the bioethanol analysis task **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Bioethanol **Reader:** *Charles Wyman. Handbook on Bioethanol: Production and Utilizationbooks.google.com › books. Taylor & Francis, 1996.* **Material:** Bioethanol **Bibliography:** *Baskar Gurunathan, Renganathan Sahadevan, Zainul Akmar Zakaria. Biofuels and Bioenergy: Opportunities and Challenges. Elsevier. 2021.*	5%
12	Understanding the mechanical system in humans (1)	1.Students are able to understand, explain human mechanical systems in anatomy and physiology 2.Convey ideas/questions	**Criteria:** 1.Student activity during discussions 2.Completeness of the report on the results of the analysis of human mechanical systems in anatomy and physiology **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Mechanical systems in humans **References:** *Karp, G. Cell and Molecular Biology, 5th ed., John Wiley and Sons, Inc.* **Material:** Mechanical systems in humans **References:** *Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011*	5%
13	Understanding mechanical systems in humans (2)	1.Students are able to understand, explain the human biomechanical system 2.Convey ideas/questions	**Criteria:** Student activity during discussions **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Mechanical systems in humans **References:** *Karp, G. Cell and Molecular Biology, 5th ed., John Wiley and Sons, Inc.* **Material:** Mechanical systems in humans **References:** *Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011* **Material:** Biomechanics **Bibliography:** *Umar, Jaka. Sports Biomechanics. Sukabina Press, 2018. ISBN: 978–623–7018– 02–5.*	5%

14	Understanding mechanical systems in humans (3)	1. Students are able to explain the basic definitions and concepts of biomaterials and bioproducts 2. Students are able to explain the classification of biomaterials and bioproducts 3. Students are able to explain the advantages and disadvantages of biomaterials 4. Students are able to explain the application of using biomaterials as bioproducts 5. Students are able to explain the mechanical properties of biomaterials 6. Convey ideas/questions	**Criteria:** 1. Student activity during discussions 2. Completeness of reports on the results of biomaterial and bioproduct analysis tasks **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Mechanical systems in humans **References:** *Karp, G. Cell and Molecular Biology, 5th ed., John Wiley and Sons, Inc.* **Material:** Mechanical systems in humans **References:** *Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011* **Material:** Biomaterials **References:** *Sukmana, Irza. Biomaterials Science and Technology. Technosain, 2017. ISBN: 978-602-6324-73-3.* **Material:** Biomaterials and bioproducts **Reader:** *Wibisono, Yusuf. Biomaterials & Bioproducts. UB Press, 2017. ISBN 978-602-432-181-9.*	5%
15	Understanding mechanical systems in humans (4)	1. Students are able to explain the basic definitions and concepts of bioinstrumentation, biosensors 2. Students are able to explain the application of using ioinstrumentation, biosensors 3. Convey ideas/questions	**Criteria:** 1. Student activity during discussions 2. Completeness of reports on the results of bioinstrumentation and biosensor analysis tasks **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 3 X 50		**Material:** Mechanical systems in humans **References:** *Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011* **Material:** Bioinstrumentation, biosensors **References:** *Berger, S. et al. Introduction to Bioengineering, Oxford University Press* **Material:** Bioinstrumentation, biosensors **References:** *Enderle, John Denis, and Joseph D. Bronzino. Introduction to biomedical engineering. Academic press, 2012.*	10%
16	UAS	Students are able to answer all questions correctly	**Criteria:** Full marks are obtained if you are able to answer all questions correctly			**Material:** 9 **Bibliography:** *Rizal Alamsyah. Biomass Processing Technology Innovation into Biofuel to Support the Application of New and Renewable Energy (EBT). National Research and Innovation Agency, 2022. ISBN-13 (15) 978-623-8052-09-7* **Material:** 10 **Bibliography:** *Baskar Gurunathan, Renganathan Sahadevan, Zainul Akmar Zakaria. Biofuels and Bioenergy: Opportunities and Challenges. Elsevier. 2021.* **Material:** 11 **Bibliography:** *Charles Wyman. Handbook on Bioethanol: Production and Utilizationbooks.google.com › books. Taylor & Francis, 1996.* **Material:** 12 **Bibliography:** *Cosentino, Carlo, and Declan Bates. Feedback control in systems biology. CRC Press, 2011* **Material:** 13 **References:** *Umar, Jaka. Sports Biomechanics. Sukabina Press, 2018. ISBN: 978–623–7018– 02–5.* **Material:** 14 **Bibliography:** *Wibisono, Yusuf. Biomaterials & Bioproducts. UB Press, 2017. ISBN 978-602-432-181-9.* **Material:** 15 **References:** *Berger, S. et al. Introduction to Bioengineering, Oxford University Press*	10%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	75%
2.	Test	5%
		80%

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.