	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
Heat and Mass Transfer 1	2120102134		T=2	P=0	ECTS=3.18	3	July 16, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
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Learning model	**Project Based Learning**

Program Learning Outcomes (PLO)

PLO study program that is charged to the course	
PLO-5	Work independently and in groups
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-5	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 discusses the concepts of heat transfer, basic laws of heat transfer and their applications in the field of mechanical engineering, heat transfer by conduction, convection and radiation, energy conservation required for heat transfer, conduction rate and 1-dimensional steady state conduction on a plane wall. as well as in radial systems and heat transfer on extended surfaces

References

Main :

1. Cengel, Y.A. 1998. Heat Transfer : A Practical Aproach. New York : Mc. Graw-Hill. [2] Holman, J.P. 1994. Perpindahan Kalor , Edisi Keenam, Alih Bahasa Ir. E. Jasjfi, Msc, Erlangga, Jakarta: Penerbit Erlangga [3] Incropera, Frank P. dan Dewitt, David P. 2011. Fundamental of Heat and Mass Transfer . 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith dan Petter Harriott. 1999. Operasi Teknik Kimia , Edisi Keempat, Alih Bahasa Ir. E. Jasjfi, Msc, Erlangga, Jakarta: Penerbit Erlangga
2. Holman, J.P. 1994. Perpindahan Kalor, Edisi Keenam, Alih Bahasa Ir. E. Jasjfi, Msc, Erlangga, Jakarta: Penerbit Erlangga.
3. Incropera, Frank P. dan Dewitt, David P. 2011. Fundamental of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.

Supporters:

Supporting lecturer	Prof. Dr. I Made Arsana, S.Pd., M.T. Ir. Priyo Heru Adiwibowo, S.T., 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 explain the basic concepts of heat transfer	1. Students are able to explain the definition of heat transfer 2. Students are able to mention the applications of heat transfer in everyday life	**Criteria:** 1. Completeness of the report on the results of the heat transfer concept analysis assignment 2. Ability to classify types of heat transfer 3. Ability to differentiate and analyze types of heat transfer 4. Student activity in the lecture process **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, practice 2 X 50		**Material:** Introduction to heat transfer **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** Introduction to heat transfer **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers* **Material:** Introduction to heat transfer **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.*	3%

2	Students are able to explain in detail the basic laws of heat transfer	1. Students are able to explain the mechanisms of heat transfer by conduction, convection and radiation 2. Students are able to formulate precise heat transfer formulas for conduction, convection and radiation 3. Students are able to analyze and solve problems related to conduction, convection and radiation heat transfer 4. Students are able to write units, quantities and dimensions correctly	**Criteria:** Student activity in the lecture process **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Introduction to heat transfer **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** Introduction to heat transfer **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	3%

3	Students are able to explain the basic concepts of energy conservation and balance	1. Students can explain energy conservation from a volume control 2. Students are able to state the concept of surface energy balance 3. Students are able to apply the law of energy conservation correctly and solve problems related to heat transfer 4. Students are able to state basic units and dimensions 5. Convey ideas/questions	**Criteria:** 1. Student activity during lectures 2. Completeness of the report on the results of the basics of conduction analysis task **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Basics of conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** Basics of conduction **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	5%

4	Students are able to explain the basics of conduction	1. Students can explain the conduction rate equation 2. Students are able to mention the thermal properties of materials 3. Students are able to write the heat diffusion equation correctly 4. Students are able to describe boundary and initial conditions 5. Convey ideas/questions	**Criteria:** 1. Student activity during lectures 2. Completeness of the report on the results of the basics of conduction analysis task **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** Basics of conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** Basics of conduction **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	5%

5	Students are able to explain and analyze 1D steady conduction heat transfer on a plane wall	1. Students are able to explain the concept of 1D heat transfer on a plane wall 2. Students are able to write the 1D heat transfer formula on a plane wall correctly 3. Students are able to describe the thermal circuit on a plane wall 4. Students can analyze the thermal resistance circuit on a plane wall either in series or parallel 5. Students are able to solve 1D heat transfer problems on plane walls 6. Students are able to analyze the conduction process with heat generation on a plane wall 7. Convey ideas/questions	**Criteria:** 1. Student activity during lectures 2. Completeness of the report on the results of the 1D heat transfer analysis task on the plane wall **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** 1D steady conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** 1D steady conduction **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers* **Material:** 1D steady conduction **References:** *Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers.*	3%

6	Students are able to explain and analyze 1D steady conduction heat transfer on a plane wall	1. Students are able to explain the concept of 1D heat transfer on a plane wall 2. Students are able to write the 1D heat transfer formula on a plane wall correctly 3. Students are able to describe the thermal circuit on a plane wall 4. Students can analyze the thermal resistance circuit on a plane wall either in series or parallel 5. Students are able to solve 1D heat transfer problems on plane walls 6. Students are able to analyze the conduction process with heat generation on a plane wall 7. Convey ideas/questions	**Criteria:** 1. Student activity during lectures 2. Completeness of the report on the results of the 1D heat transfer analysis task on the plane wall **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** 1D steady conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** 1D steady conduction **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers* **Material:** 1D steady conduction **References:** *Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers.*	4%
7	Students are able to explain and analyze 1D steady conduction heat transfer in a radial system	1. Students are able to explain 1D heat transfer in a radial system 2. Students are able to write the 1D heat	**Criteria:** 1. Student activity during lectures 2. Completeness of the report on the results of the 1D heat transfer	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** 1D steady conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals*	5%

		transfer formula in a radial system correctly 3. Students are able to describe the thermal circuit in a radial system 4. Students can analyze thermal resistance circuits in radial systems either in series or parallel 5. Students are able to solve 1D heat transfer problems in radial systems 6. Students are able to analyze the conduction process with heat generation in a radial system 7. Convey ideas/questions	analysis task in the radial system 3. Convey ideas/questions **Form of Assessment** : Participatory Activities, Portfolio Assessment			*of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** 1D steady conduction **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers* **Material:** 1D steady conduction **References:** *Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers.* **Material:** on radial systems **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.*	

8	UTS	Students are able to answer all questions correctly	**Criteria:** Answer all questions correctly **Form of Assessment** : Test	Close book 2 X 50		**Material:** 1-7 **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** 1-7 **References:** *Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers.* **Material:** 1-7 **References:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	0%

9	Students are able to understand heat transfer on extended surfaces, can design fin applications on engines (cylinder blocks)	1. Students are able to explain the concept of heat transfer in fins 2. Students can name the types of fins 3. Students are able to analyze heat transfer at the fin 4. Students can calculate fin efficiency and performance correctly 5. Students can design fin applications on engines (cylinder blocks) 6. Students can analyze the heat transfer that occurs in the cylinder block	**Criteria:** 1. Student activity during lectures 2. Completeness of the report on the results of the heat transfer analysis task on the fins **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments. 2 X 50		**Material:** Heat transfer in fins Reference **:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** Heat transfer in fins Reference **:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	25%

10	Students are able to understand heat transfer on extended surfaces, and can analyze the heat transfer that occurs in the cylinder block that has been designed	1. Students are able to explain the concept of heat transfer in fins 2. Students can name the types of fins 3. Students are able to analyze heat transfer at the fin 4. Students can calculate fin efficiency and performance correctly 5. Students can design fin applications on engines (cylinder blocks) 6. Students can analyze the heat transfer that occurs in the cylinder block	**Criteria:** 1. Student activity during lectures 2. Completeness of the report on the results of the heat transfer analysis task on the fins **Form of Assessment** : Project Results Assessment / Product Assessment	Lectures, discussions, questions and answers, exercises and assignments. 2 X 50		**Material:** Heat transfer in fins Reference **:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** Heat transfer in fins Reference **:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	25%

11	Students present journal results based on project analysis that has been carried out	1. Students can present journals well 2. Convey ideas/questions	**Criteria:** Student activity during discussions **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions, questions and answers, exercises and assignments. 2 X 50		**Material:** Transient conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** Transient conduction **References:** *Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers.*	4%
12	Students are able to understand transient conduction	1. Students can explain the lumped capacitance method and when to apply it 2. Students can differentiate between the concepts of transient conduction in flat walls, radial systems, and semi-infinite solidus 3. Convey ideas/questions	**Criteria:** 1. Student activity during discussions 2. Completeness of the report on the results of analysis tasks regarding transient conduction **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions, questions and answers, exercises and assignments. 2 X 50		**Material:** Transient conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** Transient conduction **References:** *Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers.*	4%

13	Students are able to analyze heat transfer by convection	1. Students are able to explain the concept of convection heat transfer 2. Students are able to differentiate and analyze types of convection heat transfer 3. Students mention the application of convection in the industrial world 4. Students are able to analyze problems related to convection and solve them using empirical equations correctly 5. Convey ideas/questions	**Criteria:** 5 **Form of Assessment** : Participatory Activities	Lectures, discussions, questions and answers, experiments and assignments. 2 X 50		**Material:** **Library** Convection : *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.*	4%

14	Students are able to explain and analyze 2D steady conduction		**Criteria:** 1. Students are able to explain and differentiate between variable separation methods, finite difference methods (FDM), and graphical methods 2. Students are able to analyze conduction shape factors and non-dimensional conduction rates 3. Convey ideas/questions **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions, questions and answers, experiments and assignments. 2 X 50		**Material:** 2D Conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** 2D Conduction **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	5%

15	Students are able to explain and analyze 2D steady conduction	1. Students are able to explain the concept of variable separation methods 2. Students can explain and analyze constant heat flux surfaces	**Criteria:** 1. Present journals according to assessment indicators 2. Provide opinions or responses to journals being reviewed regarding content and development ideas 3. Student activity during lectures **Form of Assessment** : Participatory Activities, Portfolio Assessment	Lectures, discussions, questions and answers, exercises and assignments 2 X 50		**Material:** 2D Conduction **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** 2D Conduction **Reference:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	5%

16	UAS	Students are able to answer all questions correctly	**Criteria:** Answer all questions correctly **Form of Assessment** : Test	Close book 2 X 50		**Material:** 9-15 **References:** *Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc.* **Material:** 9-15 **References:** *Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers.* **Material:** 9-15 **References:** *Cengel, YA 1998. Heat Transfer: A Practical Approach. New York : Mc. Graw-Hill. [2] Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers [3] Incropera, Frank P. and Dewitt, David P. 2011. Fundamentals of Heat and Mass Transfer. 7th Edition. John Wiley & Sons, Inc. [4] Warren L. McCabe, Julian C Smith and Petter Harriott. 1999. Chemical Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers*	0%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	33.5%
2.	Project Results Assessment / Product Assessment	50%
3.	Portfolio Assessment	16.5%
		100%

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.