



## Universitas Negeri Surabaya Faculty of Engineering, Mechanical Engineering Undergraduate Study Program

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			SE	ME	STE	R	LEA	RN	JII/	IG I	PL/	٩N							
Courses			CODE			C	ourse F	amil	у		Cre	dit We	eight		SEME	STER	Co	mpilat te	ion
Heat and Mas	s Transfer 1		2120102134	ļ							T=2	P=0	ECT	S=3.18		3	Jul	y 16, 2	024
AUTHORIZAT	TON		SP Develop	er					(	Cours	e Clu	ster C	oordii	nator		/ Progr dinator			
			Handini Novi	ita Sari	, S.Pd.,	, M.T			1	Or. I M	1ade A	Arsana	, S.Pd	., M.T.	lr. F	Priyo He S.T	eru Ad ., M.T	iwibow	0,
Learning model	Project Based	Learn	ning																
Program	PLO study pr	ogran	n that is char	rged to	the c	ours	е												
Learning Outcomes	PLO-5	Work	independently	and in	groups	6													
(PLO)	PLO-14	Scier	nce and engine	ering k	nowled	ge													
	Program Obje	ective	s (PO)																
	PO - 1	Know	ledge of scienc	ce and	engine	ering													
	PO - 2	Expe	rimentation and	d data a	analysis	6													
	PO - 3	Probl	em analysis																
	PLO-PO Matr	ix																	
			P.O		PLO-5		P	LO-14	L	1									
		-	PO-1	<u>'</u>			•			-									
		-																	
		-	PO-2																
			PO-3																
	PO Matrix at	the en	nd of each lea	arning	stage	(Sul	o-PO)												
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		P	O-1																1
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		P	O-3																]
Short Course	This course die	scusse	es the concept	ts of he	eat trar	nsfer,	basic	laws	of he	eat tra	ansfer	and to	their a	pplication	ons in	the fiel	d of n	nechan	ical and
Description	1-dimensional s	steady	state conduction	on on a	plane	wall.	as well	as in	radi	al syst	tems a	and he	at tran	sfer on	extend	ed surf	aces		
References	Main:																		
	Edisi K 2011. F dan Pe Erlang 2. Holma	eenam Fundar etter H ga n, J.P.	1998. Heat Tran, Alih Bahasa mental of Heat arriott. 1999. C 1994. Perpinda ank P. dan Dev	Ir. E. Ja and M Operasi ahan K	asjfi, M: ass Tra Teknik alor, Ed	sc, E ansfe K Kim disi K	rlangga r . 7th ia , Ed eenam	i, Jaka Editio isi Ke , Alih	arta: n. Jo emp Baha	Pener ohn W at, Ali asa Ir.	bit Erl 'iley & h Bah E. Ja	angga Sons asa Ir sjfi, M	a [3] In , Inc. [ . E. Ja sc, Erla	cropera 4] Wari sjfi, Ms angga,	, Frank en L. N c, Erla Jakarta	P. dan McCabe ngga, J : Pener	Dewit , Julia akarta bit Erl	t, David In C Si I: Pend angga.	d P. mith erbit
	Supporters:																		
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Support lecturer	Ir. Priyo Heru A	e Arsana, S.Pd., M.T. diwibowo, S.T., M.T. Sari, S.Pd., M.T.					
Week-	Final abilities of each learning stage	Eva	Evaluation		elp Learning, ning methods, nt Assignments, stimated time]	Learning materials [ References	Assessment Weight (%)
	(Sub-PO)	Indicator	Criteria & Form	Offline ( offline )	Online ( online )	1	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

	Charlents contain			l	1	
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 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. 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%

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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, Jakarta: Engineering Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga, Jakarta: Erlangga, Jakarta: Erlangga, Jakarta: Erlangga, Jakarta: Erlangga, Jakarta: Erlangga, Publishers	

Г	2	Students are able	10.1.	Cuitoria	Loctures	Motorist	E0/
	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,	5%
						Operations, Fourth	

<del></del>	ı	1			T T	1
to ba	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 Jakarta: Erlangga Operations, Fourth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga	

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5	Students are able	1.Students are	Criteria:	Lectures,	Material: 1D	3%
	to explain and	able to explain	1.Student activity	discussions,	steady	
	analyze 1D	the concept of	during lectures	questions	conduction	
	steady	1D heat	2.Completeness of	and	References:	
	conduction heat transfer on a		-	answers,	Incropera,	
	plane wall	transfer on a	the report on the	exercises	Frank P. and	
	plane wan	plane wall	results of the 1D	and	Dewitt, David	
		<ol><li>Students are</li></ol>	heat transfer	assignments	P. 2011.	
		able to write	analysis task on	2 X 50	F. 2011. Fundamentals	
		the 1D heat	the plane wall	2 / 30	of Heat and	
		transfer				
		formula on a	Form of Assessment :		Mass	
			Participatory Activities		Transfer. 7th	
		plane wall			Edition. John	
		correctly			Wiley & Sons,	
		<ol><li>Students are</li></ol>			Inc.	
		able to				
		describe the			Material: 1D	
		thermal circuit			steady	
		on a plane wall			conduction	
		4.Students can			Reference:	
					Cengel, YA	
		analyze the			1998. Heat	
		thermal				
		resistance			Transfer: A	
		circuit on a			Practical	
		plane wall			Approach.	
		either in series			New York :	
		or parallel			Mc. Graw-Hill.	
					[2] Holman,	
		5.Students are			JP 1994. Heat	
		able to solve			Transfer,	
		1D heat			Sixth Edition,	
		transfer			Translated by	
		problems on			Ir. E. Jasjfi,	
		plane walls			MSc,	
		6.Students are			Erlangga,	
					Jakarta:	
		able to analyze				
		the conduction			Erlangga	
		process with			Publishers [3]	
		heat generation			Incropera,	
		on a plane wall			Frank P. and	
		7.Convey			Dewitt, David	
		ideas/questions			P. 2011.	
		iucas/questions			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	
					Publishers	
					Material: 1D	
					steady	
					conduction	
					References:	
					Holman, JP	
					1994. Heat	
					Transfer,	
					Sixth Edition,	
					Translated by	
					Translated by	
					Translated by Ir. E. Jasjfi, MSc,	
					Translated by Ir. E. Jasjfi, MSc, Erlangga,	
					Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta:	
					Translated by Ir. E. Jasjfi, MSc, Erlangga,	

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, 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,	4%
					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,	
					steady conduction References: Holman, JP 1994. Heat Transfer, Sixth Edition, Translated by Ir. E. Jasjfi, MSc, Erlangga, Jakarta: Erlangga Publishers.	
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%

	nsfer	analysis task in		of Heat and	
	mula in a	the radial system		Mass Transfer. 7th	
	dial system rrectly	3.Convey ideas/questions		Edition. John	
	udents are	ideas/questions		Wiley & Sons,	
	le to	Form of Assessment :		Inc.	
	scribe the ermal circuit	Participatory Activities, Portfolio Assessment		Material: 1D	
	a radial			steady	
	stem			conduction Reference:	
	udents can			Cengel, YA	
	alyze ermal			1998. Heat	
	sistance			Transfer: A Practical	
	cuits in radial			Approach.	
	stems either			New York : Mc. Graw-Hill.	
	series or rallel			[2] Holman,	
	udents are			JP 1994. Heat	
	le to solve			Transfer, Sixth Edition,	
	heat Insfer			Translated by	
	oblems in			Ir. E. Jasjfi,	
	dial systems			MSc, Erlangga,	
	udents are le to analyze			Jakarta:	
	e conduction			Erlangga Publishers [3]	
pro	ocess with			Incropera,	
	at generation			Frank P. and	
	a radial stem			Dewitt, David P. 2011.	
	onvey			Fundamentals	
ide	eas/questions			of Heat and Mass	
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				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.	

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8	UTS	Students are able to answer all	Criteria: Answer all questions	Close book	Material: 1-7	0%
		questions correctly	correctly	2 X 50	References:	
		,	55.155.19		Incropera, Frank P. and	
			Form of Assessment :		Dewitt, David	
			Test		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	
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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, Fourtin, Fourtin, Fundaga, Jakarta: Erlangga, Publishers	25%

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10	Students are able to understand heat transfer on extended surfaces, and can analyze the heat transfer 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	Hein f Rei : Inn Fra Dei P.: Gir Ma Tra Edi Wiil Inc  Ma Hei in f Rei : C1 193 Tra Appl Nee Mc[2] JP Trix Sixix Ir. II. MS Erla Pui Inc Fra Dei Vii Inc Wii Inc Fra Dei P.: Fur Of I Ma Tra Edi Wii Inc Fra Dei P.: Fur Of I Ma Tra Edi Wii Inc Wa Mc Juli Sm Pea Ch Eng Op Foli Edi Ir. I. MS Erla Jak Jak Jak Jak Jak Jak Jak Jak Jak Ja	ference acropera, ank P. and witt, David 2011. Indamentals Heat and ass ansfer. 7th lition. John ley & Sons, and terial: Leat transfer fins ference cengel, YA 988. Heat ansfer: A actical proach. W York: C. Graw-Hill. Holman, 1994. Heat ansfer, and the Edition, anslated by E. Jasjfi, Sc, angga, karta: angga blishers [3] cropera, ank P. and witt, David 2011. Indamentals Heat and ley & Sons, ansfer. 7th lition. John ley & Sons, ansfer. 7th lition. John ley & Sons, and P. and witt. 1999. Learnen L. Scabe, lian C on the middle gineering perations, urth lition, lanslated by E. Jasjfi, lation, lation lation lation lation lation lation lation, la	25%

4.0	Operations 1			I	T	
11	Students present journal results based on project analysis that has been carried out	Students can present journals well     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. Fundamental 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.	S
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. Fundamental 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.	S

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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%

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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	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
		Form of Assessment : Participatory Activities, Portfolio Assessment		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

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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, Jakarta: Erlangga, Jakarta: Erlangga, Jakarta: 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	Reference Increase In	damentals leat and ss nsfer. 7th ion. John ey & Sons,	0%
					Refe Holm 1994 Tran Sixtl Tran Ir. E MSC Erlan Jaka Erlan Publ	ingga,	
					Cen. 1998 Trar Prac Appi New Mc. [2] H JP 1 Trar Sixti Trar Ir. E MSc	ngel, YA 8. Heat nsfer: A ctical roroach. v York: Graw-Hill. Holman, 1994. Heat nsfer, h Edition, nslated by L Jasjfi, C,	
					Jaka Erlai Pubi Incro Fran Dew P. 2 Fund of H. Mas Tran Editi	ungga ulishers [3] opera, nk P. and vitt, David 1011. damentals leat and ss ss ssfer. 7th ion. John ey & Sons,	
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Evaluation Percentage Recap: Project Based Learning

Evaluation Percentage Recapt 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

- 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.
- 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.
- 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.
- 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.
- 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.