



# MODULE HAND BOOK

## MECHANICAL ENGINEERING VOCATIONAL EDUCATION STUDY PROGRAM

### FACULTY OF ENGINEERING – UNIVERSITAS NEGERI PADANG

COURSE NAME	CODE	Course classification	CU		Sem	Version
			Theory	Pract		
Energy Conversion	MSN1.62.4104	Expertise course	2	0	4	1
Responsible	Dr. Remon Lapisa, M.Sc, Dr. Refdinal.,M.T dan Andre Kurniawan, M.T			Signature		
INFORMATION	Dean		Head of Department		Coordinator of study program	
	<u>Dr. Fahmi Rizal, M.Pd., M.T</u> NIP. 195912041985031004		<u>Drs. Purwantono, M.Pd</u> NIP. 196308041986031002		<u>Drs. Purwantono, M.Pd</u> NIP. 196308041986031002	
Program Learning Outcome	<b>Program learning outcome of Mechanical engineering vocational education:</b> <ol style="list-style-type: none"> <li>1. Possess a good ability to apply the basic science (mathematics and natural sciences) and other disciplines in profesional jobs / projects (Knowledge-understanding)               <ol style="list-style-type: none"> <li>1.1. possess a good understanding and can apply the basic concept of mathematics to solve various technical problems</li> <li>1.2. possess a good understanding and can apply basic the concept of physic to solve various technical problems</li> <li>1.3. possess a good understanding and can apply basic the concept of chemistry to solve various technical problems</li> </ol> </li> <li>2. Possess a critical and creative thinking in identifying, formulating, problem solving and evaluating various problems in mechanical engineering using the most appropriate and effective scientific method (<b><i>Engineering analysis, investigations and assessment</i></b>):               <ol style="list-style-type: none"> <li>2.1. problem identification skills</li> <li>2.2. problem analysis skills</li> </ol> </li> </ol>					

- 2.3. problem evaluation skills
- 3. Possess a good ability in designing, manufacturing and operating machines (**Engineering design**)
  - 3.1. able to formulate ideas/concepts into a technical drawing, design and budget plans
  - 3.2. able to operate various machines and other engineering equipment with the correct standard operating procedure
  - 3.3. able to design a machine or machinery system based on a valid scientific theory
  - 3.4. able to realize a concept/design into a prototype, manufacturing process and engineering system
- 4. Possess a good ability to design, organize and evaluate the education and learning process in *mechanical engineering vocational education*. (**Education design**)
  - 4.1. able to design curriculum and learning process by considering various aspects
  - 4.2. able to organize, control, evaluate and improve the quality of the learning process
  - 4.3. able to develop an interesting, effective and efficient learning medias
- 5. Possess a good ability to adapt to development in science and technology and apply it into professional jobs by considering any non-technical aspects. (**Engineering practice**)
  - 5.1. able to innovate and develop technology in the field of mechanical engineering by considering social, economic and environmental aspects
  - 5.2. able to carry out the optimization process and increase the efficiency of machines or machining system.
  - 5.3. able to improve the performance of machine/ machinery system by applying the information technology
- 6. Possess a good softskil and spirit of lifelong learning (**Transferable skill / softskill**)
  - 6.1. possess a religious character
  - 6.2. possess a spirit of nasionalisme, social sensitivity and environmental consevation orientation
  - 6.3. possess the ability to communicate effectively and work together in teamwork
  - 6.4. possess the ability to transfer science and technology to society to improve the quality of life
  - 6.5. possess a good characters of entrepreneur

Course learning

Course learning outcomes

<b>outcomes</b>	<b>CLO</b>		<b>PLO</b>
	1. Understand the types and classifications of energy		1.2, 1.3, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2
	2. Understand the basic concepts of energy conversion		1.2, 1.3, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2
	3. Understand the types of fuel and their characteristics		1.2, 1.3, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2
	4. Understand the working principles of energy conversion machines and their applications in mechanical engineering		1.2, 1.3, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2
	5. Students are able to analyze a problem, design process and machine operation related to energy conversion technology, both with individual performance and in groups in teamwork.		1.2, 1.3, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2
	6. Understand the effect of energy conversion systems on environmental pollution		1.2, 1.3, 2.1, 2.2, 2.3, 3.3, 3.4, 5.1, 5.2
<b>Course description</b>	This course provides basic knowledge of energy conversion systems which include: types and classifications of energy, basic concepts of energy conversion and working principles of conventional energy conversion machines (internal combustion engines, steam cycles, gas turbines, combustion engines and hydro), engines external combustion and introduction of new and renewable energy basics that can be converted		
<b>References</b>	<b>Main Reference (RU) :</b>		
	<ol style="list-style-type: none"> <li>1. Yunus A Cengel, "<i>Thermodynamics: an engineering approach</i>", Edisi ke-2, Mc.Graw-Hills, 2014</li> <li>2. Archie W. Culp, Jr., Ph.D, "<i>Principles of Energy Conversion</i>", McGraw-Hill, Ltd., 1979.</li> <li>3. Arismunandar.W, "<i>Penggerak Mula Motor Bakar dan Turbin</i>", Jakarta: Paramita</li> <li>4. James A. Fay &amp; Dan S. Golomb, "<i>Energy and the Environment</i>", Oxford, 2002.</li> <li>5. Pujanarsa. A, Nursuhud. D, "<i>Mesin Konversi Energi</i>", Penerbit Andi, 2006</li> </ol>		
<b>Learning media</b>	<b>Additional References (RP)</b>		
	<ol style="list-style-type: none"> <li>1. M.M. El-Wakil, "<i>Power Plant Technology</i>", McGraw-Hill,Ltd.,</li> <li>2. Duffie &amp; Beckmann, "<i>Solar Engineering of Thermal Processes</i>", 2ndEdition, Wiley Interscience, 1991.</li> <li>3. Sungkono. D, "<i>Motor Bakar Torak</i>", ITS Press, 2011</li> <li>4. Stephanov, "<i>Centrifugal and axial flow pump</i>", 2<sup>nd</sup> edition, New York, John Wiley</li> </ol>		
<b>Software:</b>	<b>Hardware:</b>		
	Computer, LCD Projector and whiteboards and other devices		
<b>Teaching team</b>			
<b>Assessment</b>	Mid Test, Final Test, Individual task & team, group discussion and presentation		
<b>Prerequisite courses</b>	No		

## Course subjects

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
(1)	<b>CLO-1 : [PLO-1.2, 1.3]</b> Students are able to explain: 1. types and classifications of energy 2. Source of energy 3. Utilization of energy	Introduction to Energy Conversion: Types and classifications of energy, energy sources and energy utilization,	Subject explanation [1x75'] Question answer [1x10'] Discussion [1x15']	Make a summary and description of the material presented in the resume book	Able to explain the type, classification, source and utilization of energy.	RU-1 and RU-2
(2)	<b>CLO-2 :[PLO-1.2, 1.3, 2.1, 2.2]</b> Students are able to explain the basic concepts of energy conversion principles	Law of fluid mechanics, Law of thermodynamics II, Entalpy, Mechanical Energy conversion processes, Electrical and Electromagnetic energy conversion processes, Chemical energy conversion processes	Subject explanation [1x75'] Question answer [1x10'] Assignment [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• coursework</li> </ul>	Able to explain the basic concepts of the energy conversion process.	RU-1, RU-2, RU-5
(3)	<b>CLO-3: [PLO-1.2, 1.3, 2.1, 2.2]</b> Students are able to explain the types of fuel, their characteristics and the combustion process	Types of fossil fuels, bioenergy, their characteristics, combustion technology and processes.	Subject explanation [1x60'] Question answer [1x10'] Assignment [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• Course Assignment</li> </ul>	Able to explain the types of fuel, their characteristics and the combustion process.	RU-1 and RU-2
(4)	<b>CLO-4.1: [CP-2.1, 2.2, 2.3, 3.3]</b> Students are able to explain thermodynamic cycles at conventional energy conversion	Thermodynamic cycle in Conventional energy conversion machines <ul style="list-style-type: none"> <li>• Carnot Cycle</li> <li>• The Otto cycle</li> <li>• Diesel Cycle</li> </ul>	Subject explanation [1x60'] Question answer [1x10'] Assignment [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• Course Assignment</li> </ul>	Able to explain various types of thermo dynamic cycles in conventional MKE	RU-1, RU-2, RU-3

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
	machine sources					
(5)	<b>CLO-4,2: [CP-2.1, 2.2, 2.3, 3.3]</b> Students are able to explain the basic principles of internal combustion motors - 1	Classification of internal combustion engines, components, cycle steps, 2 stroke and 4 stroke engines,	Subject explanation [1x60'] Question answer [1x10'] Assignment [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• Course Assignment</li> </ul>	Able to explain internal combustion motors, 2 stroke and 4 stroke engines, gasoline and diesel engines, ignition systems, engine performance	RU-1, RU-3, RP-3
(6)	<b>CLO-4,3: [CP-2.1, 2.2, 2.3, 3.3]</b> Students are able to explain the basic principles of internal combustion motors - 2	The working principle of Diesel engines and gasoline engines, gasoline and diesel engines, ignition systems, cooling, engine performance	Subject explanation [1x60'] Question answer [1x10'] Assignment [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the course material presented in the resume book</li> <li>• Demonstration of diesel engine / gasoline engine</li> </ul>	Able to explain the working principles of gasoline and diesel engines, ignition systems and cooling systems	RU-1, RU-3, RP-3
(7)	<b>CLO-4.4: [CP-2.1, 2.2, 2.3, 3.3]</b> Students are able to explain the basic principles and workings of a gas turbine	Energy Conversion Machine: Applications of gas turbines, open & closed system gas turbines, ignition, rotors, combustion chambers, compressors	Subject explanation [1x70'] Resume scientific articles [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the course material presented in the resume book</li> <li>• summary of scientific articles</li> </ul>	Able to explain the conventional conversion work system to obtain mechanical energy in a gas turbine. Summary of scientific articles on gas turbines	RU-1, RU-3, RU-5, RP-4
(8)	<b>Mid Test (UTS)</b>					

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
(9)	<b>CLO-4.5: [CP-2.1, 2.2, 2.3, 3.3]</b> Students are able to explain the basic principles of steam power engines	Students are able to explain the basic principles of Energy Conversion Machines: the working principles of steam power engines, steam turbine applications, impulse and reaction turbines, de level turbines, Curtis turbines, rateau turbines.	Subject explanation [1x60'] Question answer [1x10'] Assignment [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the course material presented in the resume book</li> <li>• Course Assignment</li> </ul>	Able to explain the working system of the conversion engine on a steam engine	RU-1, RU-3, RU-5 RP-1
(10)	<b>CLO-4.6: [CP-2.1, 2.2, 2.3, 3.3]</b> Students are able to understand the basic concepts of water turbines and their construction	Energy Conversion Machine: Impulse turbine, pelton wheel, radial & axial flow turbine. France turbine, Kaplan turbine, turbine discharge	Subject explanation [1x60'] Resume scientific articles [1x40']	<ul style="list-style-type: none"> <li>• Make a summary and description of the course material presented in the resume book</li> <li>• summarizes scientific articles related to water turbines</li> </ul>	Able to explain the water turbine working system (mechanical energy)	RU-3 RP-4
(11)	<b>CLO-4.7: [CP-2.1, 2.2, 2.3, 3.3]</b> Students are able to analyze the pump system	Types of pumps, Pump characteristics, pump operation, pump utilization applications	Subject explanation [1x70'] Question answer [1x10'] Discussion [1x20']	<ul style="list-style-type: none"> <li>• Make a summary and description of the course material presented in the resume book</li> <li>• summarizes scientific articles related to pump</li> </ul>	understand the types of pumps, their characteristics and uses	RU-5 RP-4
(12)	<b>CLO-4.8: [CP-2.1, 2.2, 2.3, 3.3]</b> Students are able to	Types of heat pumps, characteristics of heat pumps, how heat pumps	Subject explanation [1x60'] Question answer [1x10'] Discussion [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the course material</li> </ul>	understand the types of heat pumps, their	RU-1, RP-4

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
	analyze the Heat Pump system	work and applications of heat pump utilization		presented in the resume book	characteristics and their utilization	
(13)	<b>CLO-5.1: [PLO-2.1, 2.2, 2.3, 3.2, 3.4, 5.1]</b> Students are able to analyze the cooling engine system	The basic concept of the cooling system, the main components of the cooling system, refrigerant, P-H and T-S mollier diagrams	Subject explanation [1x60'] Question answer [1x10'] Discussion [1x30']	<ul style="list-style-type: none"> <li>• Make a summary and description of the course material presented in the resume book</li> </ul>	Able to master the types of heat pumps, characteristics and utilization	RU-1, RU-2, RU-3, RU-4, RU-5
(14)	<b>CLO-5.2: [PLO-2.1, 2.2, 2.3, 3.2, 3.4, 5.1]</b> Students are able to explain non-conventional energy sources and their utilization technologies	Introduction to renewable energy, and renewable energy utilization technologies: wind energy, solar energy, geothermal energy, OTEC, wave energy	Group presentation [1x80'] Question answer [1x10'] Discussion and conclusion [1x10']	<ul style="list-style-type: none"> <li>• Group discussion and presentation about non-conventional (4 groups)</li> <li>• Group discussions on renewable energy technologies</li> </ul>	Able to understand non conventional energy types and their utilization technology	RU-1, RU-3, RU-5
(15)	<b>CLO-6: [PLO-6.2,6.4]</b> Students are able to explain the impact of conventional energy conversion machines on the environment and their prevention	Air pollution, global warming, pollution prevention	Group presentation [1x80'] Question answer [1x10'] Discussion and conclusion [1x10']	Group presentations and discussions on the environmental impact of conventional energy conversion machines	Be able to explain the environmental impact of conventional energy conversion systems	RU-1, RU-4
(16)	<b>Final Test</b>					

**Remark :** 1 CU = (50' TM + 60' BT + 60' BM)/week  
 TM = Classical session  
 BT = Assignment.

BM = Individual session  
 PS = Simulation practice (160 menit/week)  
 PL = Laboratory activities (160 menit/week)

T = Theory (cognitive aspects)  
 P = Practicum (psychomotoric aspects)

### The Linkage between CLO and PLO and assessment methods

MSN1.62.4007	Assesment	Quality (%)	PLO-1			PLO-2			PLO-3				PLO-4			PLO-5			PLO-6				
			1	2	3	1	2	3	1	2	3	4	1	2	3	1	2	3	1	2	3	4	5
CLO-1	UTS.1	5		V	V																		
CLO-2	UTS.2	7.5		V	V	V	V																
CLO-3	UTS.3	7.5		V	V	V	V																
CLO-4.1	UTS.4.1	15				V	V	V			V												
CLO-4.2	UTS.4.2					V	V	V			V												
CLO-4.3	UTS.4.3					V	V	V			V												
CLO-4.4	UTS.4.4					V	V	V			V												
CLO-4.5	UAS.1	7.5				V	V	V			V												
CLO-4.6	UAS.2	7.5				V	V	V			V												
CLO-4.7	UAS.3	7,5				V	V	V			V												
CLO-4.8	UAS.4	7.5				V	V	V			V												
CLO-5.1	Presentation	20				V	V	V		V	V				V								
CLO-5.2	Presentation					V	V	V		V	V				V								
CLO-6	UAS.5	5																		V		V	
Presence		10																					
TOTAL		100																					

### Assessment components

Mid Test (Ujian Tengah Semester/UTS)	: 35 %
Final Test (Ujian Akhir Semester/UAS)	: 35 %
Student assignment	: 20 %
<u>Presence</u>	: 10 %
Total	: 100 %



### Scring/Grading level description

	Excellent	Good	Satisfy	Fail
ability to describe	Able to describe <b>correctly</b> and <b>completely</b>	Able to describe <b>correctly</b> but <b>not complete</b>	Able to describe but <b>less clear</b> and <b>incomplete</b>	<b>Unable</b> to describe
ability to formulate	Able to formulate <b>correctly</b> and <b>completely</b>	Able to formulate <b>correctly</b> but <b>not complete</b>	Able to formulate but <b>less clear</b> and <b>incomplete</b>	<b>Unable</b> to formulate
ability to calculate	Able to calculate <b>correctly</b> and <b>completely</b>	Able to calculate <b>correctly</b> but <b>not complete</b>	Able to calculate but <b>less clear</b> and <b>incomplete</b>	<b>Unable</b> to calculate
ability to analyze	Able to analysize <b>correctly</b> and <b>completely</b>	Able to analyze <b>correctly</b> but <b>not complete</b>	Able to analyze but <b>less clear</b> and <b>incomplete</b>	<b>Unable</b> to analyze

### Scoring and grading system

Score	Quality	Quality score	Designation	Score	Quality	Quality score	Designation
85 – 100	A	4.0	Outstanding	55 – 59	C	2.0	Acceptable
80 – 84	A-	3.6	Excellent	50 – 54	C-	1.6	Poor
75 – 79	B+	3.3	Very good	40 – 49	D	1.0	Poor
70 – 74	B	3.0	Good	≤ 39	E	0.0	Fail
65 – 69	B-	2.6	Good	-	T	-	Tertunda
60 – 64	C+	2.3	Acceptable				

