



# 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		
Mechanical Metallurgy	MES2.61.5109	Concentration Elective Courses Proficiency	1	2	6	1
Responsible	Hendri Nurdin, ST, MT; Andril Arafat, ST, M.Eng, Ph.D; Rodesri, ST, MT			Signature		
INFORMATION	Dean		Head of Department		Coordinator of study program	
	<u>Dr. Fahmi Rizal, M.Pd., MT</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> </ol> </li> </ol>					

- 2.2. problem analysis skills
- 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

<b>Course learning outcomes</b>	<b>Course learning outcomes</b>	
	<b>CLO</b>	<b>PLO</b>
	1. Understand the concept of microstructure and mechanical properties, the relationship and influence of microstructure on mechanical properties	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2
	2. Understand the types and causes of crystal defects and their effects on mechanical properties	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2
	3. Definition of phase transformation in the metal solidification process	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2
	4. the phenomena on the TTT diagram and the CCT diagram.	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2
	5. types and processes of heat treatment	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2
	6. surface treatment and thermo chemical process	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2
	7. type-type and the phenomena of metal strengthening mechanisms	2.1, 2.2, 2.3, 3.1, 3.2, 3.3, 3.4, 5.1, 5.2
<b>Course descriptions</b>	Students can explain the concept of understanding microstructure and mechanical properties, the relationship and influence of microstructure on mechanical properties, and the effect of surface treatment.	
<b>References</b>	<b>Main Reference (RU):</b>	
	<ol style="list-style-type: none"> <li>Alexander, WODasar Metallurgy for Engineers, PT Gramedia Pustaka. Utama, Jakarta, 1985.</li> <li>Dieter, George E., Engineering Design A Meterials and Processing Approach, McGraw-Hill Book Company, Singapore, 1987.</li> <li>Smith William, Structure and Properties of Engineering Alloys, Mc. Graw Hill, USA, 1981.</li> <li>Suratman, Rochim, Guide to Heat Treatment Process, ITB Research Institute, Bandung, 1994</li> <li>Smallman, RE, Modern Physical Metallurgy &amp; Materials Engineering, Publisher Erlangga, Jakarta, 1999.</li> </ol>	
	<b>Additional Reference (RP)</b>	
<b>Learning Media</b>	<b>Software:</b>	<b>Hardware:</b>
		Computers, whiteboards and accessories, projectors
<b>Team Teaching</b>		
<b>Assessment</b>	Assignments, Quis, UTS, UAS	
<b>Requirements Subject</b>	No	

## COURSE OBJECTS

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
(1)	<b>CLO-1: (PLO-1.1., 1.2, 1.3)</b> Students can explain the concept of understanding microstructure and properties mechanics, relationships and the influence of microstructure on mechanical properties	<ul style="list-style-type: none"> <li>Describes crystal geometry</li> <li>Describes the Micro Structure</li> <li>Describes Mechanical Properties</li> </ul>	Material explanation [1x75 '] Question and answer [1x15 '] Working on structured assignments[1x50 ']	<ul style="list-style-type: none"> <li>Pay attention</li> <li>Hear</li> <li>Take notes on the photocopy of the presentation sheet that was distributed</li> <li>Asking question</li> </ul>	Evaluation is done by giving direct questions and feedback back to the students	RU-1, RU-2 and RU-3
(2)	<b>CLO-2.1: [PLO-1.1,1.2, 1.3,]</b> Students can explain the types and causes of crystal defects and its effect on mechanical properties.	<ul style="list-style-type: none"> <li>Describe Point defects (0 D)</li> <li>Describe Line defects (1 D)</li> </ul>	Material explanation [1x75 '] Question and answer [1x15 '] Working on structured assignments[1x50 ']	<ul style="list-style-type: none"> <li>Pay attention</li> <li>Hear</li> <li>Take notes on the photocopy of the presentation sheet that was distributed.</li> <li>Asking question</li> </ul>	<ul style="list-style-type: none"> <li>Evaluation is done by giving direct questions and feedback to students</li> <li>Able to master the concept of the cause of crystal defects</li> </ul>	RU-1, RU-2 and RU-3
(3)	<b>CLO-2.2: [PLO-1.1,1.2, 1.3,]</b> Students can explain the types and causes of crystal defects and its effect on mechanical	<ul style="list-style-type: none"> <li>Describe Surface Defects (2 D)</li> <li>Describe Volume defects (3 D)</li> </ul>	Material explanation [1x75 '] Question and answer [1x15 '] Working on structured assignments[1x50 ']	<ul style="list-style-type: none"> <li>Make a summary and description of the material presented in the resume book.</li> <li>Create structured</li> </ul>	<ul style="list-style-type: none"> <li>Able to master the concept of the cause of crystal defects and their effect on mechanical</li> </ul>	RU-1, RU-2 and RU-3

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
	properties.			assignments	properties	
(4)	<b>CLO-3: [PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain the meaning of deformation and recrystallization, as well effects on microstructure and mechanical properties, examples of applications.	<ul style="list-style-type: none"> <li>Describes Deformation</li> <li>Explains Recrystallization</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Make a summary and description of the material presented in the resume book.</li> <li>Create structured assignments</li> </ul>	Able to master the basic concepts of deformation and recrystallization	RU-1, RU-2 and RU-3
(5)	<b>CLO-4.1: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain the definition of phase transformation in the process metal solidification and examples of its application.	<ul style="list-style-type: none"> <li>Describes the Process of Metal Crystal Formation</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Evaluation is done by giving direct questions and feedback to students.</li> <li>Give the task of "metal crystal formation"</li> </ul>	Be able to explain basic materials and crystal formation and phase transformations in metal freezing	RU-1, RU-2 and RU-3
(6)	<b>CLO-4.2: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain the definition of phase transformation in the process metal solidification and examples of its application.	<ul style="list-style-type: none"> <li>Describe the Phase Transformation in Metal Freezing Diagram</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Evaluation is done by giving direct questions and feedback to students.</li> <li>Give the task "Describe the phase transformation phenomenon on the Fe-Fe<sub>3</sub>C diagram"</li> </ul>	Be able to explain basic materials and crystal formation and phase transformations in metal freezing	RU-1, RU-2 and RU-3

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
(7)	<b>CLO-5: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can describe the Fe-Fe <sub>3</sub> C diagram and can explain phase transformation phenomenon that occurs.	<ul style="list-style-type: none"> <li>Describes the Fe-Fe<sub>3</sub>C Diagram</li> <li>Explain about phenomena phase transformations in the Fe-Fe<sub>3</sub>C Diagram</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Evaluation is done by giving direct questions and feedback back to the students.</li> <li>Give the task "Distinguishing phenomena on TTT and CCT diagrams"</li> </ul>	Be able to explain Fe-Fe <sub>3</sub> C diagram and phase transformation phenomena	RU-1, RU-2 and RU-3
(8)	<b>CLO-6: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain the phenomena on the TTT diagram and CCT diagram.	<ul style="list-style-type: none"> <li>Describe the phenomenon on TTT diagram</li> <li>Describe the phenomenon on CCT diagram</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Evaluation is done by giving direct questions and feedback to students.</li> <li>Give the task "Explaining the concept of hardenability"</li> </ul>	<ul style="list-style-type: none"> <li>Pay attention</li> <li>Take notes on the photocopy of the presentation sheet that was distributed</li> <li>Asking question</li> <li>Give and answer questions</li> <li>Take notes</li> </ul>	RU-1, RU-2 and RU-3
(9)	<b>MID TEST EXAM</b>					
(10)	<b>CLO-7: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain the types and processes of heat treatment	<ul style="list-style-type: none"> <li>Describe the types and processes heat treatment</li> <li>Tells about the Hardenability</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Evaluation is done by giving direct questions and feedback to students.</li> <li>Give the task "Distinguishing types of thermal process heat treatment"</li> </ul>	<ul style="list-style-type: none"> <li>Pay attention</li> <li>Take notes on the photocopy of the presentation sheet that was distributed</li> <li>Asking question</li> <li>Give and answer questions</li> <li>Take notes</li> </ul>	RU-1, RU-2 and RU-3

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
(11)	<b>CLO-8.1: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain thermal process heat treatment.	<ul style="list-style-type: none"> <li>Explains about Anil</li> <li>Explains normalizing</li> <li>Explains Hardening</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Evaluation is done by giving direct questions and feedback to students.</li> <li>Give the task "To distinguish the type of heat behavior of the thermochemical process</li> </ul>	<ul style="list-style-type: none"> <li>Pay attention</li> <li>Take notes on the photocopy of the presentation sheet that was distributed</li> <li>Asking question</li> <li>Give and answer questions</li> <li>Take notes</li> </ul>	RU-1, RU-2 and RU-3
(12)	<b>CLO-8.2: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain thermal process heat treatment.	<ul style="list-style-type: none"> <li>Explains about Tempering</li> <li>Describes Australia by its fibers and binders</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Evaluation is done by giving direct questions and feedback to students.</li> <li>Give the task "To distinguish the type of heat behavior of the thermochemical process</li> </ul>	<ul style="list-style-type: none"> <li>Pay attention</li> <li>Take notes on the photocopy of the presentation sheet that was distributed</li> <li>Asking question</li> <li>Give and answer questions</li> <li>Take notes</li> </ul>	RU-1, RU-2 and RU-3
(13)	<b>CLO-9.1: [PLO- PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain the surface treatment process and thermo chemistry	<ul style="list-style-type: none"> <li>Describes Carburization</li> <li>Explains Nitriding</li> <li>Explain about Carbonitridation</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Make a summary and description of the material presented in the resume book.</li> <li>Create structured assignments</li> </ul>	<ul style="list-style-type: none"> <li>Pay attention</li> <li>Take notes on the photocopy of the presentation sheet that was distributed</li> <li>Asking question</li> <li>Give and answer questions</li> <li>Take notes.</li> </ul>	RU-1, RU-2 and RU-3

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
(14)	<b>CLO-9.2: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain the surface treatment process and thermo chemistry	<ul style="list-style-type: none"> <li>Describes Induction Hardening</li> <li>Explains the Flame Hardening</li> </ul>	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Make a summary and description of the material presented in the resume book.</li> <li>Create structured assignments</li> </ul>	<ul style="list-style-type: none"> <li>Pay attention</li> <li>Take notes on the photocopy of the presentation sheet that was distributed</li> <li>Asking question</li> <li>Give and answer questions</li> <li>Take notes</li> </ul>	RU-1, RU-2 and RU-3
(15)	<b>CLO-10: [PLO-PLO-1.1, 1.2, 1.3, 2.1, 2.2]</b> Students can explain the types and phenomena of the mechanism metal reinforcement.	Discussion of the types and phenomena of phenomena metal strengthening mechanism	Material explanation [1x75 ' Question and answer [1x15 ' Working on structured assignments[1x50 '	<ul style="list-style-type: none"> <li>Make a summary and description of the material presented in the resume book.</li> <li>Create structured assignments</li> </ul>	Able to explain the constituent elements of composites, their advantages and applications.	RU-1, RU-2 and RU-3
(16)	<b>Final Exam</b>					

**Note** : 1 credit = (50 'TM + 60' BT + 60 'BM) / Week  
 TM = Face to Face (Lecture)  
 BT = Structured Learning.

BM = Independent Study  
 PS = Simulation Practicum (160 minutes / week)  
 PL = Laboratory Practicum (160 minutes / week)

T = Theory (aspects of science)  
 P = Practice (aspects of work skills)



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

MSN1.62.4007	Assessment	Point (%)	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	7.5	V	V	V																		
CLO-2.1	UTS. 2	5	V	V	V																		
CLO-2.2	UTS. 3	5	V	V	V	V	V																
CLO-3.1	UTS. 4	7.5	V	V	V	V	V																
CLO-3.2	UTS 5	10	V	V	V	V	V																
CLO-4.1	UAS 1	5	V	V	V	V	V																
CLO-4.2	UAS 2	5	V	V	V	V	V																
CLO-5.1	UAS 3	5	V	V	V	V	V																
CLO-5.2	UAS 4.5	10	V	V	V	V	V																
CLO-5.3	UAS 6.7	10	V	V	V	V	V																
CLO-6.1	presentation	20	V	V	V	V	V																
CLO-6.2	Presentation		V	V	V	V	V																
CLO-7.1	Presentation		V	V	V	V	V																
CLO-7.2	presentation		v	V	V	v	V																
Presence		10																					
TOTAL		100																					

### Assessment Component

Midterm exam	: 35%
Final exams	: 35%
Duty	: 20%
<u>Presence</u>	<u>: 10%</u>
Total	: 100%

### Scoring/Grading level description

	<b>Excellent</b>	<b>Good</b>	<b>Satisfy</b>	<b>Fail</b>
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 analyze <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	-	Postpone
60 – 64	C+	2.3	Acceptable				

