



# 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		
Chemistry for Engineering	MES1.61.3101	Study Program Compulsory Courses / Basic science	2	0	2	1
Responsible	Dr. Mulianti, M.Pd., Sri Rizki Putri Primandari, MT, PhD.			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 Outcomes	<b>Program Learning Outcomes (PLO):</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>Engineering analysis, investigations and assessment</b>):               <ol style="list-style-type: none"> <li>2.1. problem identification skills</li> <li>2.2. problem analysis skills</li> <li>2.3. problem evaluation skills</li> </ol> </li> </ol>					

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 Outcomes**

**Course Learning Outcomes (CLO)**

CLO	PLO
1. Be able to describe the concept of the material.	1.3
2. Able to analyze basic atomic concepts based on their position in the periodic system of elements	1.3
3. Mastering the concepts of stoichiometry which form the basis of chemical calculations	1.3, 2.1, 2.2
4. Able to apply stoichiometry in various problems related to chemical reactions	1.3, 2.1, 2.2
5. Be able to describe chemical compounds and their bonds.	1.3, 2.1, 2.2
6. Mastering the concept of solutions	1.3

	7. Able to analyze redox reactions based on oxidation number.	1.3
	8. Be able to apply Hess's Law in Thermochemistry	1.3
	9. Able to describe the use of chemistry in mechanical engineering such as electrolysis and electrochemistry.	1.3
<b>Course descriptions</b>	This course provides basic knowledge of chemistry and its applications in mechanical engineering such as matter, atomic theory, atomic and molecular structure, chemical bonds, stoichiometry, solutions, chemical reactions, electrochemistry, thermochemistry.	
<b>References</b>	<b>Main references (RU):</b>	
	1. Chang, R. (2003). Basic Chemistry Core Concepts. Third Edition Volume 1. Jakarta: Erlangga.	
	2. Chang, R. (2005). Basic Chemistry Core Concepts. Third Edition Volume 2. Jakarta: Erlangga.	
	3. Petrucci, H Ralph. 2011. Basic Chemistry Principles and Modern Applications. Jakarta: Erlangga.	
	<b>Additional references (RP)</b>	
	1. Achmad, Peter and Tupamahu, MS 2001. Study Guide for Chemistry, Stoichiometry and Energy. Bandung: PT. Cipta AdityaSungkono. 2. Brady, JE 2000. University Chemistry Principles and Structures. Jakarta: Binarupa Literacy	
<b>Learning Media</b>	<b>Software:</b>	<b>Hardware:</b>
		Computer, LCD Projector and Whiteboard and peripherals
<b>Team Teaching</b>	Dr. Mulianti, M.Pd., Sri Rizki Putri Primandari, MT, PhD.	
<b>Assessment</b>	UTS, UAS, Group assignments	
<b>Requirements Subject</b>	No	

## COURSE SUBJECTS

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
(1)	<b>CLO-1</b> College student describe the material	Definition of matter, classification of matter (element, compound, mixture), change of matter and basic laws of chemistry	Material explanation [1x60 ' Question and answer [1x20 ' '] Discussion [1x20 ']	Make a summary and description of the material presented in the resume book	Able to describe the concepts of elements, compounds and mixtures, their changes and the	RU-1, RU-2, RU-3, RP-2

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
					basic laws of chemistry	
(2)	<b>CLO-2</b> Students are able to analyze basic atomic concepts based on their position in the periodic system of elements	The theory of atoms, elementary particles, molecules, ions and isotopes	Material review by students [10'] Material explanation [1x60'] Question and answer [1x10'] group discussion [1x20']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• group discussion</li> </ul>	Able to analyze atomic theory, basic particles, molecules, ions and isotopes	RU-1, RU-2, RU-3, RP-2
(3)	<b>CLO-3.1</b> Student mable to formulate the concept of stoichiometry	Definition of Stoichiometry, relative atomic mass, relative molecular mass and mass fraction	Material review by students [10'] Material explanation [1x60'] Question and answer [1x10'] exercises [1x20']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• Task work on questions</li> </ul>	Be able to explain pThe definition of stoichiometry and formulating the concept of stoichiometry, relative atomic mass, relative molecular mass	RU-1, RU-2, RU-3, RP-1
(4)	<b>CLO-3.2</b> Able studentscalculate using the concept of stoichiometry	The concept of the mole	Material review by students [10'] Material explanation [1x60'] Question and answer [1x10'] exercises [1x20']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• Task work on questions</li> </ul>	Able calculate using the concept of stoichiometry	RU-1, RU-2, RU-3, RP-1
(5)	<b>CLO-4:</b> Students are able to apply stoichiometry in various problems related to chemical reactions	Chemical reaction equations, chemical reaction equations, empirical formulas and chemical formulas,	Material explanation [1x50'] Question and answer [1x10'] exercises [1x40']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> </ul>	Able applying stoichiometry through equalization of chemical reactions,	RU-1, RU-2, RU-3, RP-1 and RP-2

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
		products and reactants, excess reactants		<ul style="list-style-type: none"> <li>Task work on questions</li> </ul>	empirical formulas and chemical formulas, able to analyze the quantity of products and reactants and excess reactants	
(6)	<b>CLO-5</b> Student mable to describe chemical compounds	The composition of chemical compounds, the naming of chemical compounds Valence and oxidation number	Material review by students [10'] Material explanation [1x60'] Question and answer [1x10'] group discussion [1x20']	<ul style="list-style-type: none"> <li>Make a summary and description of the material presented in the resume book</li> <li>group discussion</li> </ul>	Be able to describe scomposition of chemical compounds, the naming of chemical compounds Valence and oxidation number	RU-1, RU-2, RU-3, RP-2
(7)	<b>CLO-5</b> Students are capable describe chemical bonds	Definition, characteristics, examples Chemical bonds, ionic bonds, covalent bonds, van der waal bonds and hydrogen bonds	Material review by students [10'] Material explanation [1x60'] Question and answer [1x10'] group discussion [1x20']	<ul style="list-style-type: none"> <li>Make a summary and description of the material presented in the resume book</li> <li>group discussion</li> </ul>	Able to describe defficiency, characteristics, examples of chemical bonds, ionic bonds, covalent bonds, van der waal bonds and hydrogen bonds	RU-1, RU-2, RU-3, RP-2
(8)	<b>Mid-Test</b>					
(9)	<b>CLO-2</b> College student analyzes the concept of the atom based on its position in the periodic system of	Atomic structure, quantum number and electron configuration	Material review by students [10'] Material explanation [1x60'] Question and answer [1x10']	<ul style="list-style-type: none"> <li>Make a summary and description of the material presented in the</li> </ul>	Be able to explain Atomic structure, quantum number and electron configuration	RU-1, RU-2, RU-3, RP-2

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
	elements		group discussion [1x20 ']	resume book • group discussion		
(10)	<b>CLO-2</b> Students are capable analyzes the concept of the atom based on its position in the periodic system of elements	Periodic system of elements, definitions, periods, groups, characteristics of elements in one period and one group	Material review by students [10 '] Material explanation [1x60 '] Question and answer [1x10 '] group discussion [1x20 ']	• Make a summary and description of the material presented in the resume book • group discussion	Able to analyze speriodic system of elements in one period and one group	RU-1, RU-2, RU-3, RP-2
(11)	<b>CLO-6.1</b> Students are capabledescribe the concept of the solution	Definition of solutions, electrolyte and non-electrolyte solutions, the colligative properties of the solution	Material explanation [1x60 '] Question and answer [1x10 '] group discussion [1x30 ']	• Make a summary and description of the material presented in the resume book • group discussion	Be able to describe defficiency of solutions, electrolyte and non-electrolyte solutions, and the colligative properties of the solution.	RU-1, RU-2, RU-3, RP-1 and RP-2
(12)	<b>CLO-6.2</b> Students are able to formulate solution concentrations.  <b>CLO-6.3</b> Students are able to calculate the concentration of the solution.  <b>CLO-6.4</b>	concentrations of solutions, acids and bases based on browsted lowry theory, degree of ionization	Material review by students [10 '] Material explanation [1x60 '] Question and answer [1x10 '] exercises [1x20 ']	• Make a summary and description of the material presented in the resume book • exercises	Able to formulate solution concentration, able to calculate solution concentration, and able to analyze type of solution based on the Brownsted Lowry concept.	RU-1, RU-2, RU-3, RP-1 and RP-2

Week	Expected competencies	Topics	Method and strategy for learning	Assignment	Criterion / Assessment indicator	References
	Students are capable analyze the type of solution based on the Brownsted Lowry concept.					
(13)	<b>CLO-7:</b> Students are capable analyze redox reactions based on oxidation numbers	Definition of a redox reaction, oxidation number, determination of a redox reaction	Material explanation [1x60 '] Question and answer [1x10 '] exercises [1x30 ']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• Task work on questions</li> </ul>	Able analyze redox reactions based on oxidation numbers	RU-1, RU-2, RU-3, RP-1 and RP-2
(14)	<b>CLO-8</b> Students are able to apply Hess's Law in thermochemistry	Hess's law, thermochemistry, reaction heat, enthalpy, enthalpy change, determination of reaction enthalpy, laws of thermodynamics	Material explanation [1x50 '] Question and answer [1x10 '] exercises [1x40 ']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• Task work on questions</li> </ul>	Be able to explain the definition of thermochemistry, reaction heat, enthalpy, enthalpy change, thermodynamic laws and able to calculate the enthalpy formation of reactions.	RU-1, RU-2, RU-3, and RP-2
(15)	<b>CLO-9:</b> Students are able to describe the use of chemistry in mechanical engineering such as electrolysis and electrochemistry.	Electrochemistry and electrolysis	Material explanation [1x60 '] Question and answer [1x10 '] group discussion [1x30 ']	<ul style="list-style-type: none"> <li>• Make a summary and description of the material presented in the resume book</li> <li>• group discussion</li> </ul>	Be able to describe electrochemistry and electrolysis, the differences between the two processes	RU-1, RU-2, RU-3, and RP-2
(16)	<b>Final Semester Evaluation (Evaluation which is intended to determine the final achievement of student learning outcomes)</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**

MES1.61.3101	Assessment	Weight (%)	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.a; UTS1.b	5			V																			
CLO-2	UAS 1	5			V																		V	
CLO-3.1	UTS 2.a	2			V																			
CLO-3.2	UTS 2.b	3			V																			
CLO-4.1	UTS 3.a	2			V																			
CLO-4.2	UTS 3.b	8			V																			
CLO-4.3	UTS 4	10			V																			
CLO-5	UTS 5	5			V																		V	
CLO-6.1	UAS 2.a	1			V																		V	
CLO-6.2	UAS 2.b	2			V																			
CLO-6.3	UAS 2.c	2			V																			
CLO-6.4	UAS 2.d	5			V																			
CLO-7	UAS 3	5			V																			
CLO-8.1	UAS 4.a	5			V																			
CLO-8.2	UAS 4.b	5			V																			
CLO-9	UAS 5	5			V																		V	

**Assessment Components**

Midterm exam (UTS) : 35%  
 Final exams (UAS) : 35%  
 Assignment : 20%  
 Presence : 10%  
 Total : 100%



### Scoring/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 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				

