MODULE HAND BOOK

MECHANICAL ENGINEERING VOCATIONAL EDUCATION STUDY PROGRAM

FACULTY OF ENGINEERING – UNIVERSITAS NEGERI PADANG

COURSE NAME	CODE	Course classification/ MEVE core course	CU		Sem	Version
			Theory	Pract		
Industrial Metrology	MES1.61.4107	Supporting Courses in Mechanical Engineering	2	1	4	1
Responsible	Drs. H. Yufrizal A, M.Pd, Drs.Drs. Abdul Aziz, M.Pd, M.Kes, Rifeino, S.Pd., MT, Febri Prasetya, M.Pd.T, Budi Syahri, S.Pd., M.Pd.T		Signature			
INFORMATION	**Dean**	**Head of Department**	**Coordinator of study program**			
	Dr. Fahmi Rizal, M.Pd., MT NIP. 195912041985031004	Drs. Purwantono, M.Pd NIP. 196308041986031002	Drs. Purwantono, M.Pd NIP. 196308041986031002			

Program Learning Outcome	Program learning outcome of Mechanical engineering vocational education:
	1. Possess a good ability to apply the basic science (mathematics and natural sciences) and other disciplines in profesional jobs / projects (Knowledge-understanding) 1.1. possess a good understanding and can apply the basic concept of mathematics to solve various technical problems 1.2. possess a good understanding and can apply basic the concept of physic to solve various technical problems 1.3. possess a good understanding and can apply basic the concept of chemistry to solve various technical problems 2. Possess a critical and creative thingking in identifying, formulating, problem solving and evaluating various problems in mechanical engineering using the most appropriate and effective scientific method ***(Engineering analysis, investigations and assessment):*** 2.1. problem identification skills 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

<table>
<tr><td>Course learning outcomes</td><td>Course learning outcomes
<table>
<tr><th>CLO</th><th>PLO</th></tr>
<tr><td>1. Have knowledge of geometric and quality specifications in MI, standard, unit and calibration</td><td>1.2, 2.1, 2.2,2.3, 3.1, 3.4 5.1, 5.2, 5.3</td></tr>
<tr><td>2. Can apply the theory of linear and non-linear measurements, make measurements using standard measuring instruments</td><td>1.2, 2.1, 2.2,2.3, 5.1, 5.2</td></tr>
<tr><td>3. Can apply the theory of angular measurement, make measurements using standard measuring instruments</td><td>1.2, 2.1, 2.2,2.3, 3.1, 3.4, 5.1, 5.2</td></tr>
<tr><td>4. Can apply the theory of surface roughness measurement, make measurements using standard measuring instruments</td><td>1.2, 2.1, 2.2,2.3, 5.1, 5.2</td></tr>
<tr><td>5. Can apply the theory of level, straightness and clarity measurements, take measurements using standard measuring instruments</td><td>1.2, 2.1, 2.2,2.3, 5.1, 5.2</td></tr>
<tr><td>6. Can apply the theory of measuring threads and gears, take measurements using standard measuring instruments</td><td>1.2, 2.1, 2.2,2.3, 5.1, 5.2</td></tr>
<tr><td>7. Analyze the results of a product using statistical methods</td><td>1.2, 2.1, 2.2,2.3, 5.1, 5.2</td></tr>
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<tr><td>Course descriptions</td><td colspan="2">Provides knowledge in mastering and understanding metrology, measurement principles, quality control, ISO Standard concepts, Measuring Instrument construction, Measurement Tools and Methods, Calibration Procedures, Use of standard and caliber measuring instruments, Surface Roughness Measurement, Tolerance and Customization, and use of tools. - measuring tools in the machining industry correctly</td></tr>
<tr><td rowspan="4">References</td><td colspan="2">Main Reference (RU):</td></tr>
<tr><td colspan="2">1. Taufiq, Rochim, et al., (1992). Industrial Metrology. Mechanical Engineering FTI ITB.
2. Galyer, JFW & Sholbolt, (1974). Metrology Industry S1, Metric Edition. A Cassel Technical Book: London.</td></tr>
<tr><td colspan="2">Additionl reference (RP)</td></tr>
<tr><td colspan="2">3. RK, Jain, (1981). Engineering Metrology. Khana Publisher: New Delhi.
4. Ted, Busch, (1989). Fundamentals of Dimensional Metrology. Delmar Publisher Inc .: New Delhi</td></tr>
<tr><td rowspan="2">Learning Media</td><td>Software:</td><td>Hardware:</td></tr>
<tr><td></td><td>Computers, Laptops, Data Display (Infocus), White Board, Tissue and Cleaning Gas, Measuring Instruments and Measuring Objects, Practical Manual</td></tr>
<tr><td>Team Teaching</td><td colspan="2"></td></tr>
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Assessment	Mid-Test Exam, Final Exam, Practicum Results, Practicum Report
Requirements Subject	No

Course Object

Week	Expected competencies	Topics	Method and strategy for leraning	Assignment	Criterion / Assessment indicattor	References
(1)	**CLO-1: (PLO 1,2 2.1)** Students are able to think critically in: Describe the notion of the importance of measurement for humans, Metrology as a Science of measurement Explains why Industrial Metrology is important to know for mechanical engineering practitioners. Describes the basic unit, calibration, and traceability of a measuring instrument	Introduction of the importance of measurement in human life. Merology as a science of measurement (science of measurement) Division of categories in metrology The Role of Industrial Metrology in mechanical engineering. The SI base unit for measuring distances Calibration and traceability	Material explanation [**1x50**'] Question and answer [**1x50**'] Discussions and case studies [**1 x 100 '**]	Examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-1 and RU-2
(2)	**CLO-2: [PLO-2.1, 2.2]** Students are able to think critically: About the importance of quality and geometric specification of a machining product in Industrial Metrology Several factors influence	Definition of quality and geometric specifications in Industrial Metrology and the factors affecting quality • Meaning of quality and geometric specifications in Industrial Metrology. • Several factors influence quality.	Material explanation [**1x50**'] Question and answer [**1x50**'] Discussions and case studies [**1 x 100 '**]	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-1, RU-2, RU-5

Week	Expected competencies	Topics	Method and strategy for leraning	Assignment	Criterion / Assessment indicattor	References
	the quality of machining products					
(3)	**CLO-2: [PLO-2.2, 2.3]** Students think critically about the importance of geometric tolerance, explain the type of tolerance, explain the type of customization and its use	Understanding geometric tolerance • Size tolerance • Tolerance of shape and position • Understanding custom • Loose custom • The fit is just right • Forced customization	Material explanation [**1x50**'] Question and answer [**1x50**'] Discussions and case studies [**1 x 100 '**]	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-1 and RU-2
(4)	**CLO-2: [PLO- 2.2, 2.3]** Students think critically and are able to: Describes the construction of measuring instruments Describe the types of measuring instruments, Explain the types of measurements, Be able to calibrate mechanical measuring instruments, Use mechanical measuring instruments	Construction of measuring instruments and classification of measuring instruments • Sensor • Modifiers and modifier types • Indicator: scale and numbered • Classification of tools • measure: the working principle of use, and properties, • Classification of measurement problems. • Using a mechanical measuring instrument (slide ruler and micrometer)	Material explanation **[1x60 ']** Work in group**[1x40 ']** Practice **[1x100 ']**	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-1, RU-2, RU-3

Week	Expected competencies	Topics	Method and strategy for leraning	Assignment	Criterion / Assessment indicattor	References
(5)	**CLO-2: [PLO-2.2, 2.3]]** Students think critically and are able to: Explain the definition of an angle. Determine the appropriate measuring instrument and method for measuring angles	Definition angle and angle gauge • Angle definition • Direct angle measuring instrument • Indirect angle measuring instrument • Take an angle measurement	Material explanation **[1x60 ']** Work in group **[1x40 ']** Practice **[1x100 ']**	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-1, RU-3, RP-3
(6)	**CLO-2: [CP-2.2, 2.3]]** Students think critically and are able to: Describes surface smoothness. Explain the reasons why surfaces need to be controlled. Describe surface smoothness parameters Describe the type of surface measuring instrument	The surface smoothness function is viewed from several aspects • Some of the surface smoothness parameters are Ra, Rt, Rp, and Rz • Measurement method: direct and indirect	Material explanation **[1x60 ']** Work in group **[1x40 ']** Practice **[1x100 ']**	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-1, RU-3, RP-3
(7)	**CLO-2: [PLO-2.2, 2.3]** Students think critically and are able to explain the definition of roundness. Think critically about the need for measuring roundness Able to take roundness measurements)	Roundness and roundness measuring instrument • Definition of roundness • Factors causing the occurrence of sphericity • Parameters of roundness • Take roundness measurements	Material explanation **[1x60 ']** Work in group **[1x40 ']** Practice **[1x100 ']**	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-1, RU-3, RU-5, RP-4

Week	Expected competencies	Topics	Method and strategy for leraning	Assignment	Criterion / Assessment indicattor	References
(8)	**Mid-Test Exam**					
(9)	**CLO-1: [PLO-2.2, 2.3]** Students think critically and are able to explain the definition of flatness Think critically about the need for flat measurements Able to take flat measurements	Level andstraightness • Definition of flatness and straightness • Level and straightness measuring instrument • Measurement of flatness and straightness	Material explanation **[1x60 ']** Work in group **[1x40 ']** Practice **[1x100 ']**]	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-1, RU-3, RU-5 RP-1
(10 & 11)	**CLO-: [CP-2.2, 2.3]** Students think critically and are able to explain the definition of threads Think critically about the need to control the functional size of the threads. Able to perform thread measurement	Thread and thread measurement • Definition of thread • Thread function • Thread manufacturing process • Thread type • Error in thread manufacturing • Thread measurement	Material explanation **[1x60 ']** Work in group **[1x40 ']** Practice **[1x100 ']**	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-3 RP-4
(12 & 13)	**CLO-3: [CP-2.2, 2.3]** Students think critically and are able to explain the function and classification of gears. Think critically about the gear profile (involute). Able to take gear measurements	Gear and gear measurement • Definition of a gear • Involut curve • Types of gears • Gear error • Gear measurement	Material explanation **[1x100 ']** Independent work **[1x100 ']** Practice **[1x100 ']**	examples of programming and machine operation, as well as assigning taCU (exercises)	Oral, written performance and work results	RU-5 RP-4
(14 & 15)	**CLO-4.8: [CP-2.2, 2.3, 5.2]** Students think critically	Statistical Sciences and their applications in machining products • The reason for the use of statistics in controlling the quality of	Material explanation [**1x50**'] Question and answer	giving examples and giving assignments (training), practical	Oral, written performance and work results	RU-1, RP-4

Week	Expected competencies	Topics	Method and strategy for leraning	Assignment	Criterion / Assessment indicattor	References
	and are able to explain the application of statistics in controlling the quality of machining products. Think critically about the need for quality control statistics. Able to perform statistical calculations of quality control of machining components / products	machining products • The basic theory of quality control statistics • Control chart • Carry out quality control of machining products	[**1x50**'] Discussions and case studies [**1 x 100 '**]	work		
(17)	**Final Exam**					

Note : 1 credit = (50 'TM + 100' BT + 100 'P) / 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

MSN1.62.2004	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	5				v																	
CLO-1	UTS. 2-a	10		v		v	v																
CLO-1	UTS. 2-b			v		v	v																
CLO-1	UTS. 2-c			v		v	v																
CLO-1	UTS. 2-d			v		v	v																
CLO-1	UTS. 2-e			v		v	v																

CLO-2	UTS. 3	5		v		v		v															
CLO-2	UTS. 4	5		v		v																	
CLO-1-7	UAS. 1	5				v	v	v															
CLO-1-7	UAS. 2	2.5					v	v										v					
CLO-6	UAS. 3	5				v	v	v															
CLO-3	UAS. 4	5				v	v	v															
CLO-5	UAS. 5	5				v	v	v															
CLO-5	UAS. 6	2.5				v	v	v															
CLO-1	UAS. 7	2.5				v	v	v															
CLO-2-7	UAS. 8	5					v	v										v					
CLO-2-7	UAS. 9	5																v					
Attendance + TaCU		10																					
TOTAL		100																					

Assessment Component

Midterm exam	: 30%
Final exams	: 35%
Practicum Report	: 25%
Attendance and Duties	: 10%
Total	: 100%

Scoring/Grading level description

	Excellent	**Good**	**Satisfy**	**Fail**
ability to describe	Able to describe correctly and completely	Able to describe correctly but not complete	Able to describe but less clear and incomplete	Unable to describe
ability to formulate	Able to formulate correctly and completely	Able to formulate correctly but not complete	Able to formulate but less clear and incomplete	Unable to formulate

ability to calculate	Able to calculate correctly and completely	Able to calculate correctly but not complete	Able to calculate but less clear and incomplete	Unable to calculate
ability to analyze	Able to analysize correctly and completely	Able to analyze correctly but not complete	Able to analyze but less clear and incomplete	Unable 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				