SEMESTER LESSON PLAN

	UNIVERSITAS NEGERI SURABAYA FACULTY OF MATHEMATICS AND NATURAL SCIENCES PHYSICS STUDY PROGRAM	Document Code

SEMESTER LESSON PLAN

COURSES	CODE	Course Classrom	Credit Unit		SEMESTER	Compilation date
BASIC PHYSICS I			T=3	P=0	1	11 Desember 2019

OTORISASI	Semester Learning Plan Developer	Course Classroom Coordinator	Head of the Study Program
	Diah Hari Kusumawati, M.Si	Drs. Z.A. Imam Supardi, Ph.D	Nadi Suprapto. Ph.D

Program Learning Outcomes	**PLO in the Course**	
	PLO-1	Able to demonstrate knowledge of Classical Physics and Modern Physics
	PLO-2	Able to formulate a physical systems as physical model by using mathematics
	Course Learning Outcomes (CLO)	
	CLO1	Be able to explain basic concepts and principles of kinematics, particle dynamics and rotation, vibration, heat transfer, and thermodynamics.
	CLO2	Mastering the material, structure, and concepts of physical science and its application in technology.
	CLO3	Using basic physics concepts and proper mathematical methods to get solutions to quantitative problems in physics.
	CLO4	Able to work in groups in the discussion process related to the mechanics and thermodynamics concepts that are being discussed during the lesson.
	Sub-Course Learning Outcomes (Sub-CLO)	
	Sub-CLO1	Students are able to explain the concept of particle kinematics and can solve the problems of particle kinematics.
	Sub-CLO2	Students are able to explain the concept of particle dynamics.

	Sub-CLO3	Students are able to explain the concept of work and energy.
	Sub-CLO4	Students are able to explain the concept of rotational dynamics and its calculations.
	Sub-CLO5	Students are able to explain the concepts of vibration, and are skilled at performing calculations related to vibration.
	Sub-CLO6	Students are able to explain the mechanical concept of shape–changing objects.
	Sub-CLO7	Students are able to explain the concepts of thermometry and calorimetry.
	Sub-CLO8	Students are able to explain the concept of heat transfer.
	Sub-CLO9	Students are able to explain tha concepts of thermodynamics and entropy.
A Short Course Description	The study of quantities, units and measurements, particle kinematics (one, two and three dimensional motion), particle dynamics (Newton's laws and their use, work and energy, linear momentum and collisions), rotational dynamics (rotation of rigid bodies, angular momentum and force moments , rigid body equilibrium), harmonious vibrations, universal laws of gravity, fluid mechanics, mechanical waves (sound waves, superposition and standing waves), thermophysics (temperature, expansion and ideal gases, heat) and the laws of thermodynamics I (kinetic theory of gases) and laws thermodynamics II (heat engine, ethropy) by observing physical phenomena in everyday life and analyzing them by applying learned physics concepts, problem solving, guided discovery	
Learning Materials	1. Kinematics and particle dynamics, work and energy as well as rotational dynamics 2. Vibration and deformation mechanics (hydrostatics and hydrodynamics) 3. Thermometry and calorimetry, heat transfer, thermodynamics and entropy	
References	**Main references :**	
	[1]. Sarojo, A.G., 2014, *Seri Fisika Dasar Mekanika*, edisi 5, Salemba Teknika. [2]. Halliday & Resnick, 2007, *Fisika Jilid 1*, Erlangga [3]. Serway, R.A., and Jewett, J.W., 2010, *Physics for Scientists and Engineers with Modern Physics*, Salemba Teknika	
	Supported references :	
	[4]. Bueche, F.J., 2000, *Schaum's Outline of College Physics*, McGraw-Hill.	
Lecturers	Dr. Z.A. Imam Supardi, M.Si Woro Setyarsih, S.Pd., M.Si Dra. Suliyanah, M.Si Diah Hari Kusumawati, M.Si Drs. Dwikoranto, M.Pd Nugrahani Primary Putri, M.Si Dr. Titin Sunarti, M.Si. Mukhayyarotin Niswati Rodliyatul Jauhariyah, M.Pd. Utama Alan Deta, S.Pd., M.Pd., M.Si. Dr. Binar Kurnia Prahani, M.Pd.	

Requirements course	-						
Week-	**Course Learning Outcomes (Sub-CLO)**	**Assessment**		**Learning Forms, Learning methods, Student Assignment, [Estimated time]**		**Learning materials [References]**	**The weight of assessment (%)**
		Indicator	**Criteria&Form**	**offline**	**online**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1	Students are able to understand the concept of particle kinematics	1. Students are able to explain the concept of particle kinematics and 2. Students can solve particle kinematics problems	**Criteria:** Quantitative **Form:** test	**Form:** Lecture **Method:** • Discussion • Problem solving Assignment: Independent task Estimated time: 3x50 minutes	**-**	Particle kinematics: • Quantities, units and vectors • Straight motion • Curved motion • Relative motion References: [1] Chapters 1-2 [3] Chapters 2-4 [4] Ch.1	**5%**
2-3	Students are able to understand the concept of particle dynamics	1. Students are able to explain the concept of particle dynamics 2. Students can solve particle dynamics problems	**Criteria:** Quantitative **Form:** test	**Form**: Lecture **Method:** • Discussion • Problem solving Assignment: Independent task **Estimated time**: 6x50 minutes	**-**	Particle dynamics: • Newton's laws of motion • Friction • Centripetal force • Gravity References: [1] Chapters 2-3 [3] Chapters 5-6	**10%**

4-5	Students are able to understand the concept of work and energy	1. Students are able to explain the concept of work and energy 2. Students can solve problems related to work and energy descriptions	**Criteria:** Quantitative **Form:** test	**Form**: Lecture **Method:** • Discussion • Problem solving Assignment: Independent task **Estimated time**: 6x50 minutes	**-**	Work and energy: • Fix force • Work by fix force • Work by conservative force • Work by non conservative force • Kinetic energy • Potential energy • Power • Impulses and linear momentum • Motion of the center of mass References: [1] Chapter 3 [3] Chapters 7-10	**5%**
6-7	Students are able to understand the concept of rotation dynamics	Students are able to explain the concept of rotation dynamics and their calculations	**Criteria:** Quantitative **Form:** test	**Form**: Lecture **Method:** • Discussion • Problem solving Assignment: Independent task **Estimated time**: 6x50 minutes		Rotation dynamics: • Rotational motion vector • Angular momentum and moment of force • Moment of inertia • Motion of rigid objects • Conservation of angular momentum • Rigid body balance References: [1] Chapter 6 [3] Chapter 11-	**10%**
8	**Mid-Semester Evaluation / Mid-Semester Examination**						**20%**

9-10	Students are able to understand the concept of vibration	1. Students are able to explain the concept of vibration, and 2. Students are skilled at doing calculations related to vibration	**Criteria:** Quantitative **Form:** test	**Form**: Lecture **Method:** • Discussion • Problem solving Assignment: Independent task **Estimated time**: 6x50 minutes		Vibration: • The vibration equation is in tune • Vibration power in harmony • Examples of vibrations • Combined two vibrations in tune • Vibration is harmoniously muffled References: [1] Chapter 4 [3] Chapter 15	**5%**
11	Students are able to understand the mechanical concept of shape-changing objects	Students are able to explain the mechanical concept of shape-changing objects	**Criteria:** Quantitative **Form:** test	**Form**: Lecture **Method:** • Discussion • Problem solving Assignment: Independent task **Estimated time**: 6x50 minutes	**-**	The mechanics of deforming objects: • Elasticity • Hydrostatics • Hydrodynamics References: [1] Chapter 7 [3] 17-18	**5%**
12	Students are able to understand the concepts of thermometry and calorimetry	Students are able to explain the concepts of thermometry and calorimetry	**Criteria:** Quantitative **Form:** test	**Form**: Lecture **Method:** • Discussion • Problem solving Assignment:	**-**	Thermometry and calorimetry: • The concept of temperature • Temperature scale • Various kinds of thermometers • Expansion	**5%**

				Independent task **Estimated time**: 6x50 minutes		• Heat concept • The Black Principle • Calorimetry References: [2] Chapter 21 [4] Ch.3	
13	Students are able to understand the concept of heat transfer	1. Students are able to explain the concept of heat transfer	**Criteria:** Quantitative **Form:** Non test	**Form**: Lecture **Method:** • Discussion • Problem solving Assignment: Independent task **Estimated time**: 6x50 minutes	**-**	Heat Transfer: • Conduction • Convection • Radiation References: [2] Chapter 22 [4] Ch.3	**5%**
14-15	Students are able to understand thermodynamic concepts	Students are able to explain the concepts of thermodynamics and entropy	**Criteria:** Quantitative **Form:** Non test	**Form**: Lecture **Method:** • Discussion • Problem solving Assignment: Independent task **Estimated time**: 6x50 minutes		Thermodynamics: • Macroscopic and microscopic description • The 0-th law of thermodynamics • The kinetic theory of gases • Heat and work • The first law of thermodynamics • Ideal gas heat capacity • 2nd law of thermodynamics • Entropy References:	**10%**

						[2] Chapters 23-25	
16	**Final Semester Evaluation / Final Semester Examination**						**20%**

Semester Learning Plan

	Universitas Negeri Surabaya **Faculty of Mathematics and Natural Sciences** **Physics Education Study Program**	**Document Code**

SEMESTER LEARNING PLAN						
COURSE	**CODE**	**Group of Course**	**CREDIT POINTS**		**SEMESTER**	**Date of arrangement**
Basic Education	-	**Theory and Innovation of Physics Education**	**T = 3**	**P=0**	1	30 November 2019
Authorization **Department of Physics**	**Semester Learning Plan Developer**		**Group of Course Coordinator**		**Head of Study Program**	
	Dr. Binar Kurnia Prahani, M.Pd.		**Dr. Eko Hariyono, M.Pd,**		**Nadi Suprapto, Ph.D.**	

Learning Outcome (LO)	**PLO in course**	
	PLO3	Demonstrate pedagogical knowledge in planning, teaching, and evaluating of physics learning.
	PLO10	Work as an individual as well as a team effectively, have an entrepreneur skills, and awareness of environmental issues.
	Course Learning Outcome (CLO)	
	CLO1	Students are able to master the knowledge of basic education. Mahasiswa dapat menguasai pengetahuan Dasar-dasar Kependidikan.
	CLO2	Students can work effectively both in groups and individual. Mahasiswa dapat bekerja secara efektif baik secara individu maupun dalam kelompok.
	Final competencies for each learning stage (Sub-CLO)	
	Sub-CLO1	Understand the basic education concept and able to work effectively both in groups and individual.
	Sub-CLO2	Understand the human nature and its development also able to work effectively both in groups and individual.
	Sub-CLO3	Understand the nature of education and able to work effectively both in groups and individual.
	Sub-CLO4	Understand education as a system and able to work effectively both in groups and individual.
	Sub-CLO5	Understand the national education system and able to work effectively both in groups and individual.

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	Sub-CLO6	Understand the educational foundations and able to work effectively both in groups and individual.
	Sub-CLO7	Understand the concept of teacher as a profession and able to work effectively both in groups and individual.
	Sub-CLO8	Understand the educational problems and able to work effectively both in groups and individual.
	Sub-CLO9	Understand the educational innovations in Indonesia and able to work effectively both in groups and individual.
	Sub-CLO10	Understand the character-building and able to work effectively both in groups and individual.
Short description about the course	Basic Education studies and equips pre-service teachers and or teachers in positions regarding the basic concept of education, human nature and its development, educational foundations, education as a system, the national education system, teacher as a profession, educational problems, educational innovations in Indonesia, and character-building both at school and outside of school also have capability to work effectively both individually and in groups.	
Course Content: Learning Material	1. Basic Education Concept 2. Human Nature and Their Deveopment 3. The Nature of Education Hakikat Pendidikan 4. Education as System 5. The National Education System 6. Education Foundation 7. The Concept of Teacher as Educational Problems Profession 8. Education Innovation in Indonesia 9. Character-Building	
References	**Main references:**	
	1. M.V. Roesminingsih and Lamijan Hadi Susarno. 2015. *Teori Dan Praktek Pendidikan*. Surabaya: Lembaga Pengkajian dan Pengembangan Ilmu Pendidikan Fakultas Ilmu Pendidikan Universitas Negeri Surabaya in association with Penerbit Bintang. 2. Hasbullah. 2012. *Dasar-dasar Ilmu Pendidikan*. Jakarta: PT Raja Grafindo Persada. 3. Kadir, Abdul dkk. 2012. *Dasar-dasar Pendidikan*. Jakarta: Kencana Prenada Media Group.	
	Supporting references:	
	4. Mudyaharjo, R. 2012. *Pengantar Pendidikan*. Jakarta: PT Raja Grafindo Persada. 5. Applicable and relevant education laws and regulations. 6. Tirtarahardja, U. & S. L. La Sulo. 2005. *Pengantar Pendidikan*. Jakarta: Rineka Cipta.	
Lecturers	Dr. Dwikoranto, M.Pd.	

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	Dr. Binar Kurnia Prahani, M.Pd. Nurita Apridiana Lestari, S.Pd., M.Pd.	
Requirement course	-	

Week	Final competencies for each learning stage (Sub-CLO)	Assessment		Learning Type, Learning Method, Student Tasks, [Time Estimation]		Learning Material [References]	Assessment Percentage (%)
		Indicator	Criteria & Type	Offline	Online		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	Understand the basic education concept and able to work effectively both in groups and individual.	❖ Explain the course material orientation ❖ Describe the definition of education as political science ❖ Describe the definition of education as applied science	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks ❖ [3 x 50 minutes]	-	The basic education concept: ❖ The course material orientation ❖ The definition of education as political science ❖ The definition of education as applied science ❖ [1, 2, 3, 4, 5, 6]	sub-CLO1: 5%
2	Understand the human nature and its development also able to work effectively	❖ Explain the essential nature of human	❖ Criteria: Quantitative	❖ Learning type: Course	-	The essential nature of human and their development:	sub-CLO2: 5%

	both in groups and individual.	❖ Explain the essential dimension of human ❖ Analyze the human dimension development ❖ Analyze the whole Indonesian human figure	❖ Types: Test and Non-Test	❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks ❖ [3 x 50 minutes]		❖ Nature essential of human ❖ Essential dimension of human ❖ The human dimension development ❖ The whole Indonesian human figure ❖ [1, 2, 3, 4, 5, 6]	
3-4	Understand the nature of education and able to work effectively both in groups and individual.	❖ Describe the definition of education ❖ Explain the education process ❖ Analyze the education function	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks ❖ [3 x 50 minutes]	-	The nature of education: ❖ The definition of education ❖ Education process ❖ Education function ❖ [1, 2, 3, 4, 5, 6]	sub-CLO3: 5%

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5	Understand education as a system and able to work effectively both in groups and individual.	❖ Explain the definition of system ❖ Explain various system ❖ Analyze education as system	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks ❖ [3 x 50 minutes]	-	Education as system: ❖ The definition of system ❖ Various System ❖ Education as system ❖ [1, 2, 3, 4, 5, 6]	sub-CLO4: 5%
6-7	Understand the national education system and able to work effectively both in groups and individual.	❖ Explain the fundamental, objectives and function of national education ❖ Explain educational institutions, programs and management	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks	-	The national education system: ❖ Fundamental, objectives and function of national education ❖ Educational institutions, programs and management ❖ [1, 2, 3, 4, 5, 6]	sub-CLO5: 5%

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				❖ [6 x 50 minutes]			
8	**Midterm Semester Evaluation/Midterm Exam**						Midterm Exam sub-CLO1: 5% ; sub-CLO2: 5% ; sub-CLO3: 5% ; sub-CLO4: 5% ; sub-CLO5: 5%
9	Understand the educational foundations and able to work effectively both in groups and individual. Memahami Landasan Pendidikan serta mampu bekerja secara efektif baik secara individu maupun dalam kelompok.	❖ Explain the educational foundations ❖ Explain the historical foundation ❖ Explain the philosophical foundation ❖ Explain the psychological foundation ❖ Explain the sociological foundation Menjelaskan landasan sosiologis. ❖ Explain the cultural foundation and Tut Wuri Handayani ❖ Explain the science, communication and technology foundation	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks ❖ [3 x 50 minutes]	-	The educational foundations ❖ Historical foundation ❖ Philosophical foundation ❖ Psychological foundation ❖ Sociological foundation ❖ Cultural foundation and Tut Wuri Handayani ❖ Science, communication and technology foundation ❖ [1, 2, 3, 4, 5, 6]	sub-CLO6: 15%

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10	Understand the concept of teacher as a profession and able to work effectively both in groups and individual.	❖ Describe the meaning of teacher as profession ❖ Explain teacher responsibility ❖ Explain teacher tasks ❖ Describe teacher role ❖ Analyze teacher professionalism competencies ❖ Analyze teacher ethics code	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks ❖ [3 x 50 minutes]	-	Teacher as profession ❖ The meaning of teacher as profession ❖ Teacher responsibility ❖ Teacher tasks ❖ Teacher role ❖ Teacher professionalism competencies ❖ Teacher ethics code ❖ [1, 2, 3, 4, 5, 6]	sub-CLO7: 15%
11-12	Understand the educational problems and able to work effectively both in groups and individual	❖ Explain theoretical problems ❖ Explain practical problems ❖ Analyze practical problems in Indonesia ❖ Analyze the efforts to overcome educational problems in Indonesia	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks	-	Educational problems ❖ Theoretical problems ❖ Practical problems ❖ Practical problems in Indonesia ❖ Efforts to overcome educational problems in Indonesia ❖ [1, 2, 3, 4, 5, 6]	sub-CLO8: 15%

				❖ [6 x 50 minutes]			
13	Understand the educational innovations in Indonesia and able to work effectively both in groups and individual.	❖ Explain change and innovation concepts ❖ Describe the definition of educational innovation ❖ Explain the objectives of innovation ❖ Explain the innovation cycle ❖ Explain problems that require educational innovation ❖ Analyze various educational innovation in Indonesia ❖ Analyze the renewal of the education system for educational personnel ❖ Explain the decision making in educational innovation ❖ Analyze obstacles in innovation ❖ Explain resistance. ❖ Analyze factors that need to be considered	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks ❖ [3 x 50 minutes]	-	Education in Indonesia ❖ Change and innovation concepts ❖ The definition of educational innovation ❖ The objectives of innovation ❖ The innovation cycle ❖ Problems that require educational innovation ❖ Various educational innovation in Indonesia ❖ The renewal of the education system for educational personnel ❖ The decision making in educational innovation	sub-CLO9: 15%

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		in innovation in order to avoid resistance				❖ Obstacles in innovation ❖ Resistance ❖ Factors that need to be considered in innovation in order to avoid resistance ❖ [1, 5]	
14-15	Understand the character-building and able to work effectively both in groups and individual.	❖ Explain the foundation of character-building concept ❖ Analyze the foundation of character values Menganalisis ❖ Analyze the character development stages	❖ Criteria: Quantitative ❖ Types: Test and Non-Test	❖ Learning type: Course ❖ Learning Methods: Questions and Answers, discussion and presentation ❖ Students Assignment: Individual and Group Tasks ❖ [6 x 50 minutes]	-	The character-building ❖ The foundation of character-building concept ❖ The foundation of character values ❖ The character development stages ❖ [1, 5]	sub-CLO10: 15%
16	**Final Semester Evaluation / Final Exam**						Final Exam sub-CLO6: 15% ; sub-CLO7: 15% ; sub-CLO8: 15% ; sub-

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		CLO9: 15% ; sub-CLO10: 15%

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RENCANA PEMBELAJARAN SEMESTER					
COURSE	**CODE**	**Group of Course**	**CREDIT POINTS**	**SEMESTER**	**Date of arrangement**
Learning Theories		Mandatory Course	2	2	30 Nop. 2019
Authorization **Department of Physics**	**Semester Learning Plan Developer**	**Group of Course Coordinator**		**Head of Study Program**	
	Woro Setyarsih, S.Pd., M.Si.	**Nadi Suprapto, Ph.D.**		**Nadi Suprapto, Ph.D.**	

Learning Outcome (LO)	**PLO in course**	
	PLO-3	Demonstrate pedagogical knowledge in planning, teaching, and evaluating of physics learning
	PLO-4	Demonstrate knowledge in relating to physics education research
	Course Learning Outcome (CLO)	
	CLO1	Utilize learning sources and learning media based on ICT to support learning implementation using specific learning theories
	CLO2	Master learning theories and able to apply them in learning.
	CLO3	Make decision about relevant learning theories to solve particular learning case in class
	CLO4	Have responsible attitude by applying relevant learning theories in learning
	Final competencies for each learning stage (Sub-CLO)	
	Sub-CLO1	Understand the behavioral learning theory and its implication in learning
	Sub-CLO2	Understand the social learning theory and its implication in learning
	Sub-CLO3	Understand the cognitive learning theory and its implication in learning
	Sub-CLO4	Understand the constructivism learning theory and its implication in learning
	Sub-CLO5	Understand the motivation learning theory and its implication in learning
Short description	A study about principles and how students learn according to behavioral learning theory, social learning theory, cognitive learning theory, constructivist approach, and students learning motivation; and the application in	

about the course	learning through analysis of case examples in class. Course is undertaken through lecturing, discussion, presentation, and modelling activities.
Course Content: Learning Material	behavioral learning theory, social learning theory, cognitive learning theory, constructivist approach, students learning motivation, and the application in learning through analysis of case examples in class.
References	**Main references:** 1) Budayasa, I Ketut. 2000. *Teori Belajar Perilaku (BUKU I). Ed 2. Summarized from Behavioral Learning Theory Chapter of Study Guide for Slavin Educational Psychology Theory and Practice: Fifth Edition by Charles Alberti & Catherine E. McCartney. Allyn and Bacon. 1997.* Surabaya: IKIP Surabaya. 2) Dahar, Ratna Wilis. 1989. Teori-teori Belajar. Jakarta: DEPDIKBUD. 3) Nur, Mohamad. 2000. *Teori Belajar Sosial (BUKU II). Ed. 2. Summarized from Behavioral Learning Theory Chapter of Educational Psychology Theory and Practice: Sixth Edition by Anita E. Woolfolk. Allyn and Bacon. 1995.* Surabaya: IKIP Surabaya. 4) Nur, Mohamad, & Wikandari, Prima Retno. 2004. *Teori Pembelajaran Kognitif (BUKU III). Ed. 2. Summarized from Chapter 6 Cognitive Theories of Learning: Basic Concepts of Educational Psychology Theory and Practice: Fifth Edition by Charles Robert R. Slavin. Allyn and Bacon. 1995.* Surabaya: IKIP Surabaya. 5) Nur, Mohamad, Wikandari, Prima Retno., & Sugiarto, Bambang. 2004. *Pendekatan-pendekatan Konstruktivis dalam Pembelajaran (BUKU IV). Ed. 2. Summarized from Chapter 8 Student Centered & Consructivist Approaches to Instruction of Educational Psychology Theory and Practice: Fifth Edition by Charles Robert R. Slavin. Allyn and Bacon. 1997.* Surabaya: IKIP Surabaya. 6) Nur, Mohamad. 2004. *Pemotivasian Siswa untuk Belajar (BUKU V). Ed. 2. Summarized from Chapter 10 Motivating Student to Learn of Educational Psychology Theory and Practice: Fifth Edition by Charles Robert R. Slavin. Allyn and Bacon. 1997.* Surabaya: IKIP Surabaya. 7) Slavin, R.E. 2012. *Educational Psychology: Theory and Practice Tenth Edition.* Pearson Education, Inc. 8) Santrock, J. W. 2008. *Educational Psychology Third Edition*. Boston: McGraw-Hill. 9) Slavin, R. E. 2011. *Psikologi Pendidikan Teori dan Praktik Edisi Kesembilan Jilid 1.* Jakarta: PT Indeks. 10) Slavin, R. E. 2011. *Psikologi Pendidikan Teori dan Praktik Edisi Kesembilan Jilid 2.* Jakarta: PT Indeks. 11) Woolfolk, A. 2010. *Educational Psychology, Global Edition Eleventh Edition.* New Jersey: Pearson Education. **Supporting references:**
Lecturers	Dra. Suliyanah, M.Si Nadi Suprapto, Ph.D Woro Setyarsih, S.Pd., M.Si.

	Nurita Apridiana Lestari, S,Pd., M.Pd.						
Requirement course	-						
Week	**Final competencies for each learning stage (Sub-CLO)**	**Assessment**		**Learning Type, Learning Method, Student Tasks, [Time Estimation]**		**Learning Material [References]**	**Assessment Percentage (%)**
		Indicator	**Criteria & Type**	**Offline**	**Online**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1	Understand the behavioral learning theory and its implication in learning	• Mention the definition of learning • Explain the learning concept according to the behavioral learning theory • Identify learning examples • Explain the development of behavioral learning theory • Compare the behavioral learning theory according to Ivan Pavlov, E.L. Thorndike and B.F. Skinner	Homework		√	▪ Learning concept ▪ Behavioral learning theory ▪ Learning theory principle	3

		• Give the application examples in learning					
2	Understand the behavioral learning theory and its implication in learning	• Explain the relationship among consequence role, strength and punishment • Explain the premack principle, refresh, formation in learning • Mention the stages in behavior formation • Mention the examples of behavioral learning theory in subject learning	Homework		√	• Behavioral learning theory implication in learning	3
3	Understand the social learning theory and its implication in learning	**Bandura social learning theory** • Differentiate between two learning models through observation and modelling	Homework		√	▪ Bandura social learning theory	3

		• Explain the excellence of learning theory compared to behavioral theory • Provide two learning models examples through observation on subject learning • Explain four learning elements according to Bandura • Apply learning elements in subject learning • Mention five probability results obtained from learning through observation • Apply the use of learning observation results					
4	Understand the social learning theory and its implication in learning	**Self-management**	Quiz, independent task	√		▪ Meichenbaum Model Self-regulation	4

		• Explain things that need to involve students in self-management • Provide examples in self-management program • Modify the cognitive behavior • Explain the stages in Meichenbaum cognitive behavior modification • Give examples of cognitive behavior modification				▪ Cognitive behavior modification ▪ The implication of social learning theory in learning	
5	Understand the cognitive learning theory and its implication in learning	**Information Processing Model** • Explain the components of information processing model • Explain how information processing model works • Differentiate three memory systems	Homework	√		▪ Information Processing Model ▪ Recall & Forget	3

		• Mention factors that strengthen long term memory **Recall & Forget** • Explain recall & forget processes Menjelaskan proses ingat dan lupa • Summarize the resistance and convenience Merangkum tentang hambatan dan kemudahan					
6	Understand the cognitive learning theory and its	**Memory Strategies** • Explain how to teach memory strategy • Provide example in subject learning about memory strategy application **Meaningful Information** • Compare between memory learning and	Homework, Quiz, independent task	√		▪ Cognitive teaching strategy ▪ Learning strategies	4

		meaningful learning • Explain scheme theory • Give example of scheme theory application **Metacognitive Skill** • Describe the definition of metacognitive skill • Give the example in subject learning					
7	Understand the cognitive learning theory and its implication in learning	**Learning Strategies** • Mention sorts of learning strategies • Explain learning strategy by taking notes • Explain how to read using PQ4R method • Apply PQ4R method **- Cognitive Teaching Strategies** • Describe the definition of	Quiz, independent task	√		▪ Multiple Intelligence ▪ The theory implication in learning	4

		Advanced Organizer • Explain how to use analogy in subject learning • Explain how to organize information • Apply cognitive teaching strategy in subject learning **Multiple Intelligence** • Mention the examples of multiple intelligence types • Implement multiple intelligence according to subject					
8	**Midterm Semester Evaluation/Midterm Exam**						20
9	Understand the constructivism learning theory and its implication in learning	**Learning according to constructivism theory** • Explain the constructivist principle • Explain the constructivist history	Homework	√		▪ A view of constructivist theory about learning ▪ The theory implication in learning	3

		• Explain the constructivist strategies • Make examples of the application constructivist learning in subject • Cooperative learning • Explain the cooperative learning characteristic • Denote the cooperative learning types differences • Make examples of the application in subject learning					
10	Understand the constructivism learning theory and its implication in learning	**Problem Solving and thinking skill** Students can: • Explain problem solving stages • Identify the resistance of problem solving • Explain creative problem	Homework	√		▪ A view of constructivist theory about learning ▪ The theory implication in learning	3

		solving strategy • Explain the meaning of thinking skill • Apply problem solving in real life					
11	Understand the constructivism learning theory and its implication in learning	**Linking constructivist learning theory as the foundation for innovative learning models**: *inquiry-based learning*	Homework		√	▪ A view of constructivist theory about learning ▪ The theory implication in learning	3
12	Understand the constructivism learning theory and its implication in learning	**Linking constructivist learning theory as the foundation for innovative learning models**: *problem-based learning*	Homework	√		▪ A view of constructivist theory about learning ▪ The theory implication in learning	3
13	Understand the constructivism learning theory and its implication in learning	**Linking constructivist learning theory as the foundation for innovative learning models**: *project-based learning,* dan *scientific approach*	Homework, Quiz, independent task	√		▪ A view of constructivist theory about learning ▪ The theory implication in learning	4

14	Understand the motivation learning theory and its implication in learning	**Motivation Theory** • Define and describe the characteristics of six motivation theories • Explain the implication of motivation theories in learning subject • Discuss the achievement motivation and affecting factors of motivation **Motivation Improvement** • Describe the definition of learning motivation • Differentiate between intrinsic and extrinsic motivation • Make concept map about learning motivation improvement • Give the application	Homework	√	√	▪ Motivation Theory ▪ Increase in achievement motivation and student motivation to learn	3

		examples in subject learning					
15	Understand the motivation learning theory and its implication in learning	**Teacher's way to increase students' motivation to learn** • Describe ways that teacher can increase learning motivation • Discuss the principles of providing incentives to learn **Rewards for performance, effort, and improvement Pemberian ganjaran atas kinerja, upaya, dan perbaikan** • Explain the effective use of praise • Apply ILE base score and improvement point calculations	Homework, Quiz, independent task		√	▪ Motivation Theory ▪ Increase in achievement motivation and student motivation to learn	4
16	**Final Semester Evaluation / Final Exam**						30

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SEMESTER LEARNING PLAN

	UNIVERSITAS NEGERI SURABAYA Faculty of Mathematics and Natural Sciences Physics Education Study Program	Document Code

SEMESTER LEARNING PLAN

COURSE	CODE	Group of Course	CREDIT POINTS		SEMESTER	Date of arrangement
MATHEMATICAL PHYSICS 1			T=3	P=0	2	25 September 2020

Authorization Department of Physics	Semester Learning Plan Developer	Group of Course Coordinator	Head of Study Program
	Nugrahani Primary Putri, M.Si	Dr. Z.A. Imam Supardi, M.Si	Nadi Suprapto, Ph.D

Learning Outcome (LO)		
	PLO in course	
	PLO1	Able to demonstrate their knowledge of classical physics and modern physics.
	PLO2	Able to formulate a physical system as a physical model by using mathematics.
	PLO11	Able to demonstrate good scientific manners, critical thinking, and innovation skills in educational, research, and professional fields.
	Course Learning Outcome (CLO)	
	CLO1	Students master the knowledge of classical and modern physics to identify the properties of a simple physical system using mathematical physics approach.
	CLO2	Students are able to formulate a simple physical system into mathematical model using relevant symbolic/numeric language.
	CLO3	Students are able to use high order thinking processes to form solutions from the simple physical model.
	CLO4	Students are able to apply scientific manners, critical thinking, and innovation skills for examining physics learning problems using mathematics.
	Final competencies for each learning stage (Sub-CLO)	
	Sub-CLO1	Students master the knowledge of mechanics and thermodynamics to identify the relevant properties of a simple physical system.
	Sub-CLO2	Students are able to formulate simple physical system problems related to mechanics and thermodynamics into mathematical model using relevant symbolic/numeric language.
	Sub-CLO3	Students are able to use high order thinking processes to form solutions from the simple physical model related to mechanics and thermodynamics.
	Sub-CLO4	Students are able to apply scientific manners, critical thinking, and innovation skills for examining mechanics and thermodynamics learning problems at high school using mathematics.

Short description about the course	This course examines infinite series, partial differential, ordinary differential equations, and vector analysis through active learning by combining the methods of discussion, questions and answers, also assignment using IT.
Course Content: Learning Material	• Infinite series • Partial differential • Ordinary differential equations • Vector analysis
References	**Main reference:** [1] Boas, M.L. 2006. *Mathematical Methods in the Physical Science*, 3rd ed. New York: John Wiley & Sons. **Supporting references:** [2] Arfken, G. 1995. *Mathematical Methods for Physicists.* Academic Press. [3] Riley, K.F., Hobson, M.P., Bence, S.J. 2006. *Mathematical Methods for Physics and Engineering*, 3rd ed. Cambridge Univ. Press. [4] Hassani, Sadri. 2009. *Mathematical Methods for Students of Physics and Related Fields*, 2nd ed. Illinois: Springer.
Lecturers	Dr. Z.A. Imam Supardi, M.Si Drs. Supardiyono, M.Si Nugrahani Primary Putri, M.Si
Requirement course	Basic Mathemathics

Week	**Final competencies for each learning stage (Sub-CLO)**	**Assessment**		**Learning Type, Learning Method, Student Tasks, [Time Estimation]**		**Learning Material [References]**	**Assessment Percentage (%)**
		Indicator	**Criteria & Type**	**Offline**	**Online**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1-3	a. Students master the knowledge of mechanics and thermodynamics to identify the relevant properties of a simple physical system. b. Students are able to formulate simple physical system problems related to mechanics and thermodynamics into mathematical model using relevant symbolic/numeric language.	1. Students are able to undertake convergence test of a series. 2. Students are able to analyze a function into power series. 3. Students are able to solve mechanics and thermodynamics problems using series concept.	Criteria: quantitative Type: test	Type: assignment Method; discussion Assignment: independent Time: 6 x 50 minutes	Type: Course Method: Lecture and discussion Time: 3 x 50 minutes	1. Definition and notation 2. Convergence test of infinite series 3. Alternating series 4. Power series 5. Convergence interval of power series 6. Taylor Analysis of a function	Sub CLO 1 (20%) and 2 (20%)
4-6	a. Students master the knowledge of mechanics and thermodynamics to identify the relevant	1. Students are able to execute partial differential using chain rules.	Criteria: quantitative Type: test	Type: assignment Method; discussion	Type: Course Method: Lecture and discussion	Partial differential: 1. Total differential 2. Chain rules 3. Implicit differentiation	Sub CLO 1 (20%) and 2 (20%)

	properties of a simple physical system. b. Students are able to formulate simple physical system problems related to mechanics and thermodynamics into mathematical model using relevant symbolic/numeric language.	2. Students are able to execute implicit differentiation, change variable and limit requirement 3. Students are able to look for minimum and maximum value of a function 4. Students are able to solve mechanics and thermodynamics problems using partial differential concept		Assignment: independent Time: 6 x 50 minutes	Time: 3 x 50 minutes	4. Variable changing 5. Limit requirement 6. Minimum and maximum value with limitation, Lagrange Multiplier	
7	a. Students master the knowledge of mechanics and thermodynamics to identify the relevant properties of a simple physical system. b. Students are able to formulate simple physical system problems related to mechanics and thermodynamics into mathematical model using relevant symbolic/numeric language. c. Students are able to use high order thinking processes to form solutions from the simple physical model related to mechanics and thermodynamics.	1. Students are able to identify first and second order differential equations related to physics concept particularly mechanics and thermodynamics. 2. Students are able to solve first order differential equation. 3. Students are able to find solutions for first order differential equation in physics problems.	Criteria: quantitative Type: test	Type: assignment Method; discussion Assignment: independent Time: 3 x 50 minutes	Type: Course Method: Lecture and discussion Time: 3 x 50 minutes	Ordinary differential equations: 1. Separable equations 2. Linear first-order equations 3. Other methods for first-order equations	Sub CLO 1 (20%), 2 (20%) and 3 (20%)
8	**Midterm Semester Evaluation / Midterm Exam**						Sub CLO 1(40%), 2 (10%)
9-10	b. Students are able to formulate simple physical system problems related to mechanics and thermodynamics into mathematical model using	1. Students are able to solve second order differential equation. 2. Students are able to find solutions for second order	Criteria: quantitative Type: test	Type: assignment Method; discussion Assignment: independent	Type: Course Method: Lecture and discussion Time: 3 x 50 minutes	Ordinary differential equations: 1. Second-order linear equations with constant coefficients and zero right-hand side.	Sub CLO 2 (10%) and 3 (20%)

	relevant symbolic/numeric language. c. Students are able to use high order thinking processes to form solutions from the simple physical model related to mechanics and thermodynamics.	differential equation in physics problems. 3. Students are able to apply ordinary differential equation to solve physics problems in accordance with the concept of mechanics and thermodynamics.		Time: 3 x 50 minutes		2. Second-order linear equations with constant coefficient and right-hand side not zero 3. Other second-order equations	
11-13	b. Students are able to formulate simple physical system problems related to mechanics and thermodynamics into mathematical model using relevant symbolic/numeric language. c. Students are able to use high order thinking processes to form solutions from the simple physical model related to mechanics and thermodynamics. d. Students are able to apply scientific manners, critical thinking, and innovation skills for examining mechanics and thermodynamics learning problems at high school using mathematics.	1. Students are able to hold vector multiplication and vector differentiation, also formulate simple physical system using vector multiplication and vector differentiation concepts. 2. Students are able to use vector operator in cartesian coordinate, gradient, divergence and curl in simple physical model. 3. Students are able to understand Green Theorem, divergence theorem and Stokes theorem.	Criteria: quantitative Type: test	Type: assignment Method; discussion Assignment: independent Time: 6 x 50 minutes	Type: Course Method: Lecture and discussion Time: 3 x 50 minutes	Vector analysis: 1. Vector multiplication: dot product and cross product 2. Differentiation of vectors 3. Operator vector 4. Gradient, Divergence and Curl 5. Line integrals 6. Green's theorem in the plane 7. Divergence theorem 8. Stokes theorem	Sub CLO 2 (10%), 3 (20%) and 4 (30%)
14-15	c. Students are able to use high order thinking processes to form solutions from the simple physical model related to mechanics and thermodynamics. d. Students are able to apply scientific manners, critical thinking, and innovation skills for examining	1. Students are able to identify various coordinates. 2. Students are able to understand coordinate transformation. 3. Students are able to use the concept of coordinate transformation to find solution for simple physical model.	Criteria: quantitative Type: test	Type: assignment Method; discussion Assignment: independent Time: 3 x 50 minutes	Type: Course Method: Lecture and discussion Time: 6 x 50 minutes	Coordinate transformations 1. Cartesian coordinate 2D 2. Polar coordinate 3. Cartesian coordinate 3D 4. Cylindrical coordinate 5. Spherical coordinate	Sub CLO 3 (10%) and 4 (20%)

	mechanics and thermodynamics learning problems at high school using mathematics.						
16	**Final Semester Evaluation / Final Exam**						Sub CLO 2(10%), 3(30%) and 4(50%)

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SEMESTER LEARNING PLAN

	Universitas Negeri Surabaya **Faculty of Mathematics and Natural Sciences** **Physics Education Study Program**	**Document Code**

SEMESTER LEARNING PLAN

COURSE	**CODE**	**Group of Course**	**Credit Points**		**Semester**	**Date of arrangement**
Physics Measurement System		**Mandatory Course**	**T=2**	**P=0**	1	30 Nop. 2019

Authorization Department of Physics	**Semester Learning Plan Developer**	**Group of Course Coordinator**	**Head of Study Program**
	Abu Zainuddin, S.Pd, M.Pd.	**Setyo Admoko, M.Pd**	**Nadi Suprapto, Ph.D**

Learning Outcome (LO)	**PLO in course**	
	PLO-1	Able to demonstrate their knowledge of classical physics and modern physics.
	PLO-6	Design and conduct experiments in learning physics by applying the scientific method
	PLO-7	Improve their knowledge and be able to continue their study in a higher degree program
	PLO-9	Make a decision based on the data or information in order to fulfil and evaluate the tasks responsibility
	Course Learning Outcome (CLO)	
	CLO1	Have the ability to utilize learning source and learning media based on ICT in analyzing physics measurement system.
	CLO2	Have the knowledge of physics measurement system and master its concepts.
	CLO3	Have the skills for analyzing physics measurement system including its application in measuring instruments.
	CLO4	Have a responsible attitude which is reflected in the results of the critical and thorough analysis of the physical measurement system material.
	Final competencies for each learning stage (Sub-CLO)	
	Sub-CLO1	Have the ability to choose learning source and media based on ICT to find the presentation material. Have the ability to choose learning source and media based on ICT to find the example of electrical measuring instrument application.

	Sub-CLO2	Have the ability to select a measuring instrument according to the type of quantity to be measured in order to create high-precision and accurate measurement. Have the ability to select appropriate measurement technique based on the type of quantity to be measured in order to create high-precision and accurate measurement. Have the ability to analyze measurement error and uncertainty sources. Have the ability to plan measurement by giving attention to the work safety principle.
	Sub-CLO3	Have the ability to carry out measurement of physical quantities using proper measuring instruments and measurement technique in order to create high-precision and accurate measurement. Have the ability to carry out measurement by giving attention to work safety principle. Have the ability to present measurement results and uncertainty error according to the rules correctly.
	Sub-CLO4	Have responsibility to keep measuring instruments in order to function properly by carrying out proper procedure for use and maintenace.
Short description about the course	This course describes the application of measurement technique and measurement error analysis, the application of direct current indicating instruments for solving various electrical problems, the applications of inductance and capacitance measurement concept also the explanation of CRO (*Cathode Ray Oscilloscope*) and its application in daily life. Lecturing is undertaken using group discussion, presentation, questions and answers, and also assignment.	
Course Content: Learning Material	The followings are the course content that should be studied by students: 1. Responsible and committed as physics practitioner Bertanggungjawab dan memiliki komitmen sebagai praktisi fisika. 2. Have the ability to use physics concept and suitable mathematical/computation method for solving quantitative physics problems. 3. Use demonstration tools, measuring instruments, and computer software/hardware to increase the precision and accuration of physical phenomena measurement by taking into account the work safety principle. 4. Use symbolic and numeric language creatively to describe natural phenomena both qualitatively and quantitatively. 5. Design and implement the experimental research, analyze data with precise explanation about error and uncertainty, and draw conclusion based on data and guided/independent analysis for learning and research. 6. Have the ability to collect and analyze data also to arrange coherent report on its findings.	
References	**Main references:**	
	1. Bell, D. A. 2004. *Electronics Instrumentation and Measurement*. USA: Springer. 2. Fornasini, P. 2008. *The Uncertainty in Physical Measurements an Introduction to Data Analysis in The Physics Laboratory.* New York: Springer. 3. Gupta, S.V. 2012. *Measurement Uncertainties Physical Parameters and Calibrations of Instruments*. New York: Springer.	
	Supporting references:	

	4. Keithley. 2004. *Low Level Measurement Handbook Precision DC Current, Voltage, and Resistance Measurements*. USA: Keithley Instruments Inc. 5. Moris, A. S. 2001. *Measurement and Instrumentation Principles*, Third Edition. Butterworth Heinemann 6. www.eee.metu.edu.tr~ee231/documents/NotesOnOscilloscopes.pdf						
Lecturers	Setyo Admoko, S.Pd, M.Pd Abu Zainuddin, M.Pd Nurita Apridiana Lestari, M.Pd.						
Requirement course	-						
Week	**Final competencies for each learning stage (Sub-CLO)**	**Assessment**		**Learning Type, Learning Method, Student Tasks, [Time Estimation]**		**Learning Material [References]**	**Assessment Percentage (%)**
		Indicator	**Criteria & Type**	**Offline**	**Online**		
(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
1	Students are able to explain the fundamentals of measurement system	❖ Explain the definition of measurement ❖ Write the measurement results based on its unit and the instrument characteristics ❖ Apply the measurement skills in laboratory activities	Criteria: quantitative Types: presentation and written/oral test	❖ Learning type: Course ❖ Learning methods: questions and answers, discussion, and presentation ❖ Students assignment: individual and groups tasks ❖ 6x 50 minutes		[1, 2, 3, 4 and 5]	Sub-CLO1-4: 5%
2	Students are able to explain the fundamentals of measurement system	❖ Explain the definition of measurement ❖ Write the measurement results based on its unit and the	Criteria: quantitative Types: presentation and written/oral test	❖ Learning type: Course ❖ Learning methods: questions and answers, discussion,		[1, 2, 3, 4 and 5]	Sub-CLO1-4: 5%

		instrument characteristics ❖ Apply the measurement skills in laboratory activities		and presentation ❖ Students assignment: individual and groups tasks ❖ 6x 50 minutes			
3	Students are able to explain the characteristics, performance and type of measuring instruments	❖ Explain the static characteristics of measuring instruments ❖ Explain the dynamic characteristics of measuring instruments	Criteria: quantitative Types: presentation and written/oral test	❖ Learning type: Course ❖ Learning methods: questions and answers, discussion, and presentation ❖ Students assignment: individual and groups tasks ❖ 6x 50 minutes		[1, 2, 3, 4 and 6]	Sub-CLO1-4: 5%
4	Students are able to explain the characteristics, performance and type of measuring instruments	❖ Explain the static characteristics of measuring instruments ❖ Explain the dynamic characteristics of measuring instruments	Criteria: quantitative Types: presentation and written/oral test	❖ Learning type: Course ❖ Learning methods: questions and answers, discussion, and presentation ❖ Students assignment: individual and groups tasks ❖ 6x 50 minutes		[1, 2, 3, 4 and 5]	Sub-CPMK1-4: 5%
5-6	Students are able to explain the characteristics of single and repeated measurement	❖ Explain the differences of single and repeated	Criteria: quantitative Types: presentation	❖ Learning type: Course ❖ Learning methods:		[1, 2, 3, 4 and 5]	Sub-CPMK1-4: 5%

		measurement technique ❖ Analyze the data of single and repeated measurement results	and written/oral test	questions and answers, discussion, and presentation ❖ Students assignment: individual and groups tasks ❖ 6x 50 minutes			
7	Students are able to explain the concept of uncertainty and relative error in measurement	❖ Explain the concept of measurement uncertainty ❖ Apply the concept of error propagation for determining the accuracy level of measurement results	Criteria: quantitative Types: presentation and written/oral test	❖ Learning type: Course ❖ Learning methods: questions and answers, discussion, and presentation ❖ Students assignment: individual and groups tasks ❖ 6x 50 minutes		[1, 2, 3, 4 and 5]	Sub-CPMK1-4: 5%
8	**Midterm Semester Evaluation/Midterm Exam**						Midterm Exam sub-CLO1-4: 50%
9-10	Students are able to identify the electrical measuring instruments	❖ Mention the types of electrical measuring instruments ❖ Explain the working principle of electrical measuring instruments	Criteria: quantitative Types: presentation and written/oral test	❖ Learning type: Course ❖ Learning methods: questions and answers, discussion, and presentation ❖ Students assignment:		[1, 2, 3, 4 and 5]	Sub-CLO1-4: 5%

				individual and groups tasks ❖ 6x 50 minutes			
11-12	Students are able to explain and apply the direct current indicating instrument for solving various electrical problems	❖ Explain the function, working principle and sensitivity of galvanometer ❖ Explain the working principle of amperemeter ❖ Explain the working principle of voltmeter ❖ Explain the working principle of ohmmeter ❖ Carry out the measurement of electric quantity using measuring instrument ❖ Apply the error propagation theory to the measurement results of electric quantities	Criteria: quantitative Types: presentation and written/oral test	❖ Learning type: Course ❖ Learning methods: questions and answers, discussion, and presentation ❖ Students assignment: individual and groups tasks 6x 50 minutes		[1, 2, 3, 4, 5 and 6]	Sub-CLO1-4: 5%
13-14	Students are able to explain and apply the measurement principles of inductance and capacitance measurement	❖ Explain the equivalent circuits of RL and RC.	Criteria: quantitative Types: presentation and	❖ Learning type: Course ❖ Learning methods: questions and answers,		[1, 2, 3, 4, 5 and 6]	Sub-CLO1-4: 5%

		❖ Explain the impedance bridge theory ❖ Determine the values of R, L and C in a measurement activity	written/oral test	discussion, and presentation ❖ Students assignment: individual and groups tasks ❖ 6x 50 minutes			
15	Students are able to explain and use CRO to determine electric quantities	❖ Explain the working principle of CRO tube. ❖ Know CRO parts ❖ Use CRO to measure electric quantities	Criteria: quantitative Types: presentation and written/oral test	❖ Learning type: Course ❖ Learning methods: questions and answers, discussion, and presentation ❖ Students assignment: individual and groups tasks ❖ 6x 50 minutes		[1, 2, 3, 4, 5 and 6]	Sub-CLO1-4: 5%
16	**Final Semester Evaluation / Final Exam**						Final Exam sub-CLO1-4: 50%

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