	Universitas Negeri Surabaya Faculty of Engineering, Electrical Engineering Undergraduate Study Program	Document Code

SEMESTER LEARNING PLAN

Courses	CODE	Course Family	Credit Weight			SEMESTER	Compilation Date
Image processing	2020102342	Compulsory Study Program Subjects	T=0	P=0	ECTS=0	5	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Dr. Lusia Rakhmawati, S.T., M.T.; Dr. Lilik Anifah, S.T., M.T. ; Dr. Raden Roro Hapsari Peni Agustin Tjahyaningtijas, S.Si., M.T.	Prof. Dr. I Gusti Putu Asto B., M.T.	Dr. Lusia Rakhmawati, S.T., M.T.

Learning model	**Case Studies**	
Program Learning Outcomes (PLO)	**PLO study program that is charged to the course**	
	Program Objectives (PO)	
	PO - 1	Able to apply digital image processing methods and skills needed to solve problems in the engineering field
	PO - 2	Able to apply engineering principles, identify, formulate and analyze data/information to solve digital image processing problems
	PLO-PO Matrix	

P.O
PO-1
PO-2

PO Matrix at the end of each learning stage (Sub-PO)

P.O	Week															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
PO-1																
PO-2																

Short Course Description	Explanation of the concepts of Digital Image Processing, Image Representation, Morphology Process, Preprocessing, Normalization Process, Image Restoration, Enhancement Process, Segmentation Process, Feature Extraction, Recognition Process, and image evaluation stages, as well as being able to create a simple program to solve a problem in the image field processing uses the case method learning method
References	**Main :**
	1. 1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.
	Supporters:
	1. Scott E. Umbaugh, Digital Image Processing and Analysis, CRC Press, 3rd Edition
Supporting lecturer	Dr. Raden Roro Hapsari Peni Agustin Tjahyaningtijas, S.Si., M.T. Dr. Lilik Anifah, S.T., M.T.

Week-	Final abilities of each learning stage (Sub-PO)	Evaluation		Help Learning, Learning methods, Student Assignments, [Estimated time]		Learning materials [References]	Assessment Weight (%)
		Indicator	Criteria & Form	Offline (*offline*)	Online (*online*)		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	1. Understand the relationship between basic courses and digital image processing, several examples of the benefits of digital images in everyday life 2. Understand several examples of the benefits of digital images in everyday life	1. Students understand the relationship between basic courses and digital image processing, 2. Students understand several examples of the benefits of digital images in everyday life.	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** General overview of digital image processing lectures, Human visual system and digital image processing, Benefits of digital image processing, Introduction to computer vision. **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%

2	Understand the basic concepts of digital image representation.	1. how to present image representation in the spatial domain using matrices 2. Definition of color space and examples 3. sampling and quantization methods from analog images to digital images 4. Definition of halftoning and examples.	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.* **Material:** Definition of digital image (digital image) **References:**	2%
3	Understand the basic concepts of digital image representation.	1. types of attributes used in digital images 2. types of attributes used in digital images	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%

4	1. Understand the geometric transformation process and algebraic operations that can be applied to digital images. 2. Understand algorithms and pseudocode for geometric transformation processes as well as algebraic operations that can be applied to digital images	1. understanding the dithering technique, its relationship to halftoning, and its effect on a digital image 2. Arithmetic algebra operations on digital images: addition, subtraction, multiplication and division pointwise or using matrices 3. creating programs that perform arithmetic algebraic operations on digital images 4. geometric operations on digital images: zooming, rotation, flip, and warping	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%

5	1. Understand the geometric transformation process and algebraic operations that can be applied to digital images. 2. Understand algorithms and pseudocode for geometric transformation processes as well as algebraic operations that can be applied to digital images	1. Students understand the dithering technique, its relationship to halftoning, and its effect on a digital image 2. Students understand arithmetic algebraic operations on digital images: addition, subtraction, multiplication and division pointwise or using matrices 3. Students understand how to create programs that perform arithmetic algebraic operations on digital images 4. Students understand geometric operations on digital images: zooming, rotation, flip, and warping 5. Students understand how to create programs that perform geometric operations on digital images.	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%

6	1. Understand the function and convolution process of a digital image. 2. Understand the function and process of Fourier transformation of a digital image.	1. Students understand the basics of convolution (spatial filter/discrete filter) in digital images 2. Students understand how convolution (spatial filter/discrete filter) works in digital images 3. Students understand the effect of convolution (spatial filter/discrete filter) on digital images 4. Students understand geometric operations on digital images: zooming, rotation, flip, and warping 5. Students understand how the Fourier transform works on digital images 6. Students understand the effect of the Fourier transform on digital images.	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%

7	1. Understand the histogram specification process on digital images. 2. Able to apply the histogram specification process to digital images according to needs.	1. Students understand the meaning of histogram specifications for digital images 2. Students understand how to use digital image histogram specifications according to their needs	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%
8	1. Able to re-explain previously explained material well. 2. Able to convey scientific opinions regarding the benefits of digital image processing in everyday life.	1. Able to explain the application of digital image processing described in a particular scientific article 2. Able to explain the characteristics of each type of color in digital images.	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	20%

9	1. Understand the benefits of enhancement techniques for monochrome digital images 2. Understand the use of enhancement techniques on monochrome digital images. 3. Know the benefits of enhancement techniques for color digital images. 4. Understand the use of enhancement techniques on color digital images.	1. Students understand the benefits of image sharpening on a color digital image 2. Students understand how to perform image sharpening on a color digital image.	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%
10	1. Understand the meaning of binary image morphology processing. 2. Understand the characteristics and operations of morphological processing on images 3. Understand the definition of edge detection in digital images. 4. Understand the benefits and techniques of edge detection in digital images.	1. Students understand the definition, benefits and types of edge detection techniques in digital images 2. Students understand to explain the technical steps in the edge detection method for derivative 0, derivative 1, and derivative 2 in digital images 3. apply the technical steps of the derivative 0, derivative 1, and derivative 2 edge detection methods on digital images.	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%

11	1. Understand the meaning of binary image morphology processing. 2. Understand the characteristics and operations of morphological processing on images 3. Understand the definition of edge detection in digital images. 4. Understand the benefits and techniques of edge detection in digital images.	1. Students understand the definition, benefits and types of edge detection techniques in digital images 2. Students understand to explain the technical steps in the edge detection method for derivative 0, derivative 1, and derivative 2 in digital images 3. apply the technical steps of the derivative 0, derivative 1, and derivative 2 edge detection methods on digital images.	**Criteria:** 1. The assessment criteria are carried out by looking at aspects: 2. 1. Participation: carried out by observing student activities (weight 2) 3. 2. UTS: carried out with an assessment during the middle of the semester (weight 2) 4. 3. UAS: carried out every semester to measure all indicators (weight 3) 5. 4. Task: carried out on each indicator (weight 3) 6. Student Final Grade: 7. Participation Score (2) x Lever Score (3) x UTS Score (2) x UAS Score (3) divided by 10. **Form of Assessment** : Participatory Activities	Discussion, simulation and reflection 3 X 50		**Material:** Meeting material 1 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	2%
12	Understand how to measure the performance of a particular digital image processing method.	1. Students understand the meaning and basics of fidelity criteria 2. Students understand how to determine measurement techniques for certain cases in measuring the performance of image processing processes	**Criteria:** Evaluation Rubric **Form of Assessment** : Participatory Activities	case method 2 x 50		**Material:** Meeting material 9 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	10%

13	1. Able to analyze the feature extraction process in digital images according to the problems faced. 2. Able to explain the benefits of the feature extraction process in a particular image.	1. Students are able to carry out analysis of the extraction of certain features that have been discussed 2. Students are able to apply feature extraction to a particular image.	**Criteria:** Evaluation Rubric **Form of Assessment** : Participatory Activities	case method 2 x 50		**Material:** Meeting material 9 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	10%
14	1. Understand the definition of noise in a digital image. 2. Understand the basic principles of noise removal in digital images. 3. Able to apply one of the noise removal methods for a particular digital image.	1. Students are able to explain the definition of noise in a digital image 2. Students are able to name one method of removing noise from a digital image 3. Students are able to explain several methods that have been discovered for removing noise in a digital image 4. Students are able to demonstrate the process of removing certain noise from a digital image.	**Criteria:** Evaluation Rubric **Form of Assessment** : Participatory Activities	case method 2 x 50		**Material:** Meeting material 9 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	10%
15	1. Understand the meaning of a recognition system (recognition system). 2. Understand the relationship between digital image processing and recognition systems (recognition systems).	1. explain the meaning of recognition system (recognition system) 2. Students are able to explain the stages in the recognition system (recognition system) 3. Students are able to provide examples of the application of digital image processing in recognition systems.	**Criteria:** Evaluation Rubric **Form of Assessment** : Participatory Activities	case method 2 x 50		**Material:** Meeting material 9 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	10%

16	Able to apply the noise removal process to an image with a certain programming language.	1. Students are able to create applications in certain programming languages that can be used to remove noise from a predetermined image 2. Students are able to present how to remove noise using a certain method on a predetermined image.	**Criteria:** Evaluation Rubric **Form of Assessment** : Test	written test 2 x 50		**Material:** Meeting material 9 **References:** *1. Rafel C. Gonzalez, Digital Image Processing, 3rd Ed., Pearson Education, 2008 2. Rafel C. Gonzalez, Digital Image Processing using Matlab, Pearson Education, 2003. 3. Perry. Adaptive Image Processing. CRC Press LLC, 2002.*	20%

Evaluation Percentage Recap: Case Study

No	Evaluation	Percentage
1.	Participatory Activities	80%
2.	Test	20%
		100%

Notes

1. **Learning Outcomes of Study Program Graduates (PLO - Study Program)** are the abilities possessed by each Study Program graduate which are the internalization of attitudes, mastery of knowledge and skills according to the level of their study program obtained through the learning process.
2. **The PLO imposed on courses** are several learning outcomes of study program graduates (CPL-Study Program) which are used for the formation/development of a course consisting of aspects of attitude, general skills, special skills and knowledge.
3. **Program Objectives (PO)** are abilities that are specifically described from the PLO assigned to a course, and are specific to the study material or learning materials for that course.
4. **Subject Sub-PO (Sub-PO)** is a capability that is specifically described from the PO that can be measured or observed and is the final ability that is planned at each learning stage, and is specific to the learning material of the course.
5. **Indicators for assessing** ability in the process and student learning outcomes are specific and measurable statements that identify the ability or performance of student learning outcomes accompanied by evidence.
6. **Assessment Criteria** are benchmarks used as a measure or measure of learning achievement in assessments based on predetermined indicators. Assessment criteria are guidelines for assessors so that assessments are consistent and unbiased. Criteria can be quantitative or qualitative.
7. **Forms of assessment:** test and non-test.
8. **Forms of learning:** Lecture, Response, Tutorial, Seminar or equivalent, Practicum, Studio Practice, Workshop Practice, Field Practice, Research, Community Service and/or other equivalent forms of learning.
9. **Learning Methods:** Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods.
10. **Learning materials** are details or descriptions of study materials which can be presented in the form of several main points and sub-topics.
11. **The assessment weight** is the percentage of assessment of each sub-PO achievement whose size is proportional to the level of difficulty of achieving that sub-PO, and the total is 100%.
12. TM=Face to face, PT=Structured assignments, BM=Independent study.