	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
Biomedical Instrumentation and Signal Processing	2020102045	Compulsory Study Program Subjects	T=2	P=0	ECTS=3.18	5	July 17, 2024

AUTHORIZATION	SP Developer	Course Cluster Coordinator	Study Program Coordinator
	Dr. Lilik Anifah, S.T., M.T. ; Arif Widodo, S.T., M.Sc. ; Parama Diptya Widayaka, S.ST., M.T.	Prof. Dr. I Gusti Putu Asto B., M.T.	Dr. Lusia Rakhmawati, S.T., M.T.

Learning model: Project Based Learning

Program Learning Outcomes (PLO)

PLO study program which is charged to the course

Program Objectives (PO)

PO - 1	Able to apply knowledge of mathematics, natural sciences, and Biomedical Instrumentation and Signal Processing to gain a thorough understanding of engineering principles
PO - 2	Able to be responsible by complying with norms, professional ethics and responsible for solving electrical engineering problems based on instrumentation and biomedical signal processing
PO - 3	Able to design systems or components of instrumentation and biomedical signal processing to be applied in the field of electrical engineering.

PLO-PO Matrix

P.O
PO-1
PO-2
PO-3

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																
PO-3																

Short Course Description: The biomedical instrumentation and signal processing course is an advanced course for students who are interested in studying the field of biomedical electronics engineering. In this course, two basic materials will be discussed, namely biomedical instrumentation and biomedical signal processing. Biomedical signals themselves are unique signals because they have very small amplitudes but very large noise. So the instrumentation and signal processing used is different from other electronic equipment. Students who wish to take this course are expected to have mastered the concepts of analog electronic circuits and digital signal processing. After taking this course, students are expected to be able to design and manufacture biomedical instrumentation. Furthermore, students are expected to be able to understand and apply several forms of biomedical signal processing.

References

Main :

1. Hadiyoso, Sugondo & Rizal, Achmad. 2014. Instrumentasi Biomedis berbasis PC. Gava Media.
2. Khandpur, R. S. 1992. Handbook of Biomedical Instrumentation, Second Edition. Tata Mcgraw-hill.

Supporters:

1. Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The Ibm Pc. Prentice Hall.
2. Jurnal penelitian yang relevan

Supporting lecturer: Dr. Lilik Anifah, S.T., M.T.
Parama Diptya Widayaka, S.ST., M.T.
Sayyidul Aulia Alamsyah, 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	Understand electrical signals in the human body such as ECG, EMG and EEG.	1. Able to differentiate ECG, EMG and EEG signals based on signal bandwidth and amplitude characteristics. 2. Understand the form of the ECG signal and the signal features (PQRST) contained in it. 3. Understand the shape of the EMG signal, its frequency range and amplitude in the arm and leg muscles. 4. Understand the form of alpha, beta and gamma signals on EEG.	**Form of Assessment** : Participatory Activities	Method: Discovery Approach: Scientific 2 X 50		**Material:** Electrical signals in the human body such as ECG, EMG and EEG. **Bibliography:** *Hadiyoso, Sugondo & Rizal, Achmad. 2014. PC-based Biomedical Instrumentation. Gava Media.*	5%
2	Design and manufacture instrumentation amplifiers.	1. Understand the principles and workings of instrumentation amplifier circuits. 2. Able to design instrumentation amplifiers with Op-Amp LM324. 3. Able to make an instrumentation amplifier with the LM324 Op-Amp. 4. Able to make an instrumentation amplifier with AD620. 5. Able to analyze the reliability of instrumentation amplifiers.	**Criteria:** Evaluation Rubric	Method: Discovery Approach: Scientific 2 X 50		**Material:** Amplifier instrumentation **Reference:** *Khandpur, RS 1992. Handbook of Biomedical Instrumentation, Second Edition. Tata McGraw Hill.*	5%

3	Design and manufacture instrumentation amplifiers.	1. Understand the principles and workings of instrumentation amplifier circuits. 2. Able to design instrumentation amplifiers with Op-Amp LM324. 3. Able to make an instrumentation amplifier with the LM324 Op-Amp. 4. Able to make an instrumentation amplifier with AD620. 5. Able to analyze the reliability of instrumentation amplifiers.	**Form of Assessment** : Participatory Activities	Method: Discovery Approach: Scientific 2 X 50		**Material:** Instrumentation amplifier. **References:** *Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The IBM Pc. Prentice Hall.*	5%
4	Able to design and create active filters for ECG and EMG.	1. Know the bandwidth of ECG and EMG signals. 2. Able to design and create active filters for ECG. 3. Able to design and create active filters for EMG.	**Criteria:** Evaluation Rubric **Form of Assessment** : Participatory Activities	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Active filters for ECG and EMG. **References:** *Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The IBM Pc. Prentice Hall.*	5%
5	Able to design and create active filters for ECG and EMG.	1. Know the bandwidth of ECG and EMG signals. 2. Able to design and create active filters for ECG. 3. Able to design and create active filters for EMG.	**Criteria:** Evaluation Rubric **Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Meeting material 5 **Reader:** *Hadiyoso, Sugondo & Rizal, Achmad. 2014. PC-based Biomedical Instrumentation. Gava Media.* **Material:** Active filters for ECG and EMG. **Bibliography:** *Hadiyoso, Sugondo & Rizal, Achmad. 2014. PC-based Biomedical Instrumentation. Gava Media.*	5%
6	Able to design and create active filters for ECG and EMG.	1. Know the bandwidth of ECG and EMG signals. 2. Able to design and create active filters for ECG. 3. Able to design and create active filters for EMG.	**Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Active filters for ECG and EMG. **Bibliography:** *Hadiyoso, Sugondo & Rizal, Achmad. 2014. PC-based Biomedical Instrumentation. Gava Media.*	5%

7	Able to design and create active filters for ECG and EMG.	1. Know the bandwidth of ECG and EMG signals. 2. Able to design and create active filters for ECG. 3. Able to design and create active filters for EMG.	**Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Meeting material 5 **Reader:** *Hadiyoso, Sugondo & Rizal, Achmad. 2014. PC-based Biomedical Instrumentation. Gava Media.* **Material:** Active filters for ECG and EMG. **Bibliography:** *Hadiyoso, Sugondo & Rizal, Achmad. 2014. PC-based Biomedical Instrumentation. Gava Media.*	5%
8	UTS	1. Know the bandwidth of ECG and EMG signals. 2. Able to design and create active filters for ECG. 3. Able to design and create active filters for EMG.	**Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Meeting material 5 **Reader:** *Hadiyoso, Sugondo & Rizal, Achmad. 2014. PC-based Biomedical Instrumentation. Gava Media.* **Material:** UTS **Library:** *Relevant research journals*	10%
9	Able to design a simple signal processing system using medical images	Able to design a simple signal processing system using medical imaging data	**Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Medical image processing **References:** *Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The IBM Pc. Prentice Hall.*	5%
10	Able to design a simple signal processing system using medical images	Able to design a simple signal processing system using medical imaging data	**Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Medical image processing **References:** *Relevant research journals*	5%
11	Able to design a simple signal processing system using medical images	Able to design a simple signal processing system using medical imaging data	**Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Medical image processing **Library:** **Material:** Medical image processing **References:** *Relevant research journals*	5%

12	Able to design a simple decision support system using medical images.	Able to design a simple decision support system using medical images.	**Criteria:** resulting project **Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Decision support system in medical images. **References:** *Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The IBM Pc. Prentice Hall.* **Material:** Decision support system in medical images. **Library:** *Relevant research journals*	5%
13	Able to design a simple decision support system using medical images.	Able to design a simple decision support system using medical images.	**Criteria:** resulting project **Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Decision support system in medical images. **References:** *Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The IBM Pc. Prentice Hall.* **Material:** Decision support system in medical images. **Library:** *Relevant research journals*	5%
14	Able to design a simple decision support system using medical images.	Able to design a simple decision support system using medical images.	**Criteria:** resulting project **Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Decision support system in medical images. **References:** *Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The IBM Pc. Prentice Hall.* **Material:** Decision support system in medical images. **Library:** *Relevant research journals*	5%

15	1.Able to design a simple decision support system using medical images. 2.Able to be responsible for completing projects according to the specified schedule and targets. 3.Able to explain simple signal processing using medical images.	Able to design a simple decision support system using medical images.	**Criteria:** resulting project **Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Decision support system in medical images. **References:** *Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The IBM Pc. Prentice Hall.* **Material:** Decision support system in medical images. **Library:** *Relevant research journals*	15%
16	1.Able to design a simple decision support system using medical images. 2.Able to be responsible for completing projects according to the specified schedule and targets. 3.Able to explain simple signal processing using medical images.	Able to design a simple decision support system using medical images.	**Criteria:** resulting project **Form of Assessment** : Project Results Assessment / Product Assessment	Method: Demonstration Approach: Scientific 2 X 50		**Material:** Decision support system in medical images. **References:** *Tompkins, Willis J. 1993. Biomedical Digital Signal Processing: C Language Examples And Laboratory Experiments For The IBM Pc. Prentice Hall.* **Material:** Decision support system in medical images. **Library:** *Relevant research journals*	15%

Evaluation Percentage Recap: Project Based Learning

No	Evaluation	Percentage
1.	Participatory Activities	15%
2.	Project Results Assessment / Product Assessment	85%
		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** abilities in the process and student learning outcomes are specific and measurable statements that identify the abilities 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.