# TEACHING INSTRUCTIONAL DESIGN (BRP)

# COURSE

# INSTRUMENTATION PHYSICS 2

**by**

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# PREFACE

The Teaching Instructional Design (BRP) contains lesson plans for one semester. BRP was prepared to be used as a reference for learning the Instrumentation Physics 2 course at the Department of Physics, FMIPA UI.

The Instrumentation Physics 2 course is scheduled to be followed by 6th semester physics students, with the requirement that the student has taken the Physical Instrumentation 1 course. In this course, students will learn the instrumentation methods and techniques that are widely used in Physics. At the end of the lecture, students will present the assignment given by the lecturer in accordance with the lecture topic.

With the preparation of this BRP, it is hoped that it can become a reference for the learning process for lecturers and for students participating in lectures in particular and for people who want to learn it.

Depok, May 2016

**Dr. Cuk Imawan**

## I. Informasi Umum

| | | | |
|---|---|---|---|
| 1. | Name of Program / Study Level | : | Physics / Undergraduate |
| 2. | Course Name | : | Intrumentation Physics 2 |
| 3. | Course Code | : | SCFI603714 |
| 4. | Semester | : | 5 |
| 5. | Credit | : | 2 Credits |
| 6. | Teaching Method(s) | : | Collaborative Learning |
| 7. | Prerequisite course(s) | : | Intrumentation Physics 1 |
| 8. | Requisite for course(s) | : | Instrumentation specialization courses |
| 9. | Integration Between Other Courses | : | - |
| 10. | Lecturer | : | Dr. Cuk Imawan |
| 11. | Course Description | : | To describe the instrumentation methods and techniques that are widely used in Physics. |

## II. Course Learning Outcome (CLO) and Sub-CLOs

### A. CLO

Students are able to explain basic concepts related to instrumentation based on physics and mathematics (C3) (ELO 3, 5, 6, 7)

### B. Sub-CLOs

| | | |
|---|---|---|
| 1 | Applying Learning Methods (C2) | 1 |
| 2 | Describing Simple Measurements (C2) | 1 |
| 3 | Describing Operational Amplifiers and Their Applications (C2) | 1 |
| 4 | Describe Digital and Computer Electronics (C2) | 1 |
| 5 | Describe Signals and Noise (C2) | 1 |
| 6 | Describe the Introduction to the Spectrometric Method (C2) | 1 |
| 7 | Describing the Components of Optical Instrumentation (C2) | 2 |
| 8 | Describing Introduction to the Optical Atomic Spectrometry (C2) | 2 |
| 9 | Describing Atomic Absorption and Atomic Fluorescence Spectrometry (C2) | 1 |
| 10 | Describing Atomic Emission Spectrometry (C2) | 1 |
| 11 | Describing Atomic Mass Spectrometry (C2) | 1 |
| 12 | Describing Atomic X-ray Spectrometry (C2) | 1 |

## III. Rencana Pembelajaran

| Week | Sub-CLO | Study Materials | Teaching Method | Time Required | Learning Experiences (*O-E-F) | Sub-CLO Weight on Course (%) | Sub-CLO Achievement Indicator | References |
|---|---|---|---|---|---|---|---|---|
| 1 | 1 | Introduction | Collaborative Learning | 100 minutes | O:(70%)<br>E:(0%)<br>F:(30%) | 4 | Explain Learning Methods | |
| 2 | 2 | Simple Measurement: Electronic Components and Circuits | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 7 | Explain the basic concepts:<br>a) DC circuit<br>b) AC circuit<br>c) Semiconductors and semiconductor devices<br>d) Ppower supply and regulator<br>e) Reading Device | Sec. 1<br>Page. 26 |
| 3 | 3 | Operational Amplifiers in Chemical Instrumentation | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 7 | Explain the basic concepts:<br>a) Properties of the Op-Amp<br>b) Op-Amp circuit<br>c) Transducer signal amplification and measurement<br>d) Op-Amp applications for voltage and current control<br>e) Op-Amp Application for Mathematical Operations | Sec. 1<br>Page . 59 |
| 4 | 4 | Electronics Digital and Computer | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 7 | Explain the basic concepts:<br>a) Analog and Digital Signals<br>b) *Counting and Arithmetic with Binary Numbers* | Sec. 1<br>Page . 80 |

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| | | | | | | | c) Basic Digital Circuits<br>d) Computers and computerized instruments<br>e) Computer Components<br>f) Computer Software<br>g) Computer Applications<br>h) Computer Networks | |
| 5 | 5 | Signal and Noise | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 7 | Explain the basic concepts:<br>a) Signal to noise Ratio (SNR)<br>b) Sources of noise in Instrumentation Analysis<br>c) Signal-to-Noise enhancements | Sec. 1<br>Page . 110 |
| 6 | 6 | Introduction to the Spectrometric Method | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 7 | Explain the basic concepts:<br>a) general properties of electromagnetic radiation<br>b) the nature of electromagnetic radiation waves<br>c) quantum mechanical properties of radiation<br>d) The quantitative aspect of spectrochemical measurements | Sec. 2<br>Page . 132 |
| 7 | 7 | Optical Instrumentation Components | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 8 | Explain the basic concepts:<br>a) General design of optical instruments<br>b) Radiation Sources<br>*c)* Wavelength selector<br>d) Sample Containers | Sec. 2<br>Page . 164 |

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| | | | | | | | e) Radiation transducer | |
| 8 | 7 | Optical Instrumentation Components | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 8 | Explain the basic concepts:<br>a) Signal Processing and Readout<br>b) Fiber Optic<br>c) Types of Optical Instruments<br>d) Fourier Transform Principle in Optical Measurement | Sec. 2<br>Page . 164 |
| 9 | **Mid Term Exam** | | | | | | | |
| 10 | 8 | Introduction to Optical Atomic Spectrometry | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 7 | Explain the basic concepts:<br>a) Optical atomic spectra<br>b) Atomization Method | Sec. 2<br>Page . 215 |
| 11 | 8 | Introduction to Optical Atomic Spectrometry | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 7 | Explain the basic concepts:<br>a) Introduction to Sample Methods | Sec. 2<br>Page . 215 |
| 12 | 9 | Atomic Absorption and Atomic Fluorescence Spectrometry | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 7 | Explain the basic concepts:<br>a) Sample atomization technique<br>b) Atomic Absorption Instrumentation<br>c) Interference in Atomic Absorption Spectroscopy<br>d) Atomic Absorption Analytical Techniques<br>e) Atomic fluorescence spectroscopy | Sec. 2<br>Page . 230 |
| 13 | 10 | Atomic Emission Spectrometry | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 8 | Explain the basic concepts:<br>a) Emission spectroscopy based on plasma source | Sec. 2<br>Page . 254 |

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| | | | | | | | b) emission spectroscopy based on Arc and Spark sources<br>c) Another source for optical emission spectroscopy | |
| 14 | 11 | Atomic Mass Spectrometry | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 8 | Explain the basic concepts:<br>a) Some general features of atomic mass spectrometry<br>b) Mass spectroscopy<br>c) Inductively coupled plasma *Mass Spectrometry*<br>d) Source of Mass Spectrometry Spark<br>e) *Glow discharge Mass Spectrometry*<br>f) Other Mass Spectrometric Methods | Sec. 2<br>Page . 281 |
| 15 | 12 | Atomic X-ray Spectrometry | Collaborative Learning | 100 minutes | O: (20%)<br>E: (50%)<br>F: (30%) | 8 | Explain the basic concepts:<br>a) Basic Principles<br>b) Instrument Components<br>c) X-Ray Fluorescence Method<br>d) X-Ray Absorption Method<br>e) Electron microprobe | Sec. 2<br>Page . 303 |
| 16 | **Final Exam** | | | | | | | |

*) O : Orientation
E : Exercise
F : Feedback

Reference:

1. Skoog, Douglas A, *Principles of Instrumental Analysis, 6th Ed*, Thompson Higher Education – Canada, 2007

## IV. Assignment Design

| Week | Assignment Name | Sub-CLOs | Assignment | Scope | Working Procedure | Deadline | Outcome |
|---|---|---|---|---|---|---|---|
| 1 | Individual Assignments & Group Assignments | 1 | Question | Learning methods | Group, Independent and Online | 100 minutes | - |
| 2 | Individual Assignments & Group Assignments | 2 | Question | a) DC circuit<br>b) AC circuit<br>c) Semiconductors and semiconductor devices<br>d) Ppower supply and regulator<br>e) Reading Device | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 3 | Individual Assignments & Group Assignments | 3 | Question | a) Properties of the Op-Amp<br>b) Op-Amp circuit<br>c) Transducer signal amplification and measurement<br>d) Op-Amp applications for voltage and current control<br>e) Op-Amp Application for Mathematical Operations | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 4 | Individual Assignments & Group Assignments | 4 | Question | a) Analog and Digital Signals<br>b) *Counting and Arithmetic with Binary Numbers*<br>c) Basic Digital Circuits<br>d) Computers and computerized instruments<br>e) Computer Components<br>f) Computer Software<br>g) Computer Applications<br>h) Computer Networks | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 5 | Individual Assignments & Group Assignments | 5 | Question | a) Signal to noise Ratio (SNR)<br>b) Sources of noise in Instrumentation Analysis<br>c) Signal-to-Noise enhancements | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 6 | Individual Assignments & Group Assignments | 6 | Question | a) general properties of electromagnetic radiation | Group, Independent and Online | 100 minutes | Student power points, presentation results, |

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| | | | | b) the nature of electromagnetic radiation waves<br>c) quantum mechanical properties of radiation<br>d) The quantitative aspect of spectrochemical measurements | | | independent assignment sheets |
| 7 | Individual Assignments & Group Assignments | 7 | Question | a) General design of optical instruments<br>b) Radiation Sources<br>*c)* Wavelength selector<br>d) Sample Containers<br>e) Radiation transducer | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 8 | Individual Assignments & Group Assignments | 7 | Question | a) Signal Processing and Readout<br>b) Fiber Optic<br>c) Types of Optical Instruments<br>d) Fourier Transform Principle in Optical Measurement | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 10 | Individual Assignments & Group Assignments | 8 | Question | a) Optical atomic spectra<br>b) Atomization Method | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 11 | Individual Assignments & Group Assignments | 8 | Question | a) Introduction to Sample Methods | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 12 | Individual Assignments & Group Assignments | 9 | Question | a) Sample atomization technique<br>b) Atomic Absorption Instrumentation<br>c) Interference in Atomic Absorption Spectroscopy<br>d) Atomic Absorption Analytical Techniques<br>e) Atomic fluorescence spectroscopy | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 13 | Individual Assignments & Group Assignments | 10 | Question | a) Emission spectroscopy based on plasma source<br>b) emission spectroscopy based on Arc and Spark sources<br>c) Another source for optical emission spectroscopy | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |

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|---|---|---|---|---|---|---|---|
| 14 | Individual Assignments & Group Assignments | 11 | Question | a) Some general features of atomic mass spectrometry<br>b) Mass spectroscopy<br>c) Inductively coupled plasma *Mass Spectrometry*<br>d) Source of Mass Spectrometry Spark<br>e) *Glow discharge Mass Spectrometry*<br>f) Other Mass Spectrometric Methods | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |
| 15 | Individual Assignments & Group Assignments | 12 | Question | a) Basic Principles<br>b) Instrument Components<br>c) X-Ray Fluorescence Method<br>d) X-Ray Absorption Method<br>e) Electron microprobe | Group, Independent and Online | 100 minutes | Student power points, presentation results, independent assignment sheets |

## V. Assessment Criteria (Learning Outcome Evaluation)

| Evaluation Type | Sub-CLOs | Assessment Type | Frequency | Evaluation Weight (%) |
|---|---|---|---|---|
| Online Activeness | 2 - 12 | Activities at Scele | 2 x 3 | 10 |
| Final Paper / Presentation:<br>1. HG group discussion<br>2. FG group discussion<br>3. HG group discussion (verification) | 2 – 7 and 8 – 12 | Assessment sheet | 2 x 3 | 10 |
| Topic Presentation (HG) | 2 – 7 or 8 – 12 | PowerPoint | 1 | 20 |
| Individual Assignment | 2 - 12 | Assignment sheet | 3 | 10 |
| Group Assignment | 2 - 12 | PowerPoint | 3 | 10 |
| Exam 1 | 2 - 7 | Essay Exam Questions | 1 | 20 |
| Exam 2 | 8 - 12 | Essay Exam Questions | 1 | 20 |
| **Total** | | | | **100** |

## VI. Rubric(s)

### A. Criteria of Presentation Score

| Score | Delivering the Presentation |
|---|---|
| 85-90 | Groups are able to convey explanations logically, fluently, and on time and are able to answer questions from fellow students and teachers |
| 75-84 | The group is able to convey explanations logically and smoothly and can answer questions from fellow students and teachers, but cannot manage time well |
| 65-74 | The group is able to convey explanations smoothly but is unable to convey the logic of their reasoning |
| 55-64 | The group is less able to convey explanations smoothly and on time and is less able to convey the logic of their reasoning |
| <55 | |

### B. Criteria of Essay Score

| Nilai | Answers Quality |
|---|---|
| 100 | The answer is very precise, all the definitions and main components are complete |
| 76-99 | The answer is quite precise, the meaning and the main components are almost complete |
| 51-75 | Inaccurate answers, incomplete understanding and main components |
| 26-50 | The answer is very inaccurate, the meaning and the main components are very incomplete |
| <25 | Wrong answers |