# SEMESTER LEARNING ACTIVITY PLANS (SLAP)

## SEMESTER ODD/EVEN 2022/2023

Physics Undergraduate Study Program

Physics Department

Modern Physics Experiments**)

MFF 2033/ 1 Credits


Lecturer Coordinator:

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**UNIVERSITAS GADJAH MADA**
**FACULTY OF MATHEMATICS AND NATURAL SCIENCE**
**2022**

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| | **Universitas Gadjah Mada**<br>Faculty of Mathematics and Natural Science<br>Physics Department / Physics Undergraduate Study Program<br>Semester ODD/EVEN 2022/2023 | **Document Number :**<br>…… |

**SEMESTER LEARNING ACTIVITY PLANS (SLAP)**

| Code | Course Name | Credits (Credits) | | Semester | Status | Prerequisite |
|---|---|---|---|---|---|---|
| *MFF 2033* | *Modern Physics Experiments**)* | *T: 1* | *P: …* | *ODD/EVEN* | *Compulsory* | *Basic Physics II Experiments (MFF1014)* |

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| **Short Description** | This course is an experiment that studies Modern Physics. The subjects studied in this experiment were :<br>- microwave generators,<br>- photoelectric phenomena,<br>- the working principle of the Michelson interferometer,<br>- determining the elemental charge in Millikan's experiment, and<br>- investigating the x-ray spectrum and its application in determining the absorption coefficient of a material.<br>The courses given are in the form of an experiment. The prerequisites for taking this course are Basic Physics I and II Experiments. | |
| **Program Learning Outcomes (PLO) Imposed on the Course** | ***PLO 1*** | Attitude. Have faith and fear of God Almighty, and apply good morals, ethics, initiative, and responsibility in completing their duties. |
| | ***PLO 2*** | Knowledge. Able to explain theoretical concepts and principles of classical and modern physics and able to apply basic concepts of physics and related mathematical methods in finding solutions to physical problems. |
| | ***PLO 4*** | Special Skills. Able to design and carry out experiments/theoretical reviews, able to identify a physical problem based on the results of observations and experiments, and able to operate related technologies. |
| | ***PLO 5*** | Long Life Learning. Able to analyze various alternative solutions to physical problems and conclude them for appropriate decision-making, both in familiar and new problems. |
| **Course Outcomes (CO)** | **After completing this course, students are expected to be able to:** | |
| | ***CO1*** | Students can understand the nature of existing microwave generators, namely klystrons, and can use them to measure the length of microwaves in a waveguide. |
| | ***CO2*** | Students can develop a mindset and explain how to understand the photoelectric effect/symptom experimentally and determine the work function of the photocell, the Planck constant value, and the maximum kinetic energy of the photoelectron. |
| | ***CO3*** | Students have the competence and ability to understand the working principle of the Michelson Interferometer. Students can use an interferometer to measure the wavelength of light in the spectrum of Cadmium/Sodium atoms. Students can also determine the effect of pressure on the refractive index of air/gas. |
| | ***CO4*** | Students understand the X-ray spectrum from an X-ray tube. Students can determine the distance between a crystal's Bragg planes and a material's absorption coefficient against X-rays. |

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| | ***CO5*** | Students can explain Millikan's experiment, demonstrate the discrete nature of electric and elemental charges, and determine Avogadro's number by observing Brownian motion. | | |
| **The Correlation of CO to Learning Materials and Methods, and Time Allocation** | | **Learning Materials** | **Learning Methods** | **Time Allocation** |
| | ***CO 1, CO 2, CO 3, CO 4, CO 5*** | Microwave Experiments, Photoelectric Effect Experiments, Michelson Interferometer Experiments, X-Ray Experiments, and Minster's Experiments | CBL | ***4X50 minutes*** |
| | ***CO 1, CO 2, CO 3, CO 4, CO 5*** | "Microwave Experiments, Photoelectric Effect Experiments, Michelson Interferometer Experiments, X-Ray Experiments, and Minster's Experiments | CBL | ***3X50 minutes*** |
| | **Midterm exam/Project Task Results/Case Analysis Results** | | | |
| | ***CO 1, CO 2, CO 3, CO 4, CO 5*** | Microwave Experiments, Photoelectric Effect Experiments, Michelson Interferometer Experiments, X-Ray Experiments, and Own Experiments | CBL | ***1X50 minutes*** |
| | ***CO 1, CO 2, CO 3, CO 4, CO 5*** | Microwave Experiments, Photoelectric Effect Experiments, Michelson Interferometer Experiments, X-Ray Experiments, and Minster's Experiments | CBL | ***1X50 minutes*** |
| | ***CO 1, CO 2, CO 3, CO 4, CO 5*** | Microwave Experiments, Photoelectric Effect Experiments, Michelson Interferometer Experiments, X-Ray Experiments, and Minster's Experiments | CBL | ***1X50 minutes*** |
| | ***CO 1, CO 2, CO 3, CO 4, CO 5*** | **Final Test** | CBL | ***4X50 minutes*** |
| | **Final exams/ Project Task Results/Case Analysis Results** | | | |
| **Learning Methods** | **CBL (Case Based Learning): Pretest, Presentation of material and some display material, Hands-on experiments using available set-ups, Making reports** | | | |
| **Student Learning Experience** | **Paying attention, asking questions, taking notes, and doing a practicum.** | | | |

<table>
<tr><td>Access to Learning Media/ LMS and Offline and Online Percentage</td><td>Offline (Experimental tool) and Online (Zoom Meeting, Google Meet, Google Classroom)</td></tr>
<tr><td>Assessment Methods and Synchronization with CO</td><td>
<table>
<tr><th>Assessment Methods</th><th>Assessment Percentage</th><th>Criteria/ Indicators</th><th>CO1</th><th>CO2</th><th>CO3</th><th>CO4</th><th>CO5</th></tr>
<tr><td>Participatory Activity*</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>Project Results/ Case Study Results/ PBL Results*</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="8">Cognitive</td></tr>
<tr><td>Pretest</td><td>10</td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Practicum</td><td>30</td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Practicum Report</td><td>35</td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Final Test</td><td>25</td><td></td><td>√</td><td>√</td><td>√</td><td>√</td><td>√</td></tr>
<tr><td>Total</td><td>100</td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
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*) can also be obtained from the Midterm or Final Exam as the result of participatory activities or project/ case study results. According to IKU 7, the percentage of project results/ case study/ PBL results is at least 50%.
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<tr><td>References</td><td>
Main References;
<ol>
<li>Panduan Praktikum Eksperimen Fisika Modern, Lab. Fisika Atom & Inti, FMIPA UGM, Yogyakarta, 2012..</li>
<li>Melissinos, A.C., Experiments in Modern Physics, Acad. Press, New York, 1966, hal 18-27..</li>
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<li>Harnwell, G.P. dan Livingood, J.J., Experiment Atomic Physics, Mc Graw Hill, 1933, hal. 214-223..</li>
<li>Portis, A.M., Berkeley Physics Lab MO1, MO2, MO3, Mc Graw Hill..</li>
<li>Weast, R.C., Handbook of Chemistry and Physics, Edisi ke-57, CRC Press, 1976..</li>
</ol>
Additional References:
<ol>
<li>Millikan, R.A., Electrons (+ and -), proptons, photons, neutrons, mesotrons and Cosmic Rays, 1974.</li>
<li>Semat, H., Introduction to Atomic and Nuclear Physics, Holt, Rinehart & Winston, 1962, hal 146-186.</li>
<li>Eisberg, R.M., Fundamentals of Modern Physics, John Wiley & Sons, Japan, 1961.</li>
<li>Jenkins, F.A. & White, H.E., Fundamentals of Optics, Edisi ke-4, International Student Ed, Mc Graw Hill, Japan, 1981, hal 416 – 418.</li>
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<tr><td>Lecturers (Team Teaching)</td><td>
<ol>
<li>Dra. Eko T. Sulistyani, M.Sc.</li>
<li>Dr. Fahrudin Nugroho</li>
<li>Tim dosen Lab Atom & Inti</li>
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| Authorization | Date of Drafting | Lecturer Coordinator | Head of Curriculum Committee | Head of Study Program |
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| | | *Dra. Eko T. Sulistyani, M.Sc.* | | *Dr. Eng. Ahmad Kusumaatmaja, S.Si., M.Sc.* |