

### Module Description

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| <b>Module name</b>                               | Material Characterization Techniques                                                                                                                                                                                                                                                              |
| <b>Module level, if applicable</b>               | Bachelor of Physics                                                                                                                                                                                                                                                                               |
| <b>Code, if applicable</b>                       | 18H02131703                                                                                                                                                                                                                                                                                       |
| <b>Subtitle, if applicable</b>                   | -                                                                                                                                                                                                                                                                                                 |
| <b>Course, if applicable</b>                     | -                                                                                                                                                                                                                                                                                                 |
| <b>Semester(s) in which the module is taught</b> | 5 <sup>th</sup>                                                                                                                                                                                                                                                                                   |
| <b>Person responsible for the module</b>         | Prof. Dr. Dahlang Tahir, M.Si.                                                                                                                                                                                                                                                                    |
| <b>Lecturer</b>                                  | <ol style="list-style-type: none"> <li>1. Prof. Dr. Dahlang Tahir, M. Si.</li> <li>2. Prof. Dr. Paulus Lobo Gareso, M. Sc.</li> <li>3. Heryanto, S. Si, M. Si.</li> </ol>                                                                                                                         |
| <b>Language</b>                                  | Indonesian Language [Bahasa Indonesia]                                                                                                                                                                                                                                                            |
| <b>Relation to Curriculum</b>                    | Undergraduate degree program, elective, 5 <sup>th</sup> semester                                                                                                                                                                                                                                  |
| <b>Type of teaching, contact hours</b>           | <p><b>Teaching methods</b> : [group discussion], [problem-based learning].</p> <p><b>Teaching forms</b> : [lecture], [tutorial].</p> <p>CH: 08.00 - 16.00</p>                                                                                                                                     |
| <b>Workload</b>                                  | <p>For this course, students are required to meet a minimum of 136.00 hours in one semester, which consist of:</p> <ul style="list-style-type: none"> <li>- - 40.00 hours for lecture,</li> <li>- - 48.00 hours for structured assignments,</li> <li>- - 48.00 hours for private study</li> </ul> |
| <b>Credit points</b>                             | 3 credit points (equivalent with 5.1 ECTS)                                                                                                                                                                                                                                                        |

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| <b>Requirements according to the examination regulations</b> | A student must have attended at least 75% of the lectures to sit in the exams                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <b>Recommended prerequisites</b>                             | Solid Matter Physics                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| <b>Module objectives/intended learning outcomes</b>          | <p>After completing the course, Students are able:</p> <p><b>Intended Learning Outcomes (ILO):</b></p> <p><b>ILO 1 :</b> Students have a relatively deep understanding in classical and basic quantum physics. [ILO 1 - Kn]</p> <p><b>ILO 3 :</b> Students are able to use the basic principles of physics in technology application. [ILO 3 - Kn]</p> <p><b>ILO 4 :</b> Students have capability to operate the physical instrumentation in the laboratory and conduct experiments and interpret the result. [ILO 4 - Ab]</p> <p><b>Course Learning Objective (CLO):</b></p> <p>After completing this course, students are expected to be able to:</p> <ol style="list-style-type: none"> <li>1. Explain the concept of material physics which includes the definition of artificial radiation sources, radiation characteristics, and the process of interaction of radiation with materials.</li> <li>2. Explain the types of electromagnetic wave interactions in materials and their mechanisms.</li> <li>3. Determine the properties of the material based on the results of diffraction, absorption and transmission of electromagnetic waves in the test sample.</li> <li>4. Explain the use of characterization tools and analyze the data obtained.</li> </ol> <p><b>Sub CLO :</b></p> <p>ILO 1 <math>\Rightarrow</math> CLO 1 : Explain the meaning of artificial radiation sources and utilization and characteristics of radiation.</p> <p>ILO 4 <math>\Rightarrow</math> CLO 2 : Describe the interaction of electromagnetic waves on the material.</p> <p>ILO 4 <math>\Rightarrow</math> CLO 3 : Explain the type of electromagnetic wave interaction mechanism on the test sample.</p> <p>ILO 4 <math>\Rightarrow</math> CLO 4 : Describe the properties of materials such as structure, bonding, and morphology.</p> |

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|                                               | <p>ILO 4 ⇒ CLO 5 : Explain the results of data processing from the results of the characterization.</p> <p>ILO 3 ⇒ CLO 6 : Describes how to extract data derived from characterization tools.</p> <p>ILO 3 ⇒ CLO 7 : Explain the use of tools based on their working principles.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Content</b>                                | <p>Students will learn about :</p> <ol style="list-style-type: none"> <li>1. Artificial Radiation</li> <li>2. Characteristics of Radiation</li> <li>3. Interaction of Radiation with Materials</li> <li>4. Mechanism of electromagnetic waves with materials</li> <li>5. Data extraction and data processing tools (XRD, FTIR, XRF, VNA and SEM)</li> <li>6. Determine material properties based on characterization data</li> <li>7. Material characterization tools</li> </ol>                                                                                                                                                                                                                                                                                                    |
| <b>Forms of Assessment</b>                    | <p>Assessment techniques: [performance], [written test].</p> <p>Assessment forms: [assignment], [presentation], [midterm exam], [final term exam].</p> <p>Assignment = 33%, Presentation = 15%, Mid term exam = 25% Final term exam = 27%</p> <p>CLO 1 =&gt; ILO 1: 16% (8% Assignment 1 number 1-2, 8% MID exam number 1)</p> <p>CLO 2 =&gt; ILO 4: 16% (8% Assignment 1 number 3-4, 8% MID exam number 2)</p> <p>CLO 3 =&gt; ILO 4: 17% (8% Assignment 2 number 1-2, 9% MID exam number 3)</p> <p>CLO 4 =&gt; ILO 4: 8% (8% Assignment 2 number 3)</p> <p>CLO 5 =&gt; ILO 4: 16% (8% Presentation 1, 8% Final term exam number 1)</p> <p>CLO 6 =&gt; ILO 3: 17% (8% Presentation 2, 9% Final term exam number 2)</p> <p>CLO 7 =&gt; ILO 3: 10% (10% Final term exam number 3)</p> |
| <b>Study and examination requirements and</b> | <p><b>Study and examination requirements:</b></p> <ul style="list-style-type: none"> <li>- Students must attend 15 minutes before the class starts.</li> <li>- Students must switch off all electronic devices.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |

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| <b>forms of examination</b> | <ul style="list-style-type: none"> <li>- Students must inform the lecturer if they will not attend the class due to sickness, etc.</li> <li>- Students must submit all class assignments before the deadline.</li> <li>- Students must attend the exam to get a final grade.</li> </ul> <p><b>Form of examination:</b><br/>Written exam: Essay</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Media employed</b>       | Software (Origin, MATLAB, MATCH), Hardware (LCD and White Board), Learning Management System (SIKOLA).                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Reading list</b>         | <p><b>Main :</b></p> <ul style="list-style-type: none"> <li>● Agus setia budi dkk., 2012, Karakterisasi Material: Prinsip dan aplikasinya, edisi pertama, UPI Pres, Bandung.</li> <li>● William D. Callister, Jr., 2007, Materials Science and Engineering, seventh edition, Jhon Wiley and Son, inc, Utah University.</li> <li>● B Cullity, 1956, elementary X-Ray Diffraction, Addison-Wesley company, United state of America.</li> </ul> <p><b>Support :</b></p> <ul style="list-style-type: none"> <li>● A. Khorsand Zak et al., X-ray analysis of ZnO nanoparticles by Williamson Hall and size strain plot methods Solid State Sciences 13 (2011) 251-256.</li> <li>● Suryani, et al. Quantitative analysis of diffraction and infra-red spectra of composite cement/BaSO<sub>4</sub>/Fe<sub>3</sub>O<sub>4</sub>for determining correlation between attenuation coefficient, structural and optical properties Ceramic International 46 (2020) 18601-18607.</li> <li>● K. Yasui, et al., Three-dimensional structure recognition of circuit patterns on semiconductor devices using multiple SEM images detected in different electron scattering angles Microelectronics Reliability 108 (2020) 113628.</li> <li>● Pustaka lainnya dari internet.</li> </ul> |