



Universitas Negeri Surabaya
Faculty of Mathematics and Natural Sciences
Undergraduate Chemistry Study Program

Document
Code

SEMESTER LEARNING PLAN

| Courses | CODE | Course Family | Credit Weight | | | SEMESTER | Compilation Date |
|-----------------------|------------|--------------------------------|----------------------------|-----|-----------|---------------------------|------------------|
| Solid State Chemistry | 4720102129 | Study Program Elective Courses | T=2 | P=0 | ECTS=3.18 | 4 | August 28, 2023 |
| AUTHORIZATION | | SP Developer | Course Cluster Coordinator | | | Study Program Coordinator | |
| | | Samik, S.Si., M.Si. | Prof. Dr. Suyono, M.Pd. | | | Dr. Amaria, M.Si. | |

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| Learning model | Project Based Learning |
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| Program Learning Outcomes (PLO) | PLO study program that is charged to the course |
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| | Program Objectives (PO) |
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| PO - 1 | Able to apply logical, critical, systematic and innovative thinking in the context of developing or applying science and technology related to solid chemistry. |
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| PO - 2 | Able to produce appropriate conclusions based on the results of the identification, analysis and synthesis of chemicals that have been carried out. |
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| PO - 3 | Mastering theoretical concepts about crystal structures, types of crystals, solid analysis techniques, solid properties, crystal defects, synthesis and utilization of solid materials. |
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| PO - 4 | Have a responsible attitude by applying preparative methods and characteristics of inorganic solids, properties and structure of solids, and solid solutions. |
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| | PLO-PO Matrix |
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| | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr><td>P.O</td></tr> <tr><td>PO-1</td></tr> <tr><td>PO-2</td></tr> <tr><td>PO-3</td></tr> <tr><td>PO-4</td></tr> </table> | P.O | PO-1 | PO-2 | PO-3 | PO-4 |
| P.O | | | | | | |
| PO-1 | | | | | | |
| PO-2 | | | | | | |
| PO-3 | | | | | | |
| PO-4 | | | | | | |

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| | PO Matrix at the end of each learning stage (Sub-PO) |
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| | <table border="1" style="margin-left: auto; margin-right: auto;"> <tr> <th rowspan="2">P.O</th> <th colspan="16">Week</th> </tr> <tr> <th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th><th>16</th> </tr> <tr> <td>PO-1</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>PO-2</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>PO-3</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> <tr> <td>PO-4</td> <td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td> </tr> </table> | 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 | | | | | | | | | | | | | | | | | PO-4 | | | | | | | | | | | | | | | | |
|------|--|-----|------|---|---|---|---|---|---|----|----|----|----|----|----|----|--|--|---|---|---|---|---|---|---|---|---|----|----|----|----|----|----|----|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|
| 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 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| PO-4 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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| Short Course Description | Study of crystal structure, types of crystals, solid analysis techniques, solid properties, crystal defects, synthesis and utilization of solid materials. This study was carried out through lectures, project based learning, discussions, journal reviews and presentations. |
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| References | Main : |
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1. Samik, Nasrudin, H., Setiarso, P., 2018. Kimia Zat Padat. Surabaya: Unesa University Press
2. Levine, Ira. 2009. Physical Chemistry. Sixth Edition. New York: McGraw-Hill.
3. Ropp, R.C., dan Warren. 2003. Solid State Chemistry. Amsterdam: Elsevier Science.
4. Rodgers, G.E. 2012. Descriptive Inorganic, Coordination, and Solid-State Chemistry. Third Edition. Canada: Brooks/Cole, Cengage Learning.
5. Smart, L.E., dan Moore, E.A. 2005. Solid State Chemistry An Introduction. Third Edition. Boca Raton London: Taylor & Francis Group.
6. West, A.R. 1984. Solid State Chemistry and Its Applications. New Delhi: John Wiley & Sons Ltd.

| | | Supporters: | | | | | |
|----------------------------|--|---|--|---|-------------------|---|-----------------------|
| | | 1. Askeland, D.R., dan Fulay, P.P. 2009. Essentials of Materials Science and Engineering. Second Edition. Canada: Cengage Learning. | | | | | |
| Supporting lecturer | | Nur Hayati, S.Si., M.Si. Samik, S.Si., M.Si. | | | | | |
| 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 | Mastering the solid state chemistry lecture achievement targets. Define the science of solid state chemistry comprehensively (in depth and broadly). | 1.State the achievements of the solid state chemistry lecture 2.Defines the science of solid state chemistry which contains 3 scientific questions (ontology, epistemology, and axiology). | Criteria: 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) Form of Assessment : Participatory Activities | Lectures and asking questions 2 X 50 | | Material: Introduction to Solid State Chemistry and Materials References: Samik, Nasrudin, H., Setiarso, P., 2018. Solid State Chemistry. Surabaya: Unesa University Press | 5% |
| 2 | Explain the state of matter and types of solids | 1.Describes the state of matter 2.Classifying solid substances | Criteria: 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) Form of Assessment : Participatory Activities | Lectures, discussions and asking questions 2 X 50 | | Matter: State of matter and types of solids Reference: Samik, Nasrudin, H., Setiarso, P., 2018. Solid State Chemistry. Surabaya: Unesa University Press | 0% |

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| 3 | Explain crystal structure (unit cell, crystal system, and symmetry) | <ol style="list-style-type: none"> 1.Explain unit cells 2.Explain the crystal system 3.Explain symmetry and unit cell determination | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Forms of Assessment : Participatory Activities, Project Results Assessment / Product Assessment, Portfolio Assessment</p> | Lectures, Discussions and Case studies 2 X 50 | Answering the Test | <p>Material: Crystal structure (unit cell, crystal system, and symmetry) References: <i>Samik, Nasrudin, H., Setiarso, P., 2018. Solid State Chemistry. Surabaya: Unesa University Press</i></p> | 0% |
| 4 | Explain the crystal structure (lattice and miller index) | <ol style="list-style-type: none"> 1.Explaining lattice 2.Explain the Miller index | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Form of Assessment : Participatory Activities, Portfolio Assessment</p> | Lectures, Discussions 2 X 50 | | <p>Material: crystal structure (lattice and miller index) References: <i>Smart, L.E, and Moore, EA 2005.Solid State Chemistry An Introduction. Third Edition. Boca Raton London: Taylor & Francis Group.</i></p> | 5% |

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| 5 | Explain the different types of crystals | <ol style="list-style-type: none"> 1.Explain ionic crystals 2.Explain covalent crystals 3.Explain metal crystals 4.Explain molecular crystals | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Form of Assessment : Participatory Activities</p> | Lectures, Discussions 2 X 50 | | <p>Material: Crystal types References: <i>Samik, Nasrudin, H., Setiarso, P., 2018. Solid State Chemistry. Surabaya: Unesa University Press</i></p> | 5% |
| 6 | Explain the process of characterizing solid substances using diffraction techniques | Explain the process of characterizing solid substances using diffraction techniques | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Form of Assessment : Participatory Activities</p> | Presentations, Lectures, Discussions and Case studies 2 X 50 | | <p>Material: Characterization of solids using diffraction techniques References: <i>Samik, Nasrudin, H., Setiarso, P., 2018. Solid State Chemistry. Surabaya: Unesa University Press</i></p> | 5% |

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| 7 | Explain the process of characterization of solids using thermal analysis techniques | Explain the process of characterization of solids using thermal analysis techniques | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Form of Assessment : Participatory Activities, Tests</p> | Presentation, Discussion and Case study 2 X 50 | | <p>Material: Characterization of solids using thermal analysis techniques References: <i>Samik, Nasrudin, H., Setiarso, P., 2018. Solid State Chemistry. Surabaya: Unesa University Press</i></p> | 5% |
| 8 | Answering UTS questions | meetings 1 to 7 | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Form of Assessment : Test</p> | written exam 2 X 50 | | | 10% |

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| 9 | Explain the electrical properties of solids | Explain the electrical properties of solids | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Form of Assessment : Participatory Activities</p> | Case study, Presentation and Discussion 2 X 50 | | <p>Material: Electrical properties</p> <p>References: <i>Levine, Ira. 2009. Physical Chemistry. Sixth Edition. New York: McGraw-Hill.</i></p> | 5% |
| 10 | Explain the magnetic properties of solids | Explain the magnetic properties of solids | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Form of Assessment : Participatory Activities</p> | Presentation, Discussion 2 X 50 | | <p>Material: Magnetic properties</p> <p>References: <i>Rodgers, GE 2012. Descriptive Inorganic, Coordination, and Solid-State Chemistry. Third Edition. Canada: Brooks/Cole, Cengage Learning.</i></p> | 5% |

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| 11 | Explain crystal defects and non-stoichiometric compounds | 1.Explain crystal defects 2.Explain non-stoichiometric compounds | Criteria: 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) Form of Assessment : Participatory Activities | Presentation, Discussion 2 X 50 | | Material: Crystal defects References: <i>Samik, Nasrudin, H., Setiarso, P., 2018. Solid State Chemistry. Surabaya: Unesa University Press</i> | 5% |
| 12 | Explain preparative methods for solid substances | Explains preparative methods for solid substances based on physical and chemical processes | Criteria: 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) Form of Assessment : Participatory Activities | Presentation, Discussion 2 X 50 | | Material: Preparative solid substances Reference: <i>West, AR 1984. Solid State Chemistry and Its Applications. New Delhi: John Wiley & Sons Ltd.</i> | 5% |

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| 13 | Explain the synthesis and utilization of metals and metal alloys | 1.Explain metals 2.Explain metal alloys | Criteria: 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) Form of Assessment : Test | Case study, Journal review, Presentation, Discussion 2 X 50 | | Material: Metals and metal alloys Reference: <i>Smart, LE, and Moore, EA 2005.Solid State Chemistry An Introduction. Third Edition. Boca Raton London: Taylor & Francis Group.</i> | 5% |
| 14 | Explain the synthesis and utilization of zeolite, bentonite, and clay (quartz) | 1.Explain zeolites 2.Explain bentonite 3.Explaining quartz | Criteria: 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) Form of Assessment : Participatory Activities | Case study, Journal review, Presentation, Discussion 2 X 50 | | Material: zeolite, bentonite, quartz Reference: <i>Rodgers, GE 2012. Descriptive Inorganic, Coordination, and Solid-State Chemistry. Third Edition. Canada: Brooks/Cole, Cengage Learning.</i> | 5% |

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| 15 | Explain the synthesis and utilization of organic solid substances | Describe organic solids | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) Final NA is (participation value x2) (Task value x 3) <p>Form of Assessment : Participatory Activities</p> | Case studies, journal reviews, presentations and discussions 2 X 50 | | <p>Material: organic solid substances References: <i>Ropp, RC, and Warren. 2003. Solid State Chemistry. Amsterdam: Elsevier Science.</i></p> | 5% |
| 16 | Answering UAS questions | Meeting indicators 1 to 15 | <p>Criteria:</p> <ol style="list-style-type: none"> 1.The assessment is carried out on the following aspects: 2.Participation during lectures, carried out through observation (weight 2) Sub-summative test, carried out once assessing all relevant indicators through a written test, averaged and given a weight (2) Assignments given a weight (3) The final NA is (participation value x2) (Assignment value x 3) <p>Form of Assessment : Test</p> | Written exam 2 X 50 | | | 20% |

Evaluation Percentage Recap: Project Based Learning

| No | Evaluation | Percentage |
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| 1. | Participatory Activities | 50% |
| 2. | Portfolio Assessment | 2.5% |
| 3. | Test | 37.5% |
| | | 90% |

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.