

Universitas Negeri Surabaya Faculty of Engineering, Mechanical Engineering Undergraduate Study Program

Document Code

| Learning model Project Based Learning Program Learning Outcomes (PLO) PLO study program that is comparing PLO-5 PLO-5 Work independent Work independent PLO-6 PLO-11 Design and d | | | | Course | | oneile | | | Cro dia | Mein | ht | | | | | mniletier |
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| PO - 2 a. Able to design and analyze or analyze or and analyze or analyze | | | | | | | | | | | | | | | | |
| PO - 3 a. Able to form and analyze or analyse or analys | a. Ability to identify specific facts regarding mathematics, science and engineering required for the heat treatment process of metal, namely the heating, holding, cooling process | | | | | | | | | | | | | | | |
| PLO-PO Matrix PLO-PO Matrix PO PO-1 PO-3 PO Matrix at the end of each PO-1 PO-2 PO-3 Short Course Description This course studies the basics of of materials that have gone throw o | gn experi | menta | l plans | | | | | | | | | | | | | |
| PLO-PO Matrix P.0 P0-1 P0-2 P0-3 PO Matrix at the end of each P0-1 P0-2 P0-3 Short Course Description This course studies the basics of materials that have gone through the state of the stat | a. Able to formulate problems (identify heat treatment processes for metal, namely heating, holding, cooling processes) and analyze obstacles. | | | | | | | | | | | | | | | |
| P.0 PO-1 PO-2 PO-3 PO Matrix at the end of each PO-1 PO-2 PO-3 Short Course Description This course studies the basics of of materials that have gone throw of materials that have gone thave gone thave gone thave g | | | | | | | | | | | | | | | | |
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| PO-2 PO-3 PO Matrix at the end of each PO Matrix at the end of each PO-1 PO-2 PO-3 Short Course Description This course studies the basics of of materials that have gone throw of materials that have gone that have | | PL | 0-5 | | PI | _0-0 | > | | -10-1 | | | LO-14 | | | | |
| PO Matrix at the end of each PO Matrix at the end of each PO Matrix at the end of each PO-1 PO-1 PO-2 PO-3 Short Course Description References Main : 1. Suherman, W. 2003. Ilm 2. Callister, William D. 200 3. Smith, William F. Hast Companies, Inc: New York | | | | | | | | | | | | | | | | |
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| Short Course Description This course studies the basics of of materials that have gone throut References Main : 1. Suherman, W. 2003. Ilm 2. 2. Callister, William D. 200 3. 3. Smith, William F. Hash Companies, Inc: New York | | | | | | | | | Wee | k | | | | | | |
| Short Course Description This course studies the basics of of materials that have gone throut References Main : 1. Suherman, W. 2003. Ilm 2. 2. Callister, William D. 200 3. 3. Smith, William F. Hash Companies, Inc: New York | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 |
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| Course Description of materials that have gone through an experimental strate have gone through References Main : | | | | | | | | | | | | | | | | |
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| Callister, William D. 200 Smith, William F. Hash Companies, Inc: New Yo | | | | | | | | | | | | | | | | |
| Supporters: | 3. Materia Iemi, Jav ork. | al Scie ad. 20 | nce an 006. F | d Engi ounda | inee tions | ring A s of | Mate | rial S | cience | and | Engine | ering. | Fourth | n Editio | on. Mo | -Graw-Hill |

| lecturer | Hanna Zakiyya, S | | | Hel | p Learning, | | |
|----------|--|--|--|--|-------------------|--|--------------------------|
| Week- | Final abilities of each learning stage | Eval | uation | Learning methods, Student Assignments, [Estimated time] | | Learning materials | Assessment Weight (%) |
| | (Sub-PO) | Indicator | Criteria & Form | Offline (offline) | Online (online) | [References] | Weight (%) |
| (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| 1 | Able to understand the Iron Carbon Phase Diagram Understand structural transformations and heating and cooling rates | Understanding the Iron Carbon Phase Diagram Understand structural transformations and heating and cooling rates | Criteria: mastery of material, communication skills Form of Assessment : Participatory Activities | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | | Material: Carbo-Iron Phase Diagram, structural transformation and heating and cooling rates References: <i>Smith, William</i> <i>F.</i> 1993. <i>Structure and</i> <i>Properties of</i> <i>Engineering</i> <i>Alloy. Second</i> <i>Edition. Mc-</i> <i>Graw-Hill</i> <i>Companies,</i> <i>Inc: New York.</i> | 3% |
| 2 | Understanding the Definition of Austenite, critical areas of austenite Able to predict transformation mechanisms in cooling and heating | Understanding the Definition of Austenite, critical areas of austenite Able to predict transformation mechanisms in cooling and heating | Criteria: mastery of material, communication skills Form of Assessment : Participatory Activities | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | | Material: Austenite, austenite critical region Reference: Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc- Graw-Hill Companies, Inc: New York. Material: transformation in cooling and heating areas of Austenite Reference: Suherman, W. 1999. Material | 3% |
| 3 | 1.Understanding the Definition of Austenite, critical areas of | 1.Understanding the Definition of Austenite, critical areas of | Criteria: mastery of material, communication skills | Lectures, discussions, questions and answers, exercises and | | Testing. ITS Publisher: Surabaya. Material: Austenite, austenite critical region Reference: | 5% |
| | austenite 2.Able to predict transformation mechanisms in cooling and heating | austenite 2.Able to predict transformation mechanisms in cooling and heating | Form of Assessment : Project Results Assessment / Product Assessment | assignments 2 X 50 | | Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc- Graw-Hill Companies, Inc: New York. | |
| | | | | | | Material: transformation in cooling and heating areas of Austenite Reference: Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya. | |

| 4 | Understand the definition, purpose of annealing and normalization Skilled in understanding the annealing and homogenization processes | Understand the definition, purpose of annealing and normalization Skilled in understanding the annealing and homogenization processes | Criteria: mastery of material, communication skills Form of Assessment : Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | Material: Anneling, homogenizati and spheroidizatic processes Reference: Suherman, W 1999. Materia Testing. ITS Publisher: Surabaya. Materials: Anneling, homogenizati and spheroidizatio processes References: Callister, William D. 2003. Materia Science and Engineering A Introduction. | n i on n |
|---|--|---|--|--|---|--|
| | | | | | Sixth Edition. John Wiley & Sons, Inc: US | A. |
| 5 | Understand the definition, purpose of annealing and normalization Skilled in understanding the annealing and homogenization processes | Understand the definition, purpose of annealing and normalization Skilled in understanding the annealing and homogenization processes | Criteria: mastery of material, communication skills Form of Assessment : Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | Material: Anneling, homogenizati and spheroidizatic processes Reference: Suherman, W 1999. Materia Testing. ITS Publisher: Surabaya. Materials: Anneling, homogenizati and spheroidizatic processes References: Callister, William D. 2003. Materia Science and Engineering A Introduction. Sixth Edition. John Wiley & | n ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; ; |

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|---|---|--|--|--|---|---|----|
| 6 | Understand and understand the hardening process, austenization temperature, holding time, cooling rate, | Understand and understand the hardening process, austenization temperature, holding time, cooling rate, | Criteria: mastery of material, communication skills Form of Assessment : Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | | Material: Hardening process, austenization temperature, holding time, cooling rate, surface condition, impact and weight References: <i>Smith, William</i> <i>F,</i> 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc- Graw-Hill Companies, Inc: New York. Material: Hardening process, austenization temperature, holding time, cooling rate, surface condition, impact and weight References: Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya. | 8% |
| 7 | Understand and understand the hardening process, austenization temperature, holding time, cooling rate, | Understand and understand the hardening process, austenization temperature, holding time, cooling rate, | Criteria: mastery of material, communication skills Form of Assessment : Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | | Material: Hardening process, austenization temperature, holding time, cooling rate, surface condition, impact and weight References: <i>Smith, William</i> <i>F.</i> 1993. <i>Structure and</i> <i>Properties of</i> <i>Engineering</i> <i>Alloy.</i> Second <i>Edition.</i> Mc- <i>Graw-Hill</i> <i>Companies,</i> <i>Inc:</i> New York. Material: Hardening process, austenization temperature, holding time, cooling rate, surface condition, impact and weight References: <i>Suherman, W.</i> 1999. Material <i>Testing.</i> ITS <i>Publisher:</i> <i>Surabaya.</i> | 3% |

| 8 | USS (attached) | Working independently | Criteria: USS (attached) Form of Assessment : Project Results Assessment / Product Assessment | USS (attached) 2 X 50 | Material: All materials at meetings 1-7 References: Suherman, W. 1999. Material testing. ITS Publisher: Surabaya. Material: All material at meetings 1-7 References: Smith, William F. Hashemi, Javad. 2006. Foundations of Materials Science and Engineering. Fourth Edition. Mc-Graw-Hill Companies, Inc: New York. | 3% |
|---|--|---|--|--|---|----|
| 9 | Understand hardening techniques and tempering methods | Understand hardening techniques and tempering methods | Criteria: mastery of material, communication skills Form of Assessment : Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | Material: hardening techniques and tempering methods Reference: Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya. Material: hardening techniques and tempering methods References: Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc- Graw-Hill Companies, Inc: New York. | 2% |

| 10 | Understand hardening techniques and tempering methods | Understand hardening techniques and tempering methods | Criteria: mastery of material, communication skills Forms of Assessment : Participatory Activities, Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | Material: hardening techniques and tempering methods Reference: Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya. Material: hardening techniques and tempering methods References: Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc- Graw-Hill Companies, Inc: New York. Material: hardening techniques and tempering methods Reference: Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya. | 3% |
|----|--|--|--|--|--|-----|
| 11 | Able to classify the types of fulorescence and dye penetrant testing | Understand the definitions of Austemper and Martemper Skilled in applying Austemper and Martemper | Criteria: According to the Rubric Form of Assessment : Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 50 X 2 | Material: Austemper and Martemper Reference: Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya. Material: Austemper and Martemper Library: Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya. | 20% |
| 12 | Able to understand the definitions of Austemper and Martemper | Understand the definitions of Austemper and Martemper Skilled in applying Austemper and Martemper | Criteria: According to the Rubric Forms of Assessment : Participatory Activities, Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 50 X 2 | Material: Austemper and Martemper Reference: Suherman, W. 1999. Material Testing. ITS Publisher: Surabaya. Material: Austemper and Martemper Library: Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya. | 20% |

| 13 | Understand the definition and be able to carry out surface hardening | Understand and be able to carry out surface hardening of metal | Criteria: According to the Rubric Form of Assessment : Participatory Activities | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | Material: Surface hardening techniques for metals Reference: Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya. Material: Surface hardening techniques for metals Reference: Callister, William D. 2003. Materials Science and Engineering An Introduction. Sixth Edition. John Wiley & Sons, Inc: USA. | 17% |
|----|--|--|---|--|--|-----|
| 14 | Understand the definition and be able to carry out surface hardening | Understand and be able to carry out surface hardening of metal | Criteria: According to the Rubric Form of Assessment : Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | Material: Surface hardening techniques for metals Reference: Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya. Material: Surface hardening techniques for metals Reference: Callister, William D. 2003. Materials Science and Engineering An Introduction. Sixth Edition. John Wiley & Sons, Inc: USA. | 3% |
| 15 | Understand the process of adding elements to metals using Cyaniding and Carbonitriding techniques | Understand the process of adding elements to metals using Cyaniding and Carbonitriding techniques | Criteria: According to the Rubric Form of Assessment : Project Results Assessment / Product Assessment | Lectures, discussions, questions and answers, exercises and assignments 2 X 50 | Material: addition of elements to metal Cyaniding and Carbonitriding techniques Library: Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya. Material: addition of elements to cyaniding and carbonitriding engineering metals. Reference: Smith, William F. 1993. Structure and Properties of Engineering Alloy. Second Edition. Mc- Graw-Hill Companies, Inc: New York. | 4% |

| 16 | Ability to work and punctuality | Criteria: According to the Rubric | Working independently 2 x 50 | Material: All 5% material at meeting 9-15 References: Suherman, W. 2003. Metal Science 1. ITS Publisher: Surabaya. Material: All |
|----|---------------------------------|---|------------------------------------|---|
| | | | | materials at meeting 9-15 References: <i>Smith, William</i> <i>F.</i> 1993. <i>Structure and</i> <i>Properties of</i> <i>Engineering</i> <i>Alloy. Second</i> <i>Edition. Mc-</i> <i>Graw-Hill</i> <i>Companies,</i> <i>Inc: New York.</i> |

Evaluation Percentage Recap: Project Based Learning

| No | Evaluation | Percentage |
|----|---|------------|
| 1. | Participatory Activities | 34.5% |
| 2. | Project Results Assessment / Product Assessment | 65.5% |
| | | 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.
- 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.
- 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.
- 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.