**UNIVERSITAS GADJAH MADA**
Faculty of Mathematics and Natural Sciences
Department of Mathematics
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**Doctor in Mathematics**
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**MODULE HANDBOOK**

| | |
|---|---|
| Module Name | **Topic in Optimization Theory** |
| Code, if applicable | MMM 7315 |
| Subtitle, if applicable | - |
| Semester(s) in which the module is taught | 1st or 2nd |
| Person responsible for the module | Chair of Applied Mathematics Research Group |
| Language | Bahasa Indonesia |
| Relation to curriculum | Doctoral Degree in Mathematics, ~~Compulsory /~~ Elective Course |
| Teaching methods | Lectures, structured activities (assignments, team-project) |
| Workload (incl. contact hours, self-study hours) | *Total workload is 232 hours per semester, which consists of 50 minutes lectures per week, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.* |
| Credit points in Credit Units | *3* |
| Required and recommended prerequisites for joining the module | Students should have competences in Optimization Theory |

<table>
<tr><td>Module objectives/intended learning outcomes</td><td>On successful completion of this course, students should be able:<br><br>CO 1: to mastery basic concept in non linear optimization problems such as convex set, convex function, quasi-convex function and theorems related to optimization problems with convex functions and quasi-convex function.<br><br>CO2. to solve optimization problems analitically such as optimization problem without constraints, optimization problem with equation constraints, and optimization problems with inequality constraints.<br><br>CO3. to solve optimization problem numerically.<br><br>CO4. to relate the theory and applications of optimization problem, and to interpret the solutions.<br><br>CO5. to mastery about introduction to advance theories in optimization.</td></tr>
<tr><td>Content</td><td>In this lecture, students must carry out several academic activities under the supervision of the lecturer. Academic activities are carried out based on literature studies to competences one or more of the topics in optimization theory, including:<br>Optimization without constraints, optimization with constraints, existence theorems of optimal solutions concerning convex functions and its generalization, fuzzy optimization theory, numerical methods of local and global optimization, numerical methods of nondifferentiable optimization, multi objective optimization theories to find the solutions, application of optimization theory to real problems.</td></tr>
<tr><td>Examination forms</td><td>Written assignments, written exams, class engagement, presentation, case-based project</td></tr>
<tr><td>Study and examination requirements</td><td>To pass the course, the minimum grade is B.<br>The final mark will be weighted as follows:
<table>
<tr><th>No</th><th>Assessment methods (components, activities)</th><th>Weight (percentage)</th><th>Cognitive</th><th>Case/Project Based</th></tr>
<tr><td>1.</td><td>Final Examination</td><td>25</td><td>20</td><td>5</td></tr>
<tr><td>2.</td><td>Mid-Term Examination</td><td>25</td><td>20</td><td>5</td></tr>
<tr><td>3.</td><td>Homework</td><td>20</td><td>10</td><td>10</td></tr>
<tr><td>4.</td><td>Presentation</td><td>30</td><td></td><td>30</td></tr>
<tr><td></td><td>TOTAL</td><td>100%</td><td>50%</td><td>50%</td></tr>
</table></td></tr>
</table>

| | |
|---|---|
| Media employed | Board, LCD Projector, Laptop/Computer |
| Reading list | 1. Mokhtar S Bazaraa, Hanif D. Sherali, C.M.Shetty, 2006, *Nonlinear Programming. Theory andAlgorithms* 3rd Edition, John Wiley and Sons.<br>2. Edwin K.P. Chong, and Stanislaw H. Zak, 2008, *An Introduction to Optimization* 3rd Edition, John Wiley & Sons.<br>3. Boyd, S., Vandenberghe, L., 2004, *Convex Optimization,* Cambridge University Press.<br>4. Sakawa, M., 1993, *Fuzzy Sets and Interactive Multiobjective Optimization*, Springer.<br>5. Andrew, R. C, Katya, S., Luis, N., V., 2009, *Introduction to Derivative-Free Optimization*, MOS-SIAM Series on Optimization. |

**CO-PLO Mapping**

| | **PLO 1** | **PLO 2** | **PLO 3** | **PLO 4** | **PLO 5** | **PLO 6** |
|---|---|---|---|---|---|---|
| **CO 1** | √ | √ | | | | |
| **CO 2** | √ | √ | | | | |
| **CO 3** | √ | √ | | | | |
| **CO 4** | √ | √ | | | √ | √ |
| **CO 5** | √ | √ | √ | √ | | √ |

Programme Learning Outcomes (PLO) Doctoral Programme in Mathematics

| | | |
|---|---|---|
| **PLO-1** | : | **Attitude:**<br>Devote to God Almighty, uphold the humanity values, internalize academic values and ethics, responsible in working in the area of expertise independently. |
| **PLO-2** | : | **Knowledge:**<br>Mastering philosophy of mathematics and one of the fields in mathematics (algebra, analysis, applied mathematics, statistics, computational mathematics, computational statistics). |
| **PLO-3** | : | **Knowledge:**<br>Able to think logically, analytically, inductively, deductively, and structured; having the ability to manage, lead, and develop research programs independently, and able to communicate the thoughts as well as his work to the scientific community and the general public. |

| | | |
|---|---|---|
| **PLO-4** | : | **Skill:**<br><br>Creating new concepts and / or new methods (original) in the field of mathematics that are recognized nationally and internationally. |
| **PLO-5** | : | **Skill:**<br><br>Able to apply mathematics according to their field of expertise to solve problems including those that require a multidisciplinary, cross-disciplinary, or trans-disciplinary approach. |
| **PLO-6** | : | ***Life Long Learning:***<br><br>Having lifelong learning skills and adaptive to the development of science and technology, especially in fields related to Mathematics and its applications. |

**Compilation Date : July 16, 2022**

**Modified Date : July 25, 2022**

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**MODULE HANDBOOK**

| | |
|---|---|
| Module designation | Topic in Optimization Theory |
| Code, if applicable | MMM 7315 |
| Subtitle, if applicable | Fuzzy Multi-objective Linear and Non-linear Programming |
| Semester(s) in which the module is taught | *1st or 2nd (first or second semester)* |
| Language | Bahasa Indonesia |
| Relation to curriculum | Doctoral Degree in Mathematics, Elective |
| Teaching methods | Lectures, structured activities (assignments, project based learning) |
| Workload (incl. contact hours, self-study hours) | *Total workload is 232 hours per semester, which consists of 50 minutes lectures per week, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.* |
| Credit points in Credit Units | *3* |
| Required and recommended prerequisites for joining the module | Students should have competences in Linear Programming, Multi-objective Programming , Optimization Theory, and Fuzzy Programming |
| Module objectives/intended learning outcomes | After completing this course the students should have:<br>• CO1 ability to solve the fuzzy multi-objective linear programming.<br>• CO2 ability to solve the fuzzy multi-objective non-linear programming . |

<table>
<tr><td>Content</td><td>Introduction: fuzzy number and fuzzy programming, multi-objective linear programming (MOPLP) and goal programming.<br>The relationship beetween goal programming and fuzzy programming.<br>Fuzzy multi-objective linear programming.<br>Fuzzy goal programming for solving MOLP.<br>Fuzzy multi-objective non-linear Programming</td></tr>
<tr><td>Examination forms</td><td>report, written assignments, oral presentation</td></tr>
<tr><td>Study and examination requirements</td><td>To pass the course, the minimum grade is B+.<br>The final mark will be weighted as follows:
<table>
<tr><th>No</th><th>Assessment methods (components, activities)</th><th>Weight (percentage)</th></tr>
<tr><td>1.</td><td>Final Examination</td><td>30</td></tr>
<tr><td>2.</td><td>Mid-Term Examination</td><td>30</td></tr>
<tr><td>3.</td><td>Homework</td><td>20</td></tr>
<tr><td>4.</td><td>Presentation</td><td>20</td></tr>
<tr><td></td><td>TOTAL</td><td>100%</td></tr>
</table></td></tr>
<tr><td>Reading list</td><td><ol>
<li>Bector, C.R. and Chandra, S., 2005, Fuzzy Mathematical Programming and Fuzzy Games, Springer, Germany.</li>
<li>Mohamed, R.H., 1997, The relationship beetween goal programming and fuzzy programming, Fuzzy Sets and Systems, Vol 89, pp. 215-222.</li>
<li>Sakawa, M. and Yano, H., 1989, Interactive Decision Making for Multiobjective Nonlinear Programming Problems with Fuzzy Parameters, Fuzzy Sets and Systems, 29: 315-326.</li>
<li>Sakawa, M., 1998, Fuzzy Nonlinear Programming with Single or Multiple Objective Functions, Springer.</li>
<li>Sakawa, M, 1993, Fuzzy Sets and Interactive Multi-objective Optimization, Plenum Press, New York.</li>
<li>Sakawa, M, 1993, Fuzzy Sets and Interactive Multi-objective Optimization, Plenum Press, New York.</li>
<li>Tanino, T., Tanaka, T. and Inuiguchi, M., 2003, Multi-objective Programming and Goal Programming, Springer, Berlin.</li>
<li>Veeramani,C., Duraisamy,C. and Nagoorgani,A., 2011, Solving Fuzzy Multi-Objective Linear Programming Problems with Linear Membership Functions, Australian Journal of Basic and Applied Sciences, 5(8), pp.1163-1171.</li>
</ol></td></tr>
</table>

**CO-PLO Mapping**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 |
|---|---|---|---|---|---|---|
| CO 1 | V | V | V | | | V |
| CO 2 | V | V | V | | | V |

**Last Modified Date : September 1, 2023**

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**MODULE HANDBOOK**

| | |
|---|---|
| Module designation | *Topics in Optimization Theory* |
| Code, if applicable | MMM 7315 |
| Subtitle, if applicable | *Optimization Theory* |
| Semester(s) in which the module is taught | *1st or 2nd (first or second semester)* |
| Person responsible for the module | *Chair of Applied Mathematics Research Group* |
| Language | *Bahasa Indonesia* |
| Relation to curriculum | *Compulsory / elective / specialisation*<br>*Names of other study programmes with which the module is shared* |
| Teaching methods | *3x50 minutes lectures, 3x60 minutes structured activities.* |
| Workload (incl. contact hours, self-study hours) | *Total workload is 232 hours per semester, which consists of 50 minutes lectures per week, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.* |
| Credit points in Credit Units | *3* |
| Required and recommended prerequisites for joining the module | - |

| | |
|---|---|
| Module objectives/intended learning outcomes | After completing these course the students will be able:<br>CO1. to recognize basic concept in non linear optimization problems such as convex set, convex function and theorems related to optimization problems with convex functions.<br>CO2. to solve optimization problems analitically such as optimization problem without constraints, optimization problem with equation constraints, and optimization problems with inequality constraints.<br>CO3. to solve optimization problem numerically.<br>CO4. To relate between the theory and applications of optimization problem, and to interpret the solutions.<br>CO5. To recognize about introduction to advance theories in optimization. |
| Content | In this lecture, students must carry out several academic activities under the supervision of a lecturer. Academic activities are carried out based on literature studies to master one or more of the topics in Optimization Theory, including:<br><br>unconstrained optimization, optimization with constraints, the theory of the existence of optimal solutions involving convex functions and their generalizations, analytical method to solve optimization problem, Kuhn-Tucker theory, numerical methods for local and global optimization problems, numerical methods for undifferentiated optimization problems, numerical methods for black-box optimization problems. Multi-objective optimization theory and methods to find the solution. Application of optimization theory to real problems. |
| Examination forms | *Quiz, homework, report, manuscript, oral presentation, essay.* |
| Study and examination requirements | *Requirements for successfully passing the module* |
| Reading list | 1. *Mokhtar S Bazaraa, Hanif D. Sherali, C.M.Shetty, 2006, Nonlinear Programming. Theory andAlgorithms 3rd Edition, John Wiley and Sons.*<br>2. *Edwin K.P. Chong, dan Stanislaw H. Zak, 1996, An Introduction to Optimization, John Wiley & Sons.*<br>3. *Boyd, S., Vandenberghe, L., 2004, Convex Optimization, Cambridge University Press.*<br>4. *Sakawa, M., 1993, Fuzzy Sets and Interactive Multiobjective Optimization, Springer.*<br>5. *Andrew, R. C, Katya, S., Luis, N., V., 2009, Introduction To Derivative-Free Optimization, MOS-SIAM Series on Optimization.* |

**CO-PLO Mapping**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 |
|---|---|---|---|---|---|---|
| **CO 1** | √ | √ | √ | | | |
| **CO 2** | √ | √ | | | | |
| **CO 3** | √ | √ | | | | |
| **CO 4** | √ | | | | √ | √ |
| **CO 5** | √ | | | | √ | √ |

**Last Modified Date : September 7, 2023**