



# UNIVERSITAS GADJAH MADA

Faculty of Mathematics and Natural Sciences

Mathematics Department

Sekip Utara Bulaksumur Yogyakarta 55281 Telp: +62 274 552243 Fax: +62 274 555131 Email: [math@ugm.ac.id](mailto:math@ugm.ac.id) Website: [matematika.fmipa.ugm.ac.id](http://matematika.fmipa.ugm.ac.id)

## Doctoral Program in Mathematics

Telp : +62 274 552243

Email : [maths2@ugm.ac.id](mailto:maths2@ugm.ac.id);

Website : <http://s2math.fmipa.ugm.ac.id>

**MODULE HANDBOOK**  
Doctoral in Mathematics

|   |  |
|---|--|
| <b>Module name:</b>   | <b>Representation Theory (“Teori Representasi”)</b>  |
| <b>Module level, if applicable:</b>                           | Doctoral Program   |
| <b>Code, if applicable:</b>                                   | MMM 7204   |
| <b>Semester(s) in which the module is taught:</b>             | 1st Semester (1st Year)  |
| <b>Person responsible for the module:</b>                     | Chair of Algebra Research Group  |
| <b>Lecturer(s):</b>   | 1. Prof. Dr. Sri Wahyuni<br>2. Dr. Diah Junia Eksi Palupi  |
| <b>Language:</b>  | Bahasa Indonesia   |
| <b>Relation to curriculum:</b>                                | Doctoral Degree in Mathematics, Elective Course  |
| <b>Credit points:</b>   | 3 Semester Credit Unit   |
| <b>Type of teaching, contact hours:</b>                       | 3x50 minutes lectures, 3x50 minutes structured activities.   |
| <b>Workload:</b>  | <ul style="list-style-type: none"> <li>• 3x50 minutes lectures,</li> <li>• 3x50 minutes structured activities,</li> <li>• 3x50 minutes individual study,</li> <li>• In 16 weeks per semester (including mid-term and final examinations).</li> <li>• Total Workload: 144x50 minutes per semester.</li> </ul>   |
| <b>Requirements according to the examination regulations:</b> | .....  |
| <b>Recommended prerequisites:</b>                             | <ul style="list-style-type: none"> <li>• The recommended prerequisites: <ul style="list-style-type: none"> <li>○ Familiarity with general vector space over field including the matrix representation of linear operator</li> <li>○ Knowledge of basic group and general linear group;</li> </ul> </li> </ul>  |
| <b>Module objectives/intended learning outcomes:</b>          | <p>On successful completion of this course, students should be able to:</p> <p>CO 1 : develop the basic theory of linear representations of groups, especially of finite groups over the complex numbers</p> <p>CO 2: know the standard general properties of the character table of a finite group, and have an understanding of why these properties hold, and be able to apply a variety of methods for constructing characters.</p> <p>CO 3: deduce properties of a group from its character</p> <p>CO 4: apply abstract ideas to concrete calculations.</p> |
| <b>Content:</b>   | The aims is to develop the basic theory of linear representations of groups, especially of finite groups over the complex numbers. To develop techniques for constructing characters and character tables. To explore applications of the theory.  |

|  | <p>After setting up the basics of the general theory of representations of groups, this course will concentrate on representations of finite groups over the complex numbers. The theoretical properties of the character table of a group will be studied in detail, together with practical methods of calculating the character tables of particular groups, and several applications of the theory will be given.</p> <p>This course gives an introduction to the representation theory of finite groups and finite dimensional algebras. Representation theory is a fundamental tool for studying symmetry by means of linear algebra: it is studied in a way in which a given group or algebra may act on vector spaces, giving rise to the notion of a representation.</p> <p>Syllabi:</p> <ul style="list-style-type: none"> <li>• Representation of finite group (Definition and examples, Equivalence, invariant subspace, subrepresentations) Irreducible Representation (Direct Sum, Maschke's Theorem)</li> <li>• Characters of Representation (Definition, orthogonal relation of character, Schur's lemma, Schur orthogonality relation). Class Function. Regular Representation. Character Table</li> </ul>   |                     |   |                     |   |                   |     |   |                      |     |   |                                       |     |
|--|---|---------------------|---|---------------------|---|-------------------|-----|---|----------------------|-----|---|---------------------------------------|-----|
| <p><b>Study and examination requirements and forms of examination:</b></p> | <p>The final mark will be weighted as follows:</p> <table border="1" data-bbox="526 873 1476 1019"> <thead> <tr> <th>No</th> <th>Assessment methods (components, activities)</th> <th>Weight (percentage)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Final Examination</td> <td>40%</td> </tr> <tr> <td>2</td> <td>Mid-Term Examination</td> <td>30%</td> </tr> <tr> <td>3</td> <td>Class Activities: Quiz, Homework, etc</td> <td>30%</td> </tr> </tbody> </table> <p>Final grade will be determined as follows:</p> <p>Grade Criteria</p> <ol style="list-style-type: none"> <li>1. huruf A setara dengan angka 4 (empat);</li> <li>2. huruf A- setara dengan angka 3,75 (tiga koma tujuh lima);</li> <li>3. huruf A/B setara dengan angka 3,5 (tiga koma lima);</li> <li>4. huruf B+ setara dengan angka 3,25 (tiga koma dua lima);</li> <li>5. huruf B setara dengan angka 3 (tiga);</li> <li>6. huruf B- setara dengan angka 2,75 (dua koma tujuh lima);</li> <li>7. huruf B/C setara dengan angka 2,5 (dua koma lima);</li> <li>8. huruf C+ setara dengan angka 2,25 (dua koma dua lima);</li> <li>9. huruf C setara dengan angka 2 (dua);</li> <li>10. huruf C- setara dengan angka 1,75 (satu koma tujuh lima);</li> <li>11. huruf C/D setara dengan angka 1,5 (satu koma lima);</li> <li>12. huruf D+ setara dengan angka 1,25 (satu koma dua lima);</li> <li>13. huruf D setara dengan angka 1 (satu); atau</li> <li>14. huruf E setara dengan angka 0 (nol).</li> </ol> | No                  | Assessment methods (components, activities) | Weight (percentage) | 1 | Final Examination | 40% | 2 | Mid-Term Examination | 30% | 3 | Class Activities: Quiz, Homework, etc | 30% |
| No   | Assessment methods (components, activities)   | Weight (percentage) |   |                     |   |                   |     |   |                      |     |   |                                       |     |
| 1  | Final Examination   | 40%                 |   |                     |   |                   |     |   |                      |     |   |                                       |     |
| 2  | Mid-Term Examination  | 30%                 |   |                     |   |                   |     |   |                      |     |   |                                       |     |
| 3  | Class Activities: Quiz, Homework, etc   | 30%                 |   |                     |   |                   |     |   |                      |     |   |                                       |     |
| <p><b>Media employed:</b></p>  | <p>Board, LCD Projector, Laptop/Computer</p>  |                     |   |                     |   |                   |     |   |                      |     |   |                                       |     |
| <p><b>Reading List:</b></p>  | <ol style="list-style-type: none"> <li>1. James, Gordon; Liebeck, Martin, Representations and characters of groups, Second edition. Cambridge University Press, New York, 2001. viii+458 pp. ISBN: 0-521-00392-X Morton L. CURTIS; 1999; "Abstract Linear Algebra"; Springer-Verlag, New York.</li> <li>2. Serre, Jean-Pierre, Linear representations of Finite groups, Graduate Texts in Mathematics, Vol. 42. Springer-Verlag, New York-Heidelberg, 1977. x+170 pp. ISBN: 0-387-90190-6</li> <li>3. Fulton, William; Harris, Joe, Representation theory, A first course, Graduate Texts in Mathematics, Springer-Verlag, New York, 1991. xvi+551 pp. ISBN: 0-387-97527-6; 0-387-97495-4</li> </ol>  |                     |   |                     |   |                   |     |   |                      |     |   |                                       |     |

|  |  |
|--|--|
|  | 4. Steinberg, Benjamin, Representation Theory of Finite Groups, An Introduction Approach, Springer Science+Business Media, 2012. xiii+157 pp. ISBN : 978-1-4614-0775-1 |
|--|--|

|                                    |
|------------------------------------|
| <b>Mapping of The COs and PLOs</b> |
|------------------------------------|

|             | <b>PLO - 1<br/>S3 Mat</b> | <b>PLO - 2<br/>S3 Mat</b> | <b>PLO - 3<br/>S3 Mat</b> | <b>PLO - 4<br/>S3 Mat</b> | <b>PLO - 5<br/>S3 Mat</b> | <b>PLO -6<br/>S3 Mat</b> |
|-------------|---------------------------|---------------------------|---------------------------|---------------------------|---------------------------|--------------------------|
| <b>CO 1</b> |                           | <b>v</b>                  | <b>v</b>                  |                           |                           |                          |
| <b>CO 2</b> |                           |                           | <b>v</b>                  | <b>v</b>                  |                           |                          |
| <b>CO 3</b> |                           |                           | <b>v</b>                  | <b>v</b>                  |                           | <b>v</b>                 |
| <b>CO 4</b> |                           |                           |                           | <b>v</b>                  |                           | <b>v</b>                 |