**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 Website: http://math.fmipa.ugm.ac.id

**Undergraduate Programme in Mathematics**
Telp : +62 274 552243
Email : maths1@ugm.ac.id; kaprodi-s1-matematika.mipa@ugm.ac.id
sekprodi-s1-matematika.mipa@ugm.ac.id
Website : http://s1math.fmipa.ugm.ac.id/

**MODULE HANDBOOK**

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| Module name | Introduction to Numerical Analysis |
| Module level, if applicable | Bachelor |
| Code, if applicable | MMM-2401 |
| Subtitle, if applicable | - |
| Courses, if applicable | Introduction to Numerical Analysis |
| Semester(s) in which the module is taught | 4th (fourth) |
| Person responsible for the module | Chair of the Lab. of Mathematical Computation |
| Lecturer(s) | Dr. Lina Aryati, M.S. and Dr. Sumardi, M.Si. |
| Language | Bahasa Indonesia |
| Relation to curriculum | Compulsory course in the second year (4th semester) Bachelor Degree |
| Type of teaching, contact hours | 100 minutes lectures, 240 minutes structured activities (homework and task), and 170 minutes laboratory work per week. |
| Workload | Total workload is 136 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, and 170 minutes laboratory work per week, in total is 16 weeks per semester, including mid exam and final exam. |
| Credit points | 3(1) |
| Requirements according to the examination regulations | Students have taken Introduction to Numerical Analysis course (MMM-2401) and have an examination card where the course is stated on. |
| Recommended prerequisites | Students have taken Ordinary differential equations (MMM-2301) and have participated in the final examination of the course.<br>Before taking this course, students must have a good understanding about concepts of calculus and ordinary differential equations |
| Module objectives/intended learning outcomes | After completing this course the students should have :<br>CO1. ability to analyze the error concept and predict it.<br>CO2. ability to identify roots of nonlinear equations by Bisection, Newton's, and Secant methods.<br>CO3. ability to identify polynomial which interpolates the given data.<br>CO4. ability to solve integrals and derivatives numerically by the suitable rules/methods.<br>CO5. ability to apply the Euler, Taylor and Runge-Kutta methods, analyze their error and stability, and solve initial value problem by these methods. |
| Content | Topics include:<br>a. Taylor polynomial and the error in Taylor polynomial.<br>b. The binary number system, floating point number.<br>c. Error: definitions, sources, and examples.<br>d. Finding roots of nonlinear equations: Bisection, Newton's, and Secant methods, and their error and convergence rate.<br>e. Interpolation: Polynomial interpolation and the error in polynomial interpolation.<br>f. Numerical Integration: Trapezoidal and Simpson rules, and the error formulas.<br>g. Numerical Differentiation: Forward difference, Back ward difference, central difference, undetermined Coefficients method, their error and effects of error in function values. |

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| | h. Numerical method for Initial Value Problems: Euler, Taylor and Runge Kutta Methods, their error and stability. |
| Study and examination requirements and forms of examination | The final mark will be weighted as follows:<br>No Assessment methods (components, activities) Weight (percentage)<br>1 Final Examination 30<br>2 Mid-Term Examination 25<br>3 Laboratory 30<br>4 Class Activities: Quiz, Homework, etc. 15<br><br>The initial cut-off points for grades A, B, C, and D should not be less than 80%, 70%, 50%, and 40%, respectively. |
| Media employed | White/Black Board, LCD Projector, Laptop/Computer, Laboratory |
| Reading List | 1. Kendall Atkinson, and Weimin Han, 2004, *Elementary Numerical Analysis*, 3rd Edition, John Wiley & Sons; New York.<br>2. James L. Buchanan, and Peter R. Turner, 1992, *Numerical Methods and Analysis*, McGraw Hill Inc., New York.<br>3. Brian Bradie, 2006, *A Friendly Introduction to Numerical Analysis*, Pearson International Edition, New Jersey.<br>4. Duane C. Hanselman, and Bruce L. Littlefield, 2003, *MATLAB Bahasa Pemrograman Teknis*, Perason Education Asia, Andi, Yogyakarta. |

**PLO and CO Mapping**

| | PLO 1 | PLO 2 | PLO 3 | PLO 4 | PLO 5 | PLO 6 | PLO 7 | PLO 8 | PLO 9 |
|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | | v | v | | | | | | v |
| **CO 2** | | v | v | | v | | | | v |
| **CO 3** | | v | v | | v | | | | v |
| **CO 4** | | v | v | | v | | | | v |
| **CO 5** | | | v | v | v | | | | v |