Module designation	**Numerical Methods** **Indonesian title:** *Metode Numerik* **Course code:** 8420202004
Semester(s) in which the module is taught	Semester 3 (Second year)
Person responsible for the module	**Coordinator:** Dr. Dian Savitri, M.Si. **Teaching staff:** Dr. Dian Savitri, M.Si.
Language	Indonesian
Relation to curriculum	Elective
Teaching methods	Lectures, collaborative learning with student presentations, problem-based learning with case studies, computer practice, interactive discussion, and project-based learning **Media and tools:** Slides, LCD projector, whiteboard, UNESA Learning Management System (LMS), Microsoft Excel or Google Sheets, Python (Google Colab), GeoGebra
Workload (incl. contact hours, self-study hours)	**(Estimated) total workload:** 2 CU × 170 minutes × 16 weeks = 5,440 minutes = 90.67 hours (≈ 3.18 ECTS) **Contact hours:** lectures, 2 × 50 minutes per week × 16 weeks = 26.67 hours (class hours per week: 340 minutes = 5.67 hours, including structured activities) **Private study including examination preparation:** structured assignments, 2 × 60 minutes per week × 16 weeks = 32.00 hours; independent study, 2 × 60 minutes per week × 16 weeks = 32.00 hours (total 64.00 hours)
Credit points	2 CU (3.18 ECTS) *1 CU = 170 minutes per week × 16 weeks = 45.3 hours; 1 ECTS = 28.48 hours (144 CU = 229 ECTS), so 1 CU = 1.59 ECTS (UNESA Rector's Decree No. 736/HK/KM/2023).*
Required and recommended prerequisites for joining the module	Differential Calculus and Integral Calculus
Module objectives/intended learning outcomes	**Programme learning outcomes (PLO) addressed:** • PLO-5: Apply the basic principles of mathematics to solve simple mathematical problems. • PLO-6: Demonstrate mathematical knowledge and insight. **Course learning outcomes (CLO): after completing this module, students are able to:** • CLO-1: Explain the numerical paradigm and analyse the sources, types, and propagation of errors, including floating-point representation, rounding, and truncation (PLO 5) • CLO-2: Find approximate solutions of nonlinear equations (bisection, regula falsi, secant, Newton, and fixed-point iteration) and of linear systems (Gaussian elimination, LU decomposition, and iterative methods), and estimate the errors (PLO 5) • CLO-3: Construct interpolating polynomials (Lagrange and Newton) and fit curves to data using least squares and splines (PLO 5) • CLO-4: Approximate derivatives and definite integrals numerically using various methods, and estimate the errors (PLO 5)

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- CLO-5: Implement numerical algorithms with Excel and Python, evaluate their accuracy and convergence, and apply them to contextual modelling problems and to mathematics learning at the secondary level (PLO 6)

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<tr><td>Content</td><td>This course equips students with the numerical paradigm and the basic principles of numerical solution, without leaving the analytical reasoning behind each method. Topics are the concept of error, including its sources and how to reduce it; approximate roots of nonlinear equations and solutions of linear systems; interpolation and curve fitting; and numerical differentiation and integration. Understanding of the concepts is followed by the skill to implement the methods with Excel and Python and to apply them to contextual mathematics problems and to mathematics learning at the secondary level. Learning combines collaborative and problem-based learning with case studies based on contextual and realistic data, and a project that students must present.</td></tr>
<tr><td>Examination forms</td><td>Final score is calculated from the weekly assessment scheme below (CLO/PLO addressed and weight of each assessment):
<table>
<tr><th>Week</th><th>CLO</th><th>PLO</th><th>Weight (%)</th></tr>
<tr><td>1</td><td>CLO-1</td><td>PLO-5</td><td>4</td></tr>
<tr><td>2</td><td>CLO-1</td><td>PLO-5</td><td>4</td></tr>
<tr><td>3</td><td>CLO-2</td><td>PLO-5</td><td>4</td></tr>
<tr><td>4</td><td>CLO-2</td><td>PLO-5</td><td>4</td></tr>
<tr><td>5</td><td>CLO-2</td><td>PLO-5</td><td>4</td></tr>
<tr><td>6</td><td>CLO-2</td><td>PLO-5</td><td>4</td></tr>
<tr><td>7</td><td>CLO-3</td><td>PLO-5</td><td>4</td></tr>
<tr><td>8</td><td>CLO-3</td><td>PLO-5</td><td>15</td></tr>
<tr><td>9</td><td>CLO-3</td><td>PLO-5</td><td>4</td></tr>
<tr><td>10</td><td>CLO-4</td><td>PLO-5</td><td>4</td></tr>
<tr><td>11</td><td>CLO-4</td><td>PLO-5</td><td>4</td></tr>
<tr><td>12</td><td>CLO-4</td><td>PLO-5</td><td>4</td></tr>
<tr><td>13</td><td>CLO-5</td><td>PLO-6</td><td>4</td></tr>
<tr><td>14</td><td>CLO-5</td><td>PLO-6</td><td>4</td></tr>
<tr><td>15</td><td>CLO-5</td><td>PLO-6</td><td>8</td></tr>
<tr><td>16</td><td>CLO-5</td><td>PLO-6</td><td>25</td></tr>
</table>
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<tr><td>Study and examination requirements</td><td>Students are considered competent and pass if the final score, calculated from weekly tasks, presentations, and participation (60%), the midterm formative examination (15%), and the project-based final formative examination (25%), is at least 55 or C.

Final index (grade conversion):
<table>
<tr><th>Index</th><th>Converted score</th><th>Score range (A = final score)</th></tr>
<tr><td>A</td><td>4.00</td><td>85 ≤ A ≤ 100</td></tr>
<tr><td>A-</td><td>3.75</td><td>80 ≤ A < 85</td></tr>
<tr><td>B+</td><td>3.50</td><td>75 ≤ A < 80</td></tr>
<tr><td>B</td><td>3.00</td><td>70 ≤ A < 75</td></tr>
<tr><td>B-</td><td>2.75</td><td>65 ≤ A < 70</td></tr>
<tr><td>C+</td><td>2.50</td><td>60 ≤ A < 65</td></tr>
</table>
</td></tr>
</table>

	C | 2.00 | 55 ≤ A < 60 D | 1.00 | 40 ≤ A < 55 E | 0.00 | 0 ≤ A < 40
Reading list	1. Fuad, Y. (2010). Metode numerik. Unipress IKIP Surabaya. 2. Gerald, C. F., & Wheatley, P. O. (2004). Applied numerical analysis (7th ed.). Pearson Education. 3. Kharab, A., & Guenther, R. B. (2019). An introduction to numerical methods: A MATLAB approach (4th ed.). CRC Press. 4. Gezerlis, A. (2023). Numerical methods in physics with Python (2nd ed.). Cambridge University Press. 5. LeMesurier, B. (2024). Introduction to numerical methods and analysis with Python. http://lemesurierb.people.cofc.edu/introduction-to-numerical-methods-and-analysis-python/ 6. Miles, W. (2023). Numerical methods with Python for scientists. De Gruyter. 7. Atkinson, K. (2003). Elementary numerical analysis (3rd ed.). John Wiley & Sons. 8. Fuad, Y. (2012). Lembar kerja praktikum metode numerik. FMIPA Unesa. 9. Kong, Q., Siauw, T., & Bayen, A. M. (2021). Python programming and numerical methods: A guide for engineers and scientists. Academic Press.