Computational Physics

Module Name :	Computational Physics	
Module Level :	Undergraduate	
Code :	32251013	
Sub-heading, if applicable :		
Classes, if applicable :		
Semester :	4st	
Module coordinator :	Drs. Andreas Handjoko Permana, M.Si.	
Lecturer(s) :	Drs. Andreas Handjoko Permana, M.Si. Dewi Muliyati, S.Pd., M.Si, M.Sc.	
Language :	Indonesian	
Classification within the curriculum :	Compulsory course	
Type of Teaching	Contact hours per week during the semester	Class Size
Lecture (Expository, discussion, exercise)	150 minutes	40
Workload	Total workload of this course 136 hours (4.5 ECTS) per semester which consist of 40 hours (1.32 ECTS) classroom activity, 48 hours (1.59 ECTS) structured task, and 48 hours (1.59 ECTS) per semester.	
Credit points :	4.5 ECTS	
Prerequisite course(s) :	-	
Course Outcomes :	After taking this course the student have ability to : CLO113. Describe programming and computing in physics and the limitations of computers in mathematical calculations. CLO114. Analyze numerical methods used to solve non-linear equations. CLO115. Analyze elimination, decomposition and iteration methods and apply them in solving systems of linear equations to solve physics problems. CLO116. Analyze numerical differential methods and apply them in solving ordinary differential equations in physics problems such as radioactive decay and capacitors. CLO117. Formulate ordinary differential equations to numerically solve parabolic motion and simple harmonic motion problems. CLO118. Analyze numerical integration methods to apply them in solving integral problems. CLO119. Analyze Monte-Carlo method and its application in numerical integral solving and statistical simulation. CLO120. Apply linear and polynomial interpolation methods and curve fitting of measurement data to data analysis problems. CLO121. Apply interpolation and regression methods to data analysis problems.	

	CLO122. Analyze the discrete Fourier transform and its application to periodic and non-periodic data analysis. CLO123. Analyze the finite difference method and apply it in solving elliptic partial differential equations such as heat distribution physics problems.
Content :	1. Modeling and Error Analysis, Case: Enzyme Kinematics 1.1 Mathematical Modeling and Engineering Problem Solving 1.2 Approximations and Error Analysis 1.3 Case: Enzyme Kinematics 2. Roots of Equations, Case: Bernoulli Equation 2.1 Bracketing Method 2.2 Open Method 2.3 Case: Bernoulli Equation 3. Linear Algebraic Equations, Case: Currents and Voltages in Resistor Circuits 3.1 Small Numbers of Equations 3.2 Naive Gauss Elimination 3.3 Techniques for Improving Solutions 3.4 Another Techniques 3.5 Case: Currents and Voltages in Resistor Circuits 4. Interpolation & Curve Fitting, Case: Electrostatic Force System 4.1 Polynomials Interpolation 4.2 Spline Interpolation 4.3 Least-Squares Fit Outline Image Fitting, Linear Regression Fitting 4.4 Curve Fitting Linear Regression 4.5 Case: Electrostatic Force System 4.6 Case: Outline Image 4.7 Case: Curve Fitting 5. Numerical Differentiation, Case: Kinematics 5.1 Finite Difference Approximations 5.2 Richardson Extrapolations 5.3 Case: Kinematics 6. Numerical Integration, Case: Kinematics 6.1 The Trapezoidal Rule 6.2 Simpson's Rules 6.3 Another Techniques 6.4 Case: Kinematics

<table>
<tr><td></td><td>7. Optimization
7.1 Introduction to optimization

8. Ordinary Differential Equations, Case: Transient Current for an Electric Circuit
8.1 Euler’s Method
8.2 Runge Kutta Methods
8.3 Case: Transient Current

9. Partial Differential Equations,
Case: Heat Transfer
9.1 Euler’s Method
9.2 Runge Kutta Methods
9.3 Case: Heat Transfer</td></tr>
<tr><td>Study/exam achievements:</td><td>Examination are conducted as unit test, as following
<table>
<tr><th>No</th><th>Assesment Object</th><th>Assesment Technique</th><th>Weight</th></tr>
<tr><td>1</td><td>Case-based Assignment</td><td>Exploring and discussing some problem in mathematics</td><td>50%</td></tr>
<tr><td>2</td><td>Task</td><td>6 individual assignments</td><td>20%</td></tr>
<tr><td>3</td><td>Midterm Test</td><td>Written test</td><td>10%</td></tr>
<tr><td>4</td><td>Final Test</td><td>Written test</td><td>10%</td></tr>
<tr><td>5</td><td>Attendance</td><td>Presence list</td><td>10%</td></tr>
</table></td></tr>
<tr><td>Media :</td><td>Power point presentation, textbook, learning management system (LMS)</td></tr>
<tr><td>Literatures :</td><td>1. Steven Chapra, Raymond Canale - Numerical Methods for Engineers (7th edition) - McGraw-Hill (2014)
2. Rubin H. Landau, Manuel J Pérez, Cristian C. Bordeianu - Computational Physics: Problem Solving with Python - Wiley-VCH (2015)
3. Benjamin A. Stickler, Ewald Schachinger (auth.) - Basic Concepts in Computational Physics - Springer International Publishing (2016)
4. Franklin J. - Computational Methods for Physics - Cambridge University Press (2013)
5. Piotr Kulczycki, László T. Kóczy, Radko Mesiar, Janusz Kacprzy. Advances in Intelligent Systems and Computing 462. - Information Technology and Computational Physics - Springer International Publishing
6. B H Iswanto, 2022, Workshop Pengembangan Alat Peraga Berbasis Smart Digital Devices (SDD) untuk Peningkatan Kompetensi Guru Fisika Jakarta Timur</td></tr>
</table>

	7. B H Iswanto, 2020, Pelatihan Pemrograman Simulasi Komputer Untuk Guru Fisika Di Kabupaten Bogor 8. M Delina, 2022, Simulasi Gerakan Droplet Virus Covid-19 dengan Metode Monte Carlo 9. M Delina, 2021, Simulasi pergerakan droplet virus Covid-19 dengan Metode Monte Carlo 10. M Delina, 2020, Sisi Sebaran Abu Vulkanis Dengan Metode Puff Lagrangian Studi Kasus Erupsi Gunung Tangkuban Perahu