**Computational Physics Practicum**

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| Module Name : | Computational physics practicum | |
| Module Level : | Undergraduate | |
| Code : | 32152303 | |
| Sub-heading, if applicable : | | |
| Classes, if applicable : | | |
| Semester : | 4st | |
| Module coordinator : | Dewi Muliyati, S.Pd., M.Si, M.Sc. | |
| Lecturer(s) : | Drs. Andreas Handjoko Permana, M.Si.<br>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) | 50 minutes | 40 |
| Workload | Total workload of this course 45,3 hours (1,5 ECTS) per semester which consist of 13,34 hours (0,44 ECTS) classroom activity, 16 hours (0,53 ECTS) structured task, and 16 hours (0,53 ECTS) per semester. | |
| Credit points : | 1.5 ECTS | |
| Prerequisite course(s) : | - | |
| Course Outcomes : | After taking this course the student have ability to :<br>CLO124. Understand the basic concepts of programming, modeling, computation, and system simulation.<br>CLO125. Analyze the problem of solving non-linear equations and systems of linear equations with numerical methods.<br>CLO126. Analyze the Monte-Carlo method and its application in numerical integral solving and statistical simulation.<br>CLO127. Analyze data processing and data analysis with interpolation, regression, transformation, and finite difference methods. | |
| Content : | 1. Modeling and Error Analysis<br>1.1 Mathematical Modeling and Engineering Problem Solving<br>1.2 Approximations and Error Analysis<br>1.3 IDE (Jupyter Notebook)<br><br>2. Modul-1 Bracket Method for Nonlinear Equations<br>Problem: Semiconductor<br>2.1 Bisection Method<br>2.2 False Position Method | |

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<tr><td></td><td>3. Modul-2 Open Method for Nonlinear Equations<br>Problem: Mechanics<br>3.1 Newton Raphson Method<br><br>4. Modul-3 Linear Algebraic Equations<br>4.1 Naive Gauss Elimination<br>4.2 Gauss-Jordan Technique<br><br>5. Modul-4 Interpolation<br>5.1 Polynomials Interpolation<br>5.2 Newton Interpolation<br>5.3 Project-1<br><br>6. Modul-5 Regression<br>6.1 Linear Regression<br><br>7. Modul-6 Numerical Differentiation<br>7.1 The Trapezoidal Rule<br>7.2 Simpson’s Rules<br><br>8. Modul-7 Numerical Integration<br>8.1 Finite-Methods<br><br>9. Optimization in Physics Problem<br>9.1 Optimization<br><br>10. Modul-8 Ordinary Differential Equation – Euler Method<br>10.1 Euler’s Method<br>10.2 Runge Kutta Methods<br><br>11. Modul-9 Ordinary Differential Equation – Runge-Kutta Method<br>11.1 Euler’s Method<br>11.2 Runge Kutta Methods<br><br>2. Physics Problem using Partial Differential Equations<br>12.1 Heat Distribution<br>12.2 Wave Equation</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>Project Based Learning</td><td>Non-test in the form of a report, Preliminary Report, Final Report</td><td>60%</td></tr>
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| | 2 | Task | Error Analysis and Optimasi | 10% |
| | 3 | Final Test | UAP | 20% |
| | 4 | Attendance | Presence list | 10% |
| Media : | Computer/laptop, internet, projector. | | | |
| Literatures : | 1. Steven Chapra, Raymond Canale - Numerical Methods for Engineers (7th edition) - McGraw-Hill (2014)<br>2. Rubin H. Landau, Manuel J Pérez, Cristian C. Bordeianu - Computational Physics: Problem Solving with Python - Wiley-VCH (2015)<br>3. Benjamin A. Stickler, Ewald Schachinger (auth.) - Basic Concepts in Computational Physics - Springer International Publishing (2016)<br>4. Franklin J. - Computational Methods for Physics - Cambridge University Press (2013)<br>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<br>6. Bartels, S. (2015). Numerical methods for nonlinear partial differential equations (Vol. 47). Berlin: Springer.<br>7. Folland, G. B. (2020). Introduction to partial differential equations. In Introduction to Partial Differential Equations. Princeton university press.<br>8. Rabczuk, T., Ren, H., & Zhuang, X. (2019). A nonlocal operator method for partial differential equations with application to electromagnetic waveguide problem. Computers, Materials & Continua 59 (2019), Nr. 1.<br>9. Nytrebych, Z., Il'Kiv, V., Pukach, P., & Malanchuk, O. (2018). On nontrivial solutions of homogeneous Dirichlet problem for partial differential equations in a layer. Kragujevac Journal of Mathematics, 42(2), 193-207.<br>10. Samaniego, E., Anitescu, C., Goswami, S., Nguyen-Thanh, V. M., Guo, H., Hamdia, K., ... & Rabczuk, T. (2020). An energy approach to the solution of partial differential equations in computational mechanics via machine learning: Concepts, implementation, and applications. Computer Methods in Applied Mechanics and Engineering, 362, 112790.<br>11. B H Iswanto, 2022, Workshop Pengembangan Alat Peraga Berbasis Smart Digital Devices (SDD) untuk Peningkatan Kompetensi Guru Fisika Jakarta Timur<br>12. B H Iswanto, 2020, Pelatihan Pemrograman Simulasi Komputer Untuk Guru Fisika Di Kabupaten Bogor | | | |

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| | 13. M Delina, 2022, Simulasi Gerakan Droplet Virus Covid-19 dengan Metode Monte Carlo<br>14. M Delina, 2021, Simulasi pergerakan droplet virus Covid-19 dengan Metode Monte Carlo<br>15. M Delina, 2020, Sisi Sebaran Abu Vulkanis Dengan Metode Puff Lagrangian Studi Kasus Erupsi Gunung Tangkuban Perahu |