UNIVERSITAS INDONESIA

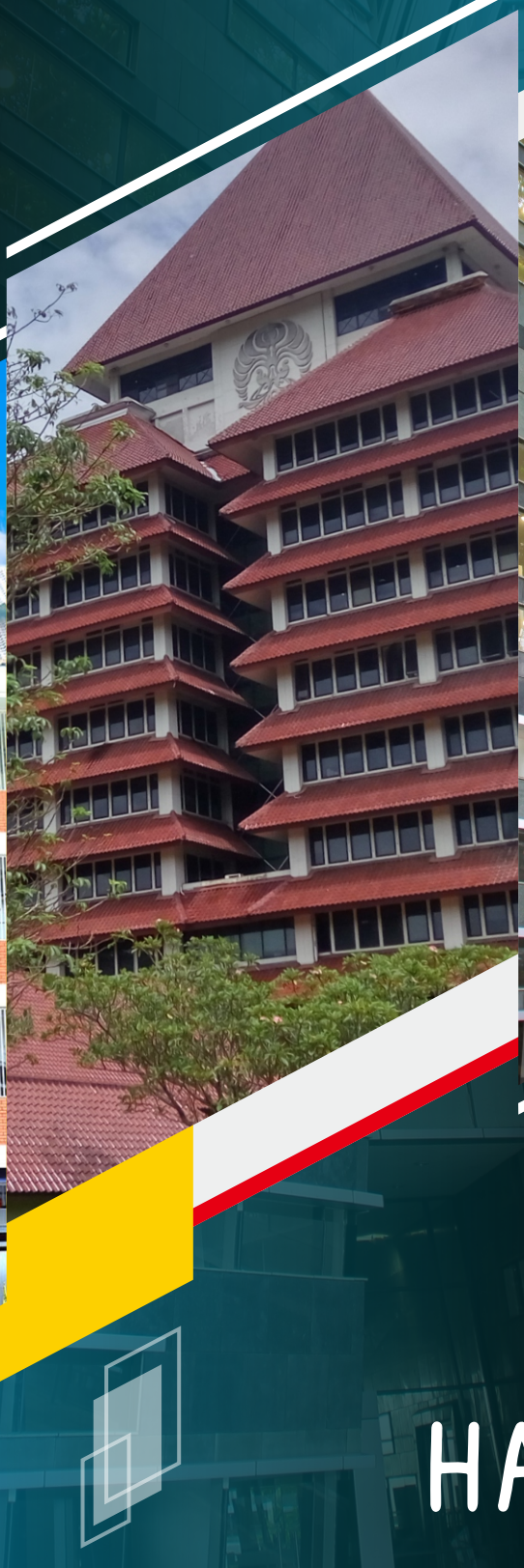
Veritas, Probitas, Iustitia

FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM

Department of Physics

Master Programme

in Physics



MODULE HANDBOOK

http://physics.ui.ac.id

Updated May 2023

List of Modules

UNIVERSITAS INDONESIA
Faculty of Mathematics and Natural Sciences
Master Program of Physics

Building F, Kampus UI Depok 16424
Telp: (+62)021-78849008, Email: sekretariat@fisika.ui.ac.id
website: www.physics.ui.ac.id

MODULE HANDBOOK

Module name	*Mathematical Method in Physics*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802811
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	3rd Semester
Person responsible for the module	
Lecturer	Efta Yudiarsah, Ph.D.
Language	Indonesian
Relation to curriculum	Compulsory Course
Type of teaching, contact hours	
Teaching methods	Interactive Lecture and Independent Learning
Workload (incl. contact hours, self-study hours)	Lectures: 3x50=150 minutes per week Exercise and assignments: 3x60=180 minutes per week Independent study: 3x60 = 180 minutes per week
Credit points	3
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	1. Apply the use of vector and tensor analysis methods in solving problems with several components. 2. Able to use the methods of complex analysis in the physical science field. 3. Formulate solutions of differential equations that represent physical phenomena. 4. Formulate functions in representation of Fourier series and integrals. 5. Able to use the concept of integral equation in the case of physics. 6. Able to use the variation method in the case of physics.
Content	▪ Vector and Tensor Analysis

<table>
<tr><td></td><td>
▪ Complex Variable Functions
▪ Differential Equations
▪ Fourier Series and Integral Transformations
▪ Integral Equations
▪ Calculus of Variations
</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>
The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

<table>
<tr><th>Mark</th><th>Grade</th></tr>
<tr><td>85—100</td><td>A</td></tr>
<tr><td>80—<85</td><td>A</td></tr>
<tr><td>75—<80</td><td>B+</td></tr>
<tr><td>70—<75</td><td>B</td></tr>
<tr><td>65—<70</td><td>B</td></tr>
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<tr><td>55—<60</td><td>C</td></tr>
<tr><td>40—<55</td><td>D</td></tr>
<tr><td><40</td><td>E</td></tr>
</table>
</td></tr>
<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>
1. Alex Gezerlis, “Numerical Methods in Physics with Python”, Cambridge University Press, 2020
2. Amos Gilat, Vish Subramaniam, “Numerical Methods for Engineers and Scientists. An Introduction with Applications using MATLAB 3rd”, John Wiley & Sons, 2014
3. Michael Bestehorn, “Computational Physics”, Walter de Gruyter GmbH, 2018
4. Rubin H. Landau, Manuel J. Páez, Cristian C. Bordeianu, “Computational Physics. Problem Solving with Python 3rd”, Wiley, 2015
5. Steven C. Chapra, Raymond P. Canale, “Numerical Methods for Engineers 8th”, McGraw-Hill Education, 2021
6. Arfken, G. B. and H. J. Weber, Mathematical Methods for Physicists, 6th Ed., Elsevier Academic Press, 2005.
7. Wyld, H. W., Mathematical Methods for Physics,
</td></tr>
</table>

	Perseus Book Publ., 1999. 8. Byron, F. W. Jr. and R. W. Fuller, *Mathematics of Classical and Quantum Physics*, Dover Publ. Inc., 1992.

MODULE HANDBOOK

Module name	*Computational Method in Physics*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802802
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Dr. rer. nat. Imam Fachruddin S.Si., M.Si.
Lecturer	Dr. rer. nat. Imam Fachruddin S.Si., M.Si.
Language	Indonesian
Relation to curriculum	Compulsory Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecture and discussion
Workload (incl. contact hours, self-study hours)	Lectures: 3x50=150 minutes per week Exercise and assignments: 3x60=180 minutes per week Independent study: 3x60 = 180 minutes per week
Credit points	3
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	Apply numerical methods to solve Physics problems Utilize Fortran programming language or equivalent to perform numerical calculations
Content	▪ Introduction to programming in Fortran language or equivalent ▪ Root-finding ▪ Solving system of linear equations ▪ Least-square fitting; interpolation ▪ Numerical integration ▪ Solving ordinary and partial differential equations ▪ Solving eigenvalue problem with power method ▪ Matrix characteristic polynomial
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %*

<table>
<tr>
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Final test : 30 %
Assignment : 40 %
Total : 100 %

<table>
<tr><th>Mark</th><th>Grade</th></tr>
<tr><td>85—100</td><td>A</td></tr>
<tr><td>80—<85</td><td>A</td></tr>
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<tr><td>70—<75</td><td>B</td></tr>
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<tr><td>55—<60</td><td>C</td></tr>
<tr><td>40—<55</td><td>D</td></tr>
<tr><td><40</td><td>E</td></tr>
</table>
</td>
</tr>
<tr>
<td>Media employed</td>
<td>Powerpoint presentation (PPT), Microsoft e-Learning Management System (EMAS)</td>
</tr>
<tr>
<td>Reading List</td>
<td>
1. P. L. DeVries, A First Course in Computational Physics, John Wiley &Sons, Inc., New York, 1994.
2. W. H. Press, et. al., Numerical Recipes in Fortran 77, 2nd Ed., CambridgeUniversity Press, New York, 1992.
3. M. Metcalf & J. Reid, Fortran 90/95 Explained, Oxford University Press, New York, 1998.
</td>
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MODULE HANDBOOK

Module name	*Seminar*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802805
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Dr. Djati Handoko, S.Si, M.Si
Lecturer	Dr. Djati Handoko, S.Si, M.Si
Language	Indonesian
Relation to curriculum	Compulsory course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to write scientific papers and present findings from research
Content	▪ Introduction to science philosophy ▪ Research proposal presentation ▪ Research report presentation ▪ Scientific discussions
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %* *Final test : 30 %* *Assignment : 40 %* *Total : 100 %* **Mark** | **Grade**

<table>
<tr><td></td><td><table>
<tr><td>85—100</td><td>A</td></tr>
<tr><td>80—<85</td><td>A</td></tr>
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<tr><td>70—<75</td><td>B</td></tr>
<tr><td>65—<70</td><td>B</td></tr>
<tr><td>60—<65</td><td>C+</td></tr>
<tr><td>55—<60</td><td>C</td></tr>
<tr><td>40—<55</td><td>D</td></tr>
<tr><td><40</td><td>E</td></tr>
</table></td></tr>
<tr><td>Media employed</td><td>PowerPoint presentation (PPT), Microsoft e-Learning Management System (EMAS)</td></tr>
<tr><td>Reading List</td><td>1. Nazir, Moh., Metode Penelitian, Ghalia Indonesia, Jakarta, 2003.
2. Young, Felina C., Fundamentals of Research Writing, IPWI Publishing Co., Jakarta, 1999
3. Surat Keputusan Rektor UI nomor 628/SK/R/UI/2008, tentang Pedoman Teknis Penulisan Tugas Akhir Mahasiswa Universitas Indonesia, 16 June 2008.
4. Format dokumen Naskah Ringkas Tugas Akhir, Perpustakaan Universitas Indonesia, Desember 2012
5. R. Weissberg dan S. Buker, Writing Up Research; Experimental Research, Report Writing for Students of
6. English, Prentice-Hall, Inc, 1990.
7. R. A. Day, How to Write and Publish a Scientific Paper, 3rd ed., Cambridge Univeristy Press, 1991.
8. Examples of scientific paper and the procedures
9. Various source from internet about scientific presentation technique.</td></tr>
</table>

MODULE HANDBOOK

Module name	*Literature Review 1*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH801001
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Team
Lecturer	Thesis Advisor
Language	Indonesian
Relation to curriculum	Compulsory Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Student Center Learning, Presentation, Discussion, Self-studying
Workload (incl. contact hours, self-study hours)	Lectures: 4x50=200 minutes per week Exercise and assignments: 4x60=240 minutes per week Independent study: 4x60=240 minutes per week
Credit points	4
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	1. Students are able to review scientific literature 2. Students are able to analyze existing facts in determining the topic and thesis of their study 3. Students are able to write and compile background and references of their study, conduct literature research according to the topic of study, and write synthesis of reputable scientific publications 4. Students are able to integrate various facts and data as well as processing, classifying, and compiling it in scientific paper 5. Students are able to edit and rewrite their scientific paper in the form of presentation material and demonstrating their ability to

<table>
<tr><td></td><td>defend it by showing the validity of the content.
6. Students can compile scientific paper in the correct format as well as presentation and maintain their ideas and results of their studies in the form of written or oral presentation</td></tr>
<tr><td>Content</td><td>▪ Literature according to research topic
▪ Systematic and format of scientific literature
▪ Thesis topic in scientific research
▪ Research background, objectives and problems
▪ Citing previous research
▪ Research methodology
▪ Written and oral presentation techniques</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>1. Hanburry Brown, AC, FRS. (1986). The Wisdom of Science : its relevance to Culture and Religion. London : Cambridge University Press.
2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA,INC.
3. Geoff, P and Judy, P. (2004). Key Concepts in Social Research. London: Sage.
4. Sandra lach, A. (1995). Practical Handbook of Spatial Statistics. New York: CRC Press</td></tr>
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MODULE HANDBOOK

Module name	*Literature Review 2*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH801002
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Team
Lecturer	Thesis Advisor
Language	Indonesian
Relation to curriculum	Compulsory Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Student Center Learning, Presentation, Discussion, Self-studying
Workload (incl. contact hours, self-study hours)	Lectures: 4x50=200 minutes per week Exercise and assignments: 4x60=240 minutes per week Independent study: 4x60=240 minutes per week
Credit points	4
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	1. Students are able to produce paper literature review and present it to the examiners 2. Students are able to analyze facts and break it down in sections to be used as elements of scientific literature 3. Students are able to integrate various facts and data as well as processing, classifying, and compiling it in scientific literature in the form of reputable publication 4. Students are able to edit and rewrite their scientific paper in the form of presentation material and demonstrating their ability to defend it by showing the validity of the content
Content	▪ Systematic and format of scientific literature

<table>
<tr><td></td><td>

Synthesize content from various literature as reference
Citation methods
Compiling scientific paper in the form of reviewing reputable sources
Written and oral presentation techniques

</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>
The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %
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2. Hawryszkiewycz, I,T. (1984). Database Analysis and Design. Chicago: SRA,INC.
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MODULE HANDBOOK

Module name	*Research Proposal*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH801003
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	
Lecturer	
Language	Indonesian
Relation to curriculum	Compulsory Course
Type of teaching, contact hours	
Teaching methods	Asynchronous: Independent Learning, Discussion Forum Synchronous: Google Meet
Workload (incl. contact hours, self-study hours)	Lectures: 4x50=200 minutes per week Exercise and assignments: 4x60=240 minutes per week Independent study: 4x60=240 minutes per week
Credit points	4
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	1. Select, organize, and evaluate most recent scientific information sources. 2. Create and design materials, processing methods, techniques in analyzing newest material or material product innovation with the scientific method. 3. Correlate the relation between structures, properties, processing, and material system performance. 4. Create hand-written reports and communicate effectively in scientific groups, industry, and public. 5. Detailing general and specific problems in the field of Material Science

<table>
<tr><td></td><td>6. Create a complete work plan and evaluate material characterization data.
7. Apply academic ethics, environmental safety, and socio-economic impact.
8. Show an increase in independent learning capacity.
9. Manage research data in order to guarantee validity and prevent plagiarism.
10. Select, organize, and evaluate most recent scientific information sources</td></tr>
<tr><td>Content</td><td>▪ Scientific Writing Format and Systematics
▪ Topics and Thesis in Scientific Research
▪ Backgrounds, Objectives, and Problems in Research
▪ Literature Review, Writing, Citation, and Previous Research
▪ Research Methodology- Research Site Selection
▪ Research Methodology- Respondent Determination
▪ Research Methodology- Research Sampling
▪ Research Methodology- Processing Techniques
▪ Research Methodology- Analyzing Techniques
▪ Written and Oral Presentation Techniques</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
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Assignment : 40 %
Total : 100 %

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Media employed	*EMAS/EMAS2*			
Reading List	1. On Being a Scientist: A Guide to Responsible Conduct in Research, Third Edition, National Academy of Sciences, USA, 2009.			

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MODULE HANDBOOK

Module name	*Scientific Publications 1*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH801004
Subtitle, if applicable	Indonesian
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	
Lecturer	
Language	Indonesian
Relation to curriculum	Compulsory course
Type of teaching, contact hours	
Teaching methods	
Workload (incl. contact hours, self-study hours)	Lectures: 2x50 = 100 minutes per week Exercise and assignments: 2x60 = 120 minutes per week Independent study: 2x60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	As a form of disseminating student research results, students are required to present their work in a national/international scientific seminar and write scientific articles that will be published in indexed national/international proceedings. The assessment is given by the supervisor based on evidence that presentations have been carried out at national/international scientific seminars and acceptance of papers for publication in indexed national/international proceedings.
Content	▪ Abstract ▪ Background of the problem ▪ Research methods ▪ Results and discussion ▪ Conclusions, suggestions, and bibliography.
Study and examination	The final score is the composition of mid-test scores,

<table>
<tr><td>requirements and form of examination</td><td>quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>-</td></tr>
</table>

MODULE HANDBOOK

Module name	*Presentation of Progress Results*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH801005
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	
Lecturer	Team
Language	Indonesian
Relation to curriculum	Compulsory Course
Type of teaching, contact hours	
Teaching methods	
Workload (incl. contact hours, self-study hours)	6x170 minutes = 1020 minutes per week
Credit points	6
Requirements according to the examination regulations	
Recommended prerequisites	-
Module objectives/intended learning outcomes	This course is intended as a form of evaluation of the students' research progress. Students are expected to make research progress reports with a minimum achievement of 50% of the overall research target.
Content	▪ Research thinking framework ▪ Methodology ▪ Provisional results ▪ Sharpness of data analysis ▪ Stability in drawing conclusions ▪ Presentation ▪ Mastery of material ▪ Potential for continuation of research.
Study and examination requirements and form of examination	The final score is the composition of mid-test scores, quizzes, and assignments with the following weight: Mid-test : 30 % Final test : 30 % Assignment : 40 %

<table>
<tr><td></td><td>Total : 100 %

<table>
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MODULE HANDBOOK

Module name	*Scientific Publications 2*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH801006
Subtitle, if applicable	Indonesian
Courses, if applicable	
Semester(s) in which the module is taught	3rd Semester
Person responsible for the module	
Lecturer	
Language	Indonesian
Relation to curriculum	
Type of teaching, contact hours	
Teaching methods	
Workload (incl. contact hours, self-study hours)	Lectures: 8x50 = 400 minutes per week Exercise and assignments: 8x60 = 480 minutes per week Independent study: 8x60 = 480 minutes per week
Credit points	8
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	As a form of disseminating student research results. Students are required to write scientific articles to be published in indexed international journals. The assessment is given by the supervisor based on evidence that papers have been received for publication in indexed international journals.
Content	▪ Abstract ▪ Background of the problem ▪ Research methods ▪ Results and discussion ▪ Conclusions, suggestions, and bibliography.
Study and examination requirements and form of examination	The final score is the composition of mid-test scores, quizzes, and assignments with the following weight: Mid-test : 30 % Final test : 30 %

<table>
<tr><td></td><td>Assignment : 40 %
Total : 100 %

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MODULE HANDBOOK

Module name	*Scientific Publications*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802806
Subtitle, if applicable	Indonesian
Courses, if applicable	
Semester(s) in which the module is taught	3rd Semester
Person responsible for the module	
Lecturer	
Language	Indonesian
Relation to curriculum	Compulsory course
Type of teaching, contact hours	
Teaching methods	
Workload (incl. contact hours, self-study hours)	Lectures: 2x50 = 100 minutes per week Exercise and assignments: 2x60 = 120 minutes per week Independent study: 2x60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	As a form of disseminating student research results, students are required to present their work in a national/international scientific seminar and write scientific articles that will be published in indexed national/international proceedings. The assessment is given by the supervisor based on evidence that presentations have been carried out at national/international scientific seminars and acceptance of papers for publication in indexed national/international proceedings.
Content	▪ Astract ▪ Background of the problem ▪ Research methods ▪ Results and discussion ▪ Conclusions, suggestions, and bibliography.
Study and examination	The final score is the composition of mid-test scores,

<table>
<tr><td>requirements and form of examination</td><td>quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

<table><tr><th>Mark</th><th>Grade</th></tr><tr><td>85—100</td><td>A</td></tr><tr><td>80—<85</td><td>A</td></tr><tr><td>75—<80</td><td>B+</td></tr><tr><td>70—<75</td><td>B</td></tr><tr><td>65—<70</td><td>B</td></tr><tr><td>60—<65</td><td>C+</td></tr><tr><td>55—<60</td><td>C</td></tr><tr><td>40—<55</td><td>D</td></tr><tr><td><40</td><td>E</td></tr></table></td></tr>
<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>-</td></tr>
</table>

MODULE HANDBOOK

Module name	*Thesis*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH801007
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	4th Semester
Person responsible for the module	-
Lecturer	Thesis Advisor
Language	
Relation to curriculum	
Type of teaching, contact hours	-
Teaching methods	-
Workload (incl. contact hours, self-study hours)	8x170=1360 minutes per week
Credit points	8
Requirements according to the examination regulations	
Recommended prerequisites	-
Module objectives/intended learning outcomes	This course is a final evaluation of the overall results of students' research. Students are expected to write a thesis that contains all stages of research carried out during their study. The research results written in the thesis are a compilation of research results that have been disseminated through seminars, proceedings, or journal articles, which are written comprehensively and continuously.
Content	*Contents of the thesis:* ● *Abstract* ● *Background of the study* ● *Research methods* ● *Results and discussion* ● *Conclusion* ● *Suggestions* ● *Bibliography*
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %*

<table>
<tr><td></td><td>
Final test : 30 %
Assignment : 40 %
Total : 100 %

<table>
<tr><th>Mark</th><th>Grade</th></tr>
<tr><td>85—100</td><td>A</td></tr>
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</table>
</td></tr>
<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>Effionora (ed.), Pedoman Pembuatan Tesis dan Disertasi di FMIPA UI, UI-Press, 2006</td></tr>
</table>

MODULE HANDBOOK

Module name	*Statistical Mechanics*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802101
Subtitle, if applicable	Indonesian
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Muhammad Aziz Majidi, S.Si., M.Si., Ph.D.
Lecturer	Muhammad Aziz Majidi, S.Si., M.Si., Ph.D.
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	
Teaching methods	
Workload (incl. contact hours, self-study hours)	Lectures: 3x50 = 150 minutes per week Exercise and assignments: 3x60 = 180 minutes per week Independent study: 3x60 = 150 minutes per week
Credit points	3
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	Explains the microscopic modeling behind the principle phenomena and macroscopic phenomena of thermodynamics, which covers the theoretical kinetics, classical statistical mechanics, statistical ensemble, partition functions, quantum statistical mechanics, partition functions, fermion systems, boson systems.
Content	▪ Laws of thermodynamics ▪ Theoretical kinetics ▪ Equilibrium ▪ Transport phenomena ▪ Classical statistical mechanics ▪ Canonical ensemble ▪ Grand canonical ensemble ▪ Partition function ▪ Approximation methods

<table>
<tr><td></td><td>
▪ Quantum statistical mechanics
▪ Partition function
▪ Fermion system
▪ Boson system
▪ Special topics in statistical mechanics
</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>
The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

<table>
<tr><th>Mark</th><th>Grade</th></tr>
<tr><td>85—100</td><td>A</td></tr>
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</table>
</td></tr>
<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>
● Kerson Huang, Statistical mechanics, Wiley, 1987
● F. Reif, Fundamentals of Statistical and Thermal Physics thermodynamics, Kinetic Theory, and Statistical Thermodynamics, McGraw-Hill Book Company, 1985
</td></tr>
</table>

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website: www.physics.ui.ac.id

MODULE HANDBOOK

Module name	*Quantum Mechanics*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH602222
Subtitle, if applicable	Indonesian
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Adam Badra Cahaya
Lecturer	Dr. Adam Badra Cahaya Prof. Dr. Anto Sulaksono
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped class, problem-based learning
Teaching methods	Flipped classroom, interactive lecture, think pair share, self-study
Workload (incl. contact hours, self-study hours)	Lectures: 3x50 = 150 minutes per week Exercise and assignments: 3x60 = 180 minutes per week Independent study: 3x60 = 150 minutes per week
Credit points	3
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After taking this course, students are able to apply the basic concepts of quantum mechanics, quantum dynamics, angular momentum theory, symmetries in quantum mechanics, approximation methods, identical particles, and scattering theory, in the microscopic region.
Content	▪ Stern-Gerlach experimental analysis ▪ Dirac notation and matrix representation ▪ Wave equation ▪ Schrodinger equation ▪ Heisenberg representation ▪ Harmonic oscillator ▪ Feynman path integral ▪ Angular momentum theory

<table>
<tr><td></td><td>
▪ Translational Symmetry
▪ Space Inversion And Time Inversion
▪ Perturbation theory
▪ Hydrogen-like atoms
▪ Interaction with the radiation field
▪ Energy shift
▪ Permutation Symmetry
▪ Two electron system
▪ Helium atom
▪ Scattering theory
</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>
The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 25 %
Final test : 25 %
Individual assignment : 30 %
Group assignment : 20%
Total : 100 %
<table>
<tr><th>Mark</th><th>Grade</th></tr>
<tr><td>85—100</td><td>A</td></tr>
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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>
1. J.J. Sakurai, Modern Quantum Mechanics, Addison-Wesley, 1994
2. S. Gasiorowicz, Quantum Physics 3rd Ed., John Wiley & Sons, Inc., 2003.
3. N. Zettili, Quantum Mechanics Concepts and Applicatons, Wiley, 2009
</td></tr>
</table>

MODULE HANDBOOK

Module name	*Analytical Dynamics*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802202
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Handhika Satrio Ramadhan, S.Si., M.Sc., Ph.D.
Lecturer	Handhika Satrio Ramadhan, S.Si., M.Sc., Ph.D.
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	
Teaching methods	Lecture and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 3x50 = 150 minutes per week Exercise and assignments: 3x60 = 180 minutes per week Independent study: 3x60 = 150 minutes per week
Credit points	3
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After taking the course, students are able to apply Lagrangian and Hamiltonian formalism in analyzing classical dynamical systems, both relativistic and non-relativistic.
Content	• Review of Newtonian mechanics • D'Alembert's Principle • Least Action Principle • Euler-Lagrange Equation • Conservation theorem • Central force problem • Dynamics of multiparticle systems • Kinematics and dynamics of rigid body • Hamilton's equation • Jacobi-Hamilton theorem • Relativistics kinematics and dynamics • Covariant Lagrangian formulation
Study and examination	*The final score is the composition of mid-test scores,*

<table>
<tr>
<td>requirements and form of examination</td>
<td>quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

<table>
<tr><th>Mark</th><th>Grade</th></tr>
<tr><td>85—100</td><td>A</td></tr>
<tr><td>80—<85</td><td>A</td></tr>
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</tr>
<tr>
<td>Media employed</td>
<td>EMAS/EMAS2</td>
</tr>
<tr>
<td>Reading List</td>
<td>1. Goldstein, C. Poole, and J. Safko, Classical Mechanics, 3rd Ed, Addison Wesley, 2000.
2. L.D. Landau and E.M. Lifshitz, Mechanics, 3rd Ed., Butterworth-Heinenann, 2000.
3. W. Greiner, Classical Mechanics: Point Particles and Relativity, Springer, 1989.
4. W. Greiner, Classical Mechanics: Systems of Particles and Hamiltonian Dynamics, 2nd Ed., Springer, 2010.
5. A.L. Fetter and J.D. Walecka, Theoretical Mechanics of Particles and Continua, Dover Publications, New York, 2003.</td>
</tr>
</table>

MODULE HANDBOOK

Module name	*Measurement Method and Sensor Technology*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802311
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Santoso
Lecturer	Dr. Santoso
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Lecture and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to analyze and apply concepts and principles of the subject in the experiment and design instrumentation measurement system

Content	• Instrumentation measurement system • Noise and coherence in measurement • Physics principles in detecting stimulus • Measurement methods • Sensor technology • Actuator technology • Signal conditioning • Digital technique in measurement mechanism • Display and data processing
Study and examination requirements and form of examination	The final score is the composition of mid-test scores, quizzes, and assignments with the following weight: LTM-PK: 15 % LTM-PPT : 15% LTM-PK : 15% LTP-PPT : 15% Final-Test : 50% Total : 100 % **Mark** — **Grade** 85—100 — A 80—<85 — A 75—<80 — B+ 70—<75 — B 65—<70 — B 60—<65 — C+ 55—<60 — C 40—<55 — D <40 — E
Media employed	Powerpoint presentation (PPT), Microsoft Teams, e-Learning Management System (EMAS)
Reading List	1. Robert B. Northrop, Introduction to Instrumentation and Measurements, CRC Press, Taylor Francis Group, 2ed ,2005 2. Clarence W. De Silva., Sensors and Actuators - Control Systems Instrumentation, CRC Press, 2007. 3. Alan S Morris, Measurement and Instrumentation

	Principles, Butterworth-Heinemann, 2001. 4. Webster, John G., Measurement, Instrumentation and Sensors Handbook, CRC Press, 2ed 2014. 5. Fraden, J., GAIP Handbook of Modern Sensors, Physics, Designs and Applications, J American Institute of Physics, 2004. 6. Nathan Ida, Sensors, Actuators, and Their Interfaces, The Institution of Engineering and Technology, London, UK, 2ed , 2020 7. Beckwith, T. G. , Marangoni, R. D. dan J. H. Lienhard V, Mechanical Malan easurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements), Addison-Wesley Publishing Company, 6ed , 2006.

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website: www.physics.ui.ac.id

MODULE HANDBOOK

Module name	*Signal Processing*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802314
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Adhi Harmoko Saputro, Ph.D
Lecturer	Drs. Sastra Kusuma Wijaya, Ph.D
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Student centered learning and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	After receiving this course, students are expected ti be able to identify signal processing on instrument systems and analyze signal processing components on latest technologies
Content	▪ Discrete signal transformation ▪ Z-transformation ▪ Signal filtering ▪ Designing FIR and IIR system ▪ Adaptive filter ▪ Quantization and compression ▪ 2D signal processing ▪ Software and hardware signal processing
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %* *Final test : 30 %*

<table>
<tr><td></td><td>
Assignment : 40 %
Total : 100 %
<table>
<tr><th>Mark</th><th>Grade</th></tr>
<tr><td>85—100</td><td>A</td></tr>
<tr><td>80—<85</td><td>A</td></tr>
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<tr><td><40</td><td>E</td></tr>
</table>
</td></tr>
<tr><td>Media employed</td><td>Powerpoint presentation (PPT), Microsoft Teams, e-Learning Management System (EMAS)</td></tr>
<tr><td>Reading List</td><td>
1. Lizhe Tan, Jean Jiang, Digital Signal Processing,
2. Fundamentals and Applications 3 rd, Academic Press, 2019
3. Robert J. Schilling and Sandra L. Harris, Digital Signal Processing Using MATLAB® Third Edition, Cengage Learning, 2017
4. Vinay K. Ingle, John G. Proakis, Digital Signal Processing Using MATLAB® 4th Edition, Cengage Learning, 2015
5. Dimitris G. Manolakis, Vinay K. Ingle, Applied Digital Signal Processing, Cambridge University Press, 2011
6. Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, Digital Image Processing Using MATLAB, Gatesmark Publishing, 2009
</td></tr>
</table>

MODULE HANDBOOK

Module name	*Data Analysis*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802804
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Dr. Prawito Prajitno
Lecturer	Dr. Prawito Prajitno
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	
Teaching methods	Lecture and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 3x50 = 150 minutes per week Exercise and assignments: 3x60 = 180 minutes per week Independent study: 3x60 = 150 minutes per week
Credit points	3
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After the course, students are able to understand and apply data analysis and visualization methods to find information, patterns and relations in data.
Content	1. Introduction to data analysis: data transformation, cleaning, handling of missing data, exploring patterns and relations in data, visualization 2. Linear dimensionality reduction: principal component analysis (PCA), singular value decomposition (SVD), Fischer's linear discriminant, nearest neighbor approach, maximum likelihood approach 3. Nonlinear dimensionality reduction: multidimensional scaling, manifold learning, artificial neural network approach, stochastic

<table>
<tr><td></td><td>neighbor embedding;
4. Data inspection method: interpolation, projection, Posse chi-square index, moment index, independent component analysis (ICA)
5. Clustering: hierarchical, k-means, spectral, minimum spanning tree, model-based clustering;
6. Scatter plots refinement;
7. Cluster visualization;
8. Data distribution visualization;
9. Multivariate data visualization;
10. Categorical data visualization</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>1. W.L.Martinez, A.R.Martinez and J.L. Solka, Exploratory Data Analysis with Matlab, 3rd edition, CRC Press, 2017.
2. G.J.Myatt, W.P.Johnson, Making Sense of Data, 2nd edition, Wiley, 2007</td></tr>
</table>

MODULE HANDBOOK

Module name	*Structural Geology and Seismic Interpretation*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802511
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester`
Person responsible for the module	Dr. Ir. Agus Guntoro, M.Si
Lecturer	Dr. Ir. Agus Guntoro, M.Si
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Lecture and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to analyze basic concept of geologic structure and its relation to seismic reflection interpretation in oil and gas exploration.
Content	▪ Introduction to Some Basin Evolution & Structurization. ▪ Basic Geological Structural Understanding ▪ Reconnaissance Deformation of The Earth Crust, ▪ Basic Method and Principle of Seismic Interpretation. ▪ Petroleum Systems Elements and Seismic Analyses; ▪ Plays Concepts and Structural Geology
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:*

<table>
<tr><td></td><td>
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

<table>
<tr><th>Mark</th><th>Grade</th></tr>
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</td></tr>
<tr><td>Media employed</td><td>PowerPoint presentation (PPT), Microsoft e-Learning Management System (EMAS)</td></tr>
<tr><td>Reading List</td><td>
1. Davis, G. H. and Reynolds, S. J., 1996, Structural Geology of Rock and Regions : 2nd edition, John and Wiley and Sons, Inc., 776 p.
2. Fossen, H.,2010: Structural Geology: CAMBRIDGE UNIVERSITY PRESS
3. Keary, P., and Vine, F. J., 1990, Global Tectonics; Blackwell Scientific Pub.
4. Lowell, J. D., 1985, Structural Styles in Petroleum Exploration : OGCI Publication, 480 p
5. Park, R. G., 1988, Geological Structures and Moving Plates : Blackie, Glasgow and London, 337 p
6. Sharma, PV, 1990, Geophysical Methods in Geology, 2nd, Elsevier
7. Sheriff, RE, 1995, Encyclopedic Dictionary of Exploration Geophysics, 3th ed, SEG
8. Suppe, J., 1985, Principles of Structural Geology : Prentice-Hall, Inc., Englewood Cliffs, New Jersey, 537p
9. Telford, WM., Geldart, LPm, Sherriff, RE., 1990, Apllied Geophysics, 2nd ed, Cambridge University Press.
10. Twiss, R. J. and Moores, E. M., 1992, Structural Geology : W. H. Freeman and Company, New York, 532 p
</td></tr>
</table>

	11. Zhou, H.W.,2014. Practical Seismic Data Analysis. Cambridge University Press

MODULE HANDBOOK

Module name	*Oil Geology*
Module level, if applicable	*Graduate Program*
Code, if applicable	SCPH802504
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Waluyo Dr. Syahrizal
Lecturer	Dr. Waluyo Dr. Syahrizal
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped class and problem based learning
Teaching methods	Problem-based learning/Project-based learning, Collaborative learning/Active learning
Workload (incl. contact hours, self-study hours)	Lectures: 2x50 = 100 minutes per week Exercise and assignments: 2x60 = 120 minutes per week Independent study: 2x60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	▪ Applying physics or its application in solving work problems. ▪ Analyzing petroleum system problems which include reservoir characterization, source rock types and maturity processes, overburden, trapping systems and dynamic processes that occur as a condition for the accumulation of oil and gas in the reservoir.
Content	▪ Petroleum System ▪ Reservoir Migas ▪ Source Rocks/Batuan Sumber ▪ Oil print analysis and Seal Rocks ▪ Trapping Mechanism

<table>
<tr><td></td><td>▪ Structural and Stratigraphic traps
▪ Dynamic and Migration</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

<table><tr><th>Mark</th><th>Grade</th></tr><tr><td>85—100</td><td>A</td></tr><tr><td>80—<85</td><td>A</td></tr><tr><td>75—<80</td><td>B+</td></tr><tr><td>70—<75</td><td>B</td></tr><tr><td>65—<70</td><td>B</td></tr><tr><td>60—<65</td><td>C+</td></tr><tr><td>55—<60</td><td>C</td></tr><tr><td>40—<55</td><td>D</td></tr><tr><td><40</td><td>E</td></tr></table></td></tr>
<tr><td>Media employed</td><td>Microsoft Teams, Zoom Meeting, Google Meet</td></tr>
<tr><td>Reading List</td><td>1. Selley, R.C., Elements of Petroleum Geology, Academic Press inc., 1997.
2. North, F.K., Petroleum Geology, Routledge, 1985.
3. Journal and Proceeding Seminars.</td></tr>
</table>

MODULE HANDBOOK

Module name	*Sedimentology*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802506
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Nanang Muksin Halik
Lecturer	Dr. Nanang Muksin Halik
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped class and problem based learning
Teaching methods	Flipped classroom, interactive lecture, think pair share, self-study
Workload (incl. contact hours, self-study hours)	Lectures: 2x50 = 100 minutes per week Exercise and assignments: 2x60 = 120 minutes per week Independent study: 2x60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	▪ Applying physics or its application in solving work problems. ▪ After completing this course, students are expected to be able to correlate the basic concepts of sedimentology, the process of sedimentary rock formation, as well as analyzing and applying the interpretations of geophysical modeling
Content	▪ Preliminary which covers the understanding of sedimentary rocks, the importance of sedimentary rocks, the cycle of rock formation, weathering and types of weathering. ▪ Sediment transport which includes rocks cycle, hydrologic cycle, rock-forming minerals, rock types, genesis of sedimentary rock classification, sedimentation aspect, and mass movement fluid

<table>
<tr><td></td><td>dynamic.
▪ Sedimentary rock textures which include grain size, grain shape, grain fabric, roundness, provenance, textural maturity, grain size distribution, and textural components.
▪ Sandstone reservoir and porosity which includes reservoir rock types, porosity types, sedimentary rock permeability, the relationship between porosity, permeability, and texture, diagenetic process effects, reservoir continuity, and petroleum system.
▪ Sedimentary structure which includes current flow structure, deformational structure, biogenic structure, chemical structure.
▪ Depositional environment which includes continental environment, marginal marine environment, marine environment, sedimentary facies, facies model.</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
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<tr><td>Media employed</td><td>Video conference application.</td></tr>
<tr><td>Reading List</td><td>1. Boggs, S., Jr 1995, Principles of Sedimentology and Stratigraphy 2nd., Prentice hall, Inc.
2. Selley, R. C., 1992, Applied Sedimentology, Academic Press, 2nd printing.
3. Scholle, P. A., and Spearing, 1982, Sandstone Depositional Environment, The American</td></tr>
</table>

	Association of Petroleum Geologist.

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website: www.physics.ui.ac.id

MODULE HANDBOOK

Module name	*Seismic Data Processing and Interpretation*
Module level, if applicable	Graduate Program
Code, if applicable	
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st semester
Person responsible for the module	
Lecturer	
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Using MS Teams
Workload (incl. contact hours, self-study hours)	Lectures: 2 x 50 minutes per week Exercises and assignments: 2 x 60 = 120 minutes per week Independent study: 2 x 60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	1. Applications of analytical tools in seismic data processing to ensure data is processed using the method and/or the right technique so that the final result can be used optimally for qualitative and quantitative interpretation purposes.
Content	▪ Seismic Wave Propagation ▪ Seismic Data Recording ▪ Factors that Affect Amplitude ▪ Corrections ▪ Noise ▪ Frequency Filter ▪ Wavenumber Filter ▪ Tau-p

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<tr><td></td><td>
▪ Radon
▪ Anisotropy
▪ Speed and Analysis of Speed
▪ Time Domain Imaging
▪ Depth Domain Imaging
</td></tr>
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</td></tr>
<tr><td>Media employed</td><td></td></tr>
<tr><td>Reading List</td><td>Yilmaz, O., Seismic Data Analysis, Society of Exploration Geophysicsit, 2001</td></tr>
</table>

MODULE HANDBOOK

Module name	*Geothermal Systems & Technology*
Module level, if applicable	Graduate Program
Code, if applicable	SCOH802611
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Dr. Eng. Yunus Dipl.Geotherm.Tech., MSc
Lecturer	Dr. Eng. Yunus Dipl.Geotherm.Tech., MSc
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecturer Presentation and discussion
Workload (incl. contact hours, self-study hours)	Lectures: 3 x 50 minutes per week Exercises and assignments: 3 x 60 = 180 minutes per week Independent study: 3 x 60 = 180 minutes per week
Credit points	3
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	Identify and analyze geothermal systems, system type, manifestation, geothermal resources in Indonesia, exploration and exploitation technology, environmental aspects, and geothermal development regulation in Indonesia
Content	1. Definition of Geothermal Systems 2. Tectonic Plate and Geothermal Systems Formations 3. Types of Surface Manifestation of Geothermal Systems 4. Geothermal Energy Development Stages 5. Introduction to Geothermal Technology (Exploration, Production, Monitoring) 6. Introduction to Environmental Aspects in Geothermal Energy Development 7. Introduction to Regulation Aspects in Geothermal Energy Development

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<td>Reading List</td>
<td>
1. Harvey, C. And Beardsmore, G., Geothermal Exploration – Global Strategies and Applications, IGA Academy Books, 2016.
2. DiPippo, R., Geothermal Power Plants (2nd edition): Principles, Applications, Case Studies and Environmental Impact. Amazon, 2008.
3. Saptadji, N., Teknik Geotermal. Penerbit ITB, 2019.
</td>
</tr>
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MODULE HANDBOOK

Module name	*Geothermal Geology*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802602
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Dr. Raden Fajar Hendrasto, M. T.
Lecturer	Dr. Raden Fajar Hendrasto, M. T.
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecturer Presentation and Discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2 x 50 minutes per week Exercises and assignments: 2 x 60 = 120 minutes per week Independent study: 2 x 60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	Identify and analyze tectonic concept, volcanism, geothermal system formation, geological survey method for geothermal exploration: remote sensing analysis, field survey method, rock sample analysis, geological and structural maps, geothermal system geological modelling, and study case.
Content	▪ Concept of Tectonism and Vulcanism ▪ Geothermal System Formation ▪ Geological Survey Method for Geothermal Exploration ▪ Remote Sensing Method for Geothermal Exploration ▪ Geological Field Mapping Method (Structure and Lithology) ▪ Rock Sample Analyzing Methods in Geothermal Environment (XRD, Petrography, Fluid Inclusion, Age Dating)

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▪ Geological and Structural Mapping Formation in Geothermal Environment
▪ Geothermal System Geological Modelling Formation
▪ Role of Geology in Geothermal Drilling
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The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
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</table>
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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>
1. Harvey, C. And Beardsmore, G., Geothermal Exploration – Global Strategies and Applications, IGA Academy Books, 2016.
2. Boden, D.R., Geologic Fundamentals of Geothermal Energy. CRC Press, 2017.
3. Chandrashekaram, D., Low-Enthalpy Geothermal Resources for Power Generation, Taylor and Francis Group, 2008.
</td></tr>
</table>

MODULE HANDBOOK

Module name	*Geothermal Geochemistry*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802603
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Dr. Zainal Abidin
Lecturer	Dr. Zainal Abidin
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecturer Presentation and Discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2 x 50 minutes per week Exercises and assignments: 2 x 60 = 120 minutes per week Independent study: 2 x 60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	Identify and analyze the origin geothermal fluid, types and composition of geothermal fluids, liquid and gas sampling technique, and geochemical modelling of geothermal system.
Content	1. Basic Chemistry 2. Basic Geothermal Energy 3. Surface Manifestation 4. Liquid Geothermometer
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %* *Final test : 30 %* *Assignment : 40 %* *Total : 100 %*

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<tr><td>Reading List</td><td>1. Atkins, Peter, Julio De Paula, and James Keeler. 2017. Physical Chemistry. 11th ed. London, England: Oxford University Press.
2. Ellis, A. J., and W. A. J. Mahon. 1977. Chemistry and geothermal systems. New York: Academic Press. Marini L. 2000. Geochemical techniques for the exploration and exploitation of geothermal energy. Italy: University of Genua.
3. Giggenbach, W. F., and R. L. Goguel. 1989. Collection and analysis of geothermal and volcanic water and gas discharges. Petone, N.Z.: Chemistry Division, Dept. of Scientific and Industrial Research.
4. R.O. Fournier, 1991, Water geothermometers applied to geothermal energy: Center on Small Energy Resources.</td></tr>
</table>

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MODULE HANDBOOK

Module name	*Geothermal Geophysics 1*
Module level, if applicable	Graduate program
Code, if applicable	SCPH802608
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Dr. Eng. Yunus Dipl.Geotherm.Tech., M.Sc
Lecturer	Dr. Eng. Yunus Dipl.Geotherm.Tech., M.Sc
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecturer Presentation and Discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	Identify and analyze electrical properties of rocks, fundamental concepts of EM and MT technology Explain MT data processing, modeling and interpretation
Content	▪ Introduction to Geothermal Geophysics 1 ▪ Electrical properties of rocks ▪ Fundamental concept of EM ▪ Fundamental concept of MT technology ▪ MT Data Processing ▪ MT Data Modelling ▪ MT Data Interpretation
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %* *Final test : 30 %* *Assignment : 40 %*

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MODULE HANDBOOK

Module name	*Symmetry, Energy Bands, and Phonons*
Module level, if applicable	Graduate program
Code, if applicable	SCPH802112
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2
Person responsible for the module	Efta Yudiarsah, Ph.D.
Lecturer	Efta Yudiarsah, Ph.D.
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecturer Presentation and Discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	• Analyzing (C4) existing phenomena and related mechanisms underlying them, including the motion of electrons, periodic crystal lattice structures and vibrations, of atoms in solids.
Content	▪ Structure of Solid Materials (Introduction and Metal Drude Theory, Metal Sommerfeld Theory, Failure of the Free Electron Model, Crystal Lattice and Back Lattice, X-Ray Diffraction, Crystal Structure) ▪ Electronic Structure (Level of Electrons at Periodic Potential, Electrons at Weak Periodic Potential, Strongly Bound Methods, Other Band Calculation Methods) ▪ Mechanical Properties (Classification of Solid Materials and Cohesive Energy) ▪ Thermal Properties (Failure of Static Lattice Theory, Classical Theory of Harmonic Crystals, Quantum Crystal Harmonic Theory and Dispersion Relations, Anharmonity Effects in Crystals, Phonons in Metals)

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1. Neil W . Ashcroft dan N. David Mermin, Solid State Physics, Harcourt Inc, 1976.
2. C. Kittle, Introduction to Solid State Physics 8th Ed., Wiley, 2005.
3. R. Hook and H. E. Hall, Solid State Physics 2nd Ed., Wiley, 1991.
4. Michael P . Marder, Condensed Matter Physics. 2nd Ed, John Wiley, New Jersey, 2010.
5. Leonard M. Sander, Advanced Condensed Matter Physics, Cambridge University Press, 2009
</td>
</tr>
</table>

MODULE HANDBOOK

Module name	*Electromagnetism in Solids*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802803
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st semester
Person responsible for the module	Muhammad Aziz Majidi, S.Si., M.Si., Ph.D.
Lecturer	Muhammad Aziz Majidi, S.Si., M.Si., Ph.D.
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	
Teaching methods	Hybrid Method
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After the course, students are able to analyze the concepts of charge dynamics, fields, and electromagnetic waves which are commonly found in physical phenomena based on Maxwell's equations and its applications in the fields of Nuclear and Particle Physics, Condensed Matter Physics, Geophysics, Geothermal, Instrumentation, and Medical Physics.
Content	• Static electric and magnetic fields, including solving Poisson and Laplace equations with boundary conditions, static multi-pole expansion, and static electromagnetic properties of the medium. • Dynamics of charged particles and Maxwell's equations within them, including Faraday's law; the law of conservation of charge, energy, momentum, and angular momentum of systems of charged particles; and the electromagnetic properties of the medium.

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Electromagnetic waves: the nature of electromagnetic waves and their interaction with matter. Radiation of charged particle systems based on dynamic multi-polar expansion and moving charge radiation.
Relativistic formalism of electrodynamics, including Lagrangian and Hamiltonian for charged particle systems and electromagnetic fields.
Electromagnetic phenomena in the interaction of solar wind, geomagnetic and the emergence of telluric induced currents under the earth's surface.
Application of Maxwell's equations in Nuclear and Particle Physics, Condensed Matter, Geophysics, Geothermal, Instrumentation, and Medical Physics.

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Jackson, J. D., Classical Electrodynamics, 3rd Ed., John Wiley and Sons Inc., 1999.
Greiner, W, Classical Electrodynamics, Springer-Verlag New York Inc, 1998.

</td></tr>
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UNIVERSITAS INDONESIA
Faculty of Mathematics and Natural Sciences
Master Program of Physics

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MODULE HANDBOOK

Module name	*Advanced Spectroscopy*
Module level, if applicable	
Code, if applicable	SCPH802103
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2
Person responsible for the module	Prof. Dr.Techn. Djoko Triyono, S.Si., M.Si.
Lecturer	Prof. Dr.Techn. Djoko Triyono, S.Si., M.Si.
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	
Teaching methods	Interactive Lecture and Independent Learning
Workload (incl. contact hours, self-study hours)	Lectures: 3x50 = 150 minutes per week Exercise and assignments: 3x60 = 180 minutes per week Independent study: 3x60 = 180 minutes per week
Credit points	3
Requirements according to the examination regulations	
Recommended prerequisites	
Module objectives/intended learning outcomes	
Content	• Light interactions with matter and experimental methods • Rotational Spectroscopy • Vibrational Spectroscopy • Electronic Spectroscopy • Photoelectronic Spectroscopy • Laser Spectroscopy • Magnetic Spectroscopy • Electron Spin Resonance (ESR) • Nuclear Magnetic Resonance Spectroscopy • Mossbauer Spectroscopy • Thermal Analysis • Electron Microscope

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<td>Reading List</td>
<td>
1. M. Hollas, Modern Spectroscopy, 4th Ed., Wiley, 2004.
2. D. R. Vij, Handbook of Applied Solid State Spectroscopy, Springer, 2006.
3. G. Gaulitz and T. Vo-Dinh, Handbook of Spectroscopy, Wiley-VCH Verlag GmbH & Co, 2003.
</td>
</tr>
</table>

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MODULE HANDBOOK

Module name	*Special Topics*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802104
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	
Person responsible for the module	
Lecturer	
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	
Teaching methods	Interactive Lecture and Independent Learning
Workload (incl. contact hours, self-study hours)	Lectures: 3x50 = 150 minutes per week Exercise and assignments: 3x60 = 180 minutes per week Independent study: 3x60 = 180 minutes per week
Credit points	3
Requirements according to the examination regulations	
Recommended prerequisites	
Module objectives/intended learning outcomes	
Content	• Electronic Material Physics • Plasmonic • Photonic • Metamaterial • Strongly Correlated Electron System • Nanoscience • Mesoscopic System • Analytical and Numerical Methods, i.e., Green Function • Linear Response Theory • Static and Dynamic Mean Field Approaches
Study and examination requirements and form of examination	The final score is the composition of mid-test scores, quizzes, and assignments with the following weight: Mid-test : 30 %

<table>
<tr><td></td><td>Final test : 30 %
Assignment : 40 %
Total : 100 %

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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>1. Michele Cini, Topics and Methods in Condensed Matter Theory: From Basic Quantum Mechanics to the Frontiers of Research, Springer, 2007.</td></tr>
</table>

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MODULE HANDBOOK

Module name	*Angular Momentum Theory*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802203
Subtitle, if applicable	Indonesian
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Prof. Dr. Terry Mart
Lecturer	Prof. Dr. Terry Mart
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	
Teaching methods	
Workload (incl. contact hours, self-study hours)	Lectures: 2x50 = 100 minutes per week Exercise and assignments: 2x60 = 120 minutes per week Independent study: 2x60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	Students are able to derive relations in the theory of angular momentum and are able to apply them to physics problems which include quantum mechanics, nuclear physics, particle physics, and the physics of several bodies (few-body physics).
Content	• The definition of angular momentum • Commutation relations and commutator eigenvalues • Sum of two angular momentum • Definition of Clebsch-Gordan coefficients • Relations on Clebsch-Gordan coefficients • Calculation of Clebsch-Gordan coefficients • Symbols 3j, 6j, and 9j • Rotational operators and their orthogonality properties • Spherical harmonic functions • Irreducible tensors

<table>
<tr><td></td><td>

Wigner-Eckart theorem
Sum of two angular momentum
Racah coefficient
Maxwell's equations and multipole fields in spherical form
Static interactions and 1/2 spin interactions
Applications in nuclear systems and emission of alpha particles by the nucleus.

</td></tr>
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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>

M. E. Rose, Elementary Theory of Angular Momentum, Dover Books on Physics, reprint edition, 2011.
R. Edmonds, Angular Momentum in Quantum Mechanics, Princeton University Press,Reissue edition,1996.

</td></tr>
</table>

MODULE HANDBOOK

Module name	General Relativity and Intro to Astrophysics
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802205
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Prof. Dr. Drs. Anto Sulaksono M.Si.
Lecturer	Prof. Dr. Drs. Anto Sulaksono M.Si.
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Collaborative Learning/Active Learning
Workload (incl. contact hours, self-study hours)	Lectures: 3x50 = 150 minutes per week Exercise and assignments: 3x60 = 180 minutes per week Independent study: 3x60 = 180 minutes per week
Credit points	3
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	• Students are able to analyze spacetime based on General Relativity, Einstein field equations, interior and exterior solutions for spherically symmetric objects, and effects of slow rotation in compact objects. • Students are able to analyze interior and exterior properties of white dwarfs, neutron stars, black holes and its constituent matter.
Content	• Lorentz invariance • Tensors in curvilinear coordinates • Gravity • Covariance • Riemann tensor • Einstein field equations • Relativistic star • Slow rotation • Properties and composition of white dwarfs,

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<tr><td></td><td>neutron stars and black holes</td></tr>
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<tr><td>Media employed</td><td>EMAS/EMAS2, Microsoft Teams</td></tr>
<tr><td>Reading List</td><td>1. Norman K Glendenning, Compact Stars: Nuclear Physics, Particle Physics, and General Relativity, Springer International Publishing (1997)
2. P. Haensel, Neutron Stars 1: Equation of State and Structure, Springer International Publishing (2020)
3. Stuart L. Shapiro, Saul A. Teukolsky, Black Holes, White Dwarfs, and Neutron Stars, WILEY-VCH Verlag GmbH & Co. KGaA (2004)
4. Luciano Rezzolla, Pierre Pizzochero, David Ian Jones, Nanda Rea, Isaac Vidana, The Physics and Astrophysics of Neutron Stars. Springer International Publishing (2018)
5. Max Camenzind, Compact Objects in Astrophysics, Springer International Publishing (2007)</td></tr>
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MODULE HANDBOOK

Module name	*Relativistic Quantum Field Theory*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802204
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. rer. nat. Agus Salam S.Si., M.Si.
Lecturer	Dr. rer. nat. Agus Salam S.Si., M.Si.
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped class and problem-based learning
Teaching methods	Problem-based Learning/Project-based Learning/Collaborative Learning/Active Learning
Workload (incl. contact hours, self-study hours)	Lectures: 4x50 minutes per week Exercise and assignments: 4x60=240 minutes per week Independent study: 4x60=240 minutes per week
Credit points	4
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	1. Analyzing quantum phenomenon at high energy and the quantization of fundamental fields in order to be applied in solving nuclear and particle physics' problems. 2. Identifying and analyzing the quantization of non-relativistic String, electromagnetic field, interaction between radiation and matter, Klein-Gordon equation, Dirac equation, Second Quantization, and Interacting Field Theory.
Content	1. Preliminary 2. Quantization of the Nonrelativistic String 3. Quantization of the Electromagnetic Field 4. Interaction of Radiation with Matter 5. The Klein-Gordon Equation 6. The Dirac Equation 7. Second Quantization 8. Interacting Field Theories

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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>1. W. Greiner, Relativistic Quantum Mechanics: Wave Equations, Springer, 3rd edition, 2000.
2. L. Maiani and O. Benhar, Relativistic Quantum Mechanics, Routledge, 1 edition, 2015.
3. D. Bjorken and S.D. Drell, Relativistic Quantum Mechanics, McGraw-Hill, 1964.
4. Halzen and A. D. Martin, Quarks and Leptons, John Wiley & Sons, 1984.
5. Gross, Relativistic Quantum Mechanics and Field Theory, John Wiley & Sons, 1993.
6. J. R. Aitchison, Relativistic Quantum Mechanics, Macmillan, 1982.
7. J. R. Aitchison and A. J. G. Hey, Gauge Theories in Particle Physics, Adam Hilger, 1989.
8. Lahiri and P.B. Pal, A First Book of Quantum Field Theory, 2nd Ed., Alpha Science International Ltd., 2005.
9. Guidry, Gauge Field Theory: An Introduction with Applications, Wiley VCH Verlag GmbH, 2004.
10. Maggiore, A Modern Introduction to Quantum Field Theory, Oxford University Press, 2005.</td></tr>
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MODULE HANDBOOK

Module name	*Embedded Instrumentation*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802314
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Prawito Prajitno
Lecturer	Dr. Prawito Prajitno
Language	Indonesia
Relation to curriculum	Elective coursea
Type of teaching, contact hours	Problem-based learning
Teaching methods	Group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to apply embedded system concept as the main component in data acquisition and control system
Content	▪ Introduction to embedded system ▪ FPGA architecture in microcontrollers ▪ Basic VHDL commands ▪ Applied Finite State Machine (FSM) in FPGA ▪ ARM32 microcontroller's architecture and programming ▪ GPIO: Timer/Counter, RTC, Interrupt, and Power Management ▪ ADC and DAC ▪ Serial communication: UART, SPI, I2C
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %*

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Assignment : 40 %
Total : 100 %

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<tr><td>Media employed</td><td>Powerpoint presentation (PPT), Microsoft e-Learning Management System (EMAS)</td></tr>
<tr><td>Reading List</td><td>
1. Klei§, W., Digital Electronics, A Practical Approach with VHDL 9th ed, Pearson Publishing, 2012.
2. Pedroni,V.A., Circuit Design with VHDL, 3rd Ed, MIT Press, 2020.
3. Ünsalan,C., Gürhan,H.D, and Yücel,M.E., Embedded System Design with ARM Cortex-M Microcontroller, Springer, 2022.
4. Pakdel, M., Advanced Programming with STM32 Microcontrollers, Elektor International Media,
</td></tr>
</table>

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MODULE HANDBOOK

Module name	*Instrumentation System*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802313
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Santoso
Lecturer	Dr. Santoso
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Lecture and forum discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to analyze concepts and principles needed in one instrumentation system which applied on analytical instrument and recent lab on chips and lab in a phone technology through literature and scientific studies,

	critical analysis, and design development.
Content	• Elements of instrument system • Analytical instruments • Calibration techniques and instrument validation • Instruments system and analytical intelligence • Pc based analytical system instruments • MEMs based analytical system instruments • Optical instruments in spectrophotometer • Mass spectrometer • Radiation methods for spectrometry • Thermonalytics instruments • Microscopy instruments • Electrochemical instruments • Lab on chips technology • Lab on chips design • Smartphone instruments Lab in a phoinstrumentation sne
Study and examination requirements and form of examination	The final score is the composition of mid-test scores, quizzes, and assignments with the following weight: LTM-PK: 15 % LTM-PPT : 15% LTM-PK : 15% LTP-PPT : 15% Final-Test : 50% Total : 100 % Mark — Grade 85—100 — A 80—<85 — A 75—<80 — B+ 70—<75 — B 65—<70 — B 60—<65 — C+ 55—<60 — C 40—<55 — D <40 — E
Media employed	Powerpoint presentation (PPT), Microsoft Teams, e-Learning Management System (EMAS)
Reading List	1. Khandpur RS, Handbook of Analytical Instruments, Third Edition, McGraw Hill Education (India) Private Limited, 2015.

	2. Eugenio Iannone, Lab on Chips: Principle, Design and Technology, CRC Press, Taylor & Francis Group, 2015. 3. Abbas Jamalipour and Md Arafat Hossain, Smartphone Instrumentations for Public Health Safety, Springer Nature Switzerland AG, 2019

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MODULE HANDBOOK

Module name	*Virtual Instruments*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802314
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Drs. Sastra Kusuma Wijaya, Ph.D
Lecturer	Drs. Sastra Kusuma Wijaya, Ph.D
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to devise virtual instruments
Content	▪ Introduction to LabVIEW : subVI, loop structure, charts and graphs, IO files, mathscript RT, and measurement system analysis ▪ Data acquisition in USB6008/9, myDAQ, ELVIS III, myRIO ▪ Linx on arduino and raspberry PI ▪ Capacitance tomography with LabVIEW
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %* *Final test : 30 %* *Assignment : 40 %* *Total : 100 %*

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<tr><td>Media employed</td><td>Powerpoint presentation (PPT), Microsoft Teams, e-Learning Management System (EMAS)</td></tr>
<tr><td>Reading List</td><td>1. Bishop, R. H. (2015). Learning with LabVIEW. Upper Saddle River, New Jersey, Pearson.
2. Doering, E. (2016). NI myRIO Project Essentials Guide, National Instruments..
3. Singh, R., et al. (2017). Arduino-based embedded systems: interfacing, simulation, and LabVIEW GUI, CRC Press.
4. Silviu, F., Ed. (2011). LabVIEW-Practical Applications and Solutions. Rijeka, Croatia, InTech</td></tr>
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MODULE HANDBOOK

Module name	*Intelligence Instruments*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802315
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Adhi Harmoko Saputro, Ph.D
Lecturer	Adhi Harmoko Saputro, Ph.D
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Student centered learning and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to identify AI based instrument systems and analyze intelligence system components on latest technologies
Content	▪ Introduction of Intelligence Instrument ▪ Machine Learning for Regression ▪ Machine Learning for Classification ▪ Shallow Neural Network ▪ Deep Neural Network ▪ Expert System ▪ Pattern Recognition ▪ Application of AI in Intelligent Agents, Machine Vision and RoboticsSmart & Soft Sensing ▪ Self-Correction ▪ Indirect Sensing ▪ Multidimensional Intelligent Sensors

<table>
<tr><td></td><td>
▪ Prognostic Instrumentation using AI
▪ Fault Detection using AI
▪ Linearization using AI
▪ Smart Calibration
</td></tr>
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<tr><td>Reading List</td><td>
1. Bhuyan, Manabendra, Intelligent Instrumentation: Principles and Applications, CRC Press (2010)
2. Ameet V Joshi, Machine Learning and Artificial Intelligence, Springer International Publishing (2020)
3. Stuart J. Russell, Peter Norvig, Artificial Intelligence: A Modern Approach, Global Edition, Pearson (2021)
4. Charu C. Aggarwal, Neural Networks and Deep Learning, Springer International Publishing (2018)
5. Ethem Alpaydin, Introduction to Machine Learning, The MIT Press (2009)
6. K. R. Chowdhary, Fundamentals of Artificial Intelligence, Springer-Nature New York Inc (2020)
7. Ulisses Braga-Neto, Fundamentals of Pattern Recognition and Machine Learning, Springer (2020)
8. Ranjan Parekh, Fundamentals of Image, Audio, and
</td></tr>
</table>

	Video Processing Using MATLAB With Applications to Pattern Recognition, CRC Press (2021)

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MODULE HANDBOOK

Module name	*Image Processing*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802316
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Adhi Harmoko Saputro, Ph.D
Lecturer	
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Student centered learning and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to identify image processing on instrument systems and analyze algorithms and components on latest technologies
Content	▪ Image Representations and Pre-processing ▪ Segmentation ▪ Shape Representation and Description ▪ Object Recognition ▪ Image Understanding ▪ 3D Geometry and Vision ▪ Texture Analysis ▪ Motion Analysis ▪ Camera Systems in Machine Vision ▪ Machine Vision Algorithms ▪ Machine Vision Application
Study and examination	*The final score is the composition of mid-test scores,*

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<td>Media employed</td>
<td>Powerpoint presentation (PPT), Microsoft e-Learning Management System (EMAS)</td>
</tr>
<tr>
<td>Reading List</td>
<td>1. Milan Sonka, Vaclav Hlavac, Roger Boyle, Image Processing, Analysis, and Machine Vision, CL Engineering (2014)
2. Johan Pehcevski, Machine Vision and Image Recognition, Arcler Press (2020)
3. Hornberg, Alexander, Handbook of machine and computer vision; the guide for developers and users, Wiley VCH (2017)
4. Muthukumaran Malarvel, Machine Vision Inspection Systems, Machine Learning-Based Approaches, John Wiley & Sons (2021)</td>
</tr>
</table>

MODULE HANDBOOK

Module name	*Process Control*
Module level, if applicable	
Code, if applicable	
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	
Person responsible for the module	Dr. Arief Sudarmaji, MT
Lecturer	Dr. Arief Sudarmaji, MT
Language	Indonesian
Relation to curriculum	
Type of teaching, contact hours	
Teaching methods	Student centered learning and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to analyze problem in Process Dynamics and Control and implementing the concept to solve the problem in their work
Content	▪ *Dynamic Response Characteristics of More Complicated Processes* ▪ *Development of Empirical Models from Process Data* ▪ *Feedback Controllers* ▪ *Control System Instrumentation* ▪ *Process Safety and Process Control* ▪ *Dynamic Behavior and Stability of Closed-Loop Control Systems* ▪ *PID Controller Design, Tuning, and Troubleshooting* ▪ *Control Strategies at the Process Unit Level* ▪ *Frequency Response Analysis and Control System Design*

<table>
<tr><td></td><td>▪ Feedforward and Ratio Control</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

<table><tr><th>Mark</th><th>Grade</th></tr><tr><td>85—100</td><td>A</td></tr><tr><td>80—<85</td><td>A</td></tr><tr><td>75—<80</td><td>B+</td></tr><tr><td>70—<75</td><td>B</td></tr><tr><td>65—<70</td><td>B</td></tr><tr><td>60—<65</td><td>C+</td></tr><tr><td>55—<60</td><td>C</td></tr><tr><td>40—<55</td><td>D</td></tr><tr><td><40</td><td>E</td></tr></table></td></tr>
<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>1. Dale E. Seborg, Thomas F. Edgar, Duncan A. Mellichamp, Process Dynamics and Control [2 ed.], Wiley, 2010
2. Brian Roffel, Ben Betlem, Process Dynamics and Control: Modeling for Control and Prediction, Wiley, 2007
3. Babatunde A. Ogunnaike, W. Harmon Ray, Process Dynamics, Modeling, and Control, Oxford University Press, 2004
4. Ruben Gonzalez, Fei Qi, Biao Huang, Process Control System Fault Diagnosis: A Bayesian Approach, John Wiley & Sons, Ltd, 2016</td></tr>
</table>

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MODULE HANDBOOK

Module name	*Well Log Analysis and Formation Evaluation*
Module level, if applicable	
Code, if applicable	SCPH802502
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Ricky Adi Wibowo, S.T., M.Sc.
Lecturer	Dr. Ricky Adi Wibowo, S.T., M.Sc.
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Student centered learning and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to analyze an open well, explain the history of well log, determine the best log for application, and know the logging research in the future
Content	▪ Introduction to petrophysics logging ▪ SP Application ▪ Gamma rays ▪ Log's porosity and resistivity ▪ Log interpretation ▪ Log's quality control ▪ Lithology identification based on log techniques and mapping ▪ Computerized log analysis ▪ Log's special techniques and interpretation ▪ Advanced logging and its application
Study and examination	*The final score is the composition of mid-test scores,*

<table>
<tr>
<td>requirements and form of examination</td>
<td>quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

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<tr>
<td>Media employed</td>
<td>EMAS/EMAS2</td>
</tr>
<tr>
<td>Reading List</td>
<td>1. Asquith, D. A., Basic Well Log Analysis, AAPG, 1982.
2. Schlumberger, Log Interpretation Principle and Application, 1989.</td>
</tr>
</table>

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MODULE HANDBOOK

Module name	*Reservoir Engineering*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802503
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	1st Semester
Person responsible for the module	Dr. Ir. I Nengah Suabdi MT.
Lecturer	Dr. Ir. I Nengah Suabdi MT.
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped class and problem-based learning
Teaching methods	
Workload (incl. contact hours, self-study hours)	Lectures: 3x50 = 150 minutes per week Exercise and assignments: 3x60 = 180 minutes per week Independent study: 3x60 = 180 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	Basic Chemistry Basic Physics Mathematical Petrophysics
Module objectives/intended learning outcomes	▪ Knowing how to calculate custom to get variables that are used to calculate reserves such as Area (A), thickness (h), initial water saturation (Swi) and oil or gas formation volume factor (Boi, Bgi). ▪ Summarizes basic knowledge of reservoir science, fluid flow science in porous media. ▪ Using these reservoir variables to calculate volumetric reserves and material balance. ▪ Able to calculate the amount of oil and gas reserves from an exploration drilling result.
Content	▪ Studying the fluid properties of rocks such as how to calculate, and getting the variables such as: HC composition, specific gravity, viscosity, oil and gas formation volume factor, etc.

<table>
<tr><td></td><td>
▪ Knowing how to take fluid samples in exploration and exploitation wells.
▪ Determine the amount of fluid properties.
▪ Rock properties.
▪ DST/Well Testing.
▪ Gas Well Testing.
▪ Forecast and Production Decline Analysis.
▪ Acidizing and fracturing.
▪ Production optimization.
▪ Economics aspect.
</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>
The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
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Final test : 30 %
Assignment : 40 %
Total : 100 %
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</td></tr>
<tr><td>Media employed</td><td></td></tr>
<tr><td>Reading List</td><td>
1. L.P. Dake : Fundamental Reservoir Engineering
2. John Lee : Gas Reservoir Engineering
3. John Lee : Well Testing
4. Mc Cain : The Properties of Petroleum Fluids
5. B.C Craft and M. Hawkins : Applied Petroleum Reservoir Engineering
6. Boyun Gao : Petroleum Production Engineering_Elsevier 2007
7. Amyx : Petroleum Reservoir Engineering
8. Economides M and Hills A : Petroleum Production System
9. Heriot Watt University : Production Technology I and
</td></tr>
</table>

	II *10. Petro Skill : Well Test Design and Analysis.*

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MODULE HANDBOOK

Module name	*Seismic Stratigraphy and Sequence*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802505
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Ir. Agus Guntoro, M.Si
Lecturer	Dr. Ir. Agus Guntoro, M.Si
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Lecture and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to analyze vertical and lateral sediment changes in space and time coordinates and identify the applications in geologic exploration and development
Content	▪ Seismic stratigraphy and sequence ▪ Tectonic developments ▪ Fundamental of stratigraphy ▪ Applied stratigraphy in oil and gas industry ▪ Stratigraphy genetics, depositional stratigraphy, and TR Stratigraphy ▪ Sequence Stratigraphy applications in log-well analysis ▪ Sequence Stratigraphy applications in system tracks analysis ▪ Seismic principles and wave characteristics in Stratigraphy interpretation ▪ Seismic cross section analysis

<table>
<tr><td></td><td>

Seismic integration, well and Stratigraphy sequence
Facies seismic analysis in sedimentation model system
Seismic sequence analysis implementation in sedimentation model system
Seismic Stratigraphy application and implementation in hydrocarbon exploration
Integration, analysis, and seismic interpretation based on data and stratigraphy sequence

</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>
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<tr><td>Media employed</td><td>Powerpoint presentation (PPT), Microsoft e-Learning Management System (EMAS)</td></tr>
<tr><td>Reading List</td><td>

Bally, A.W., 1987: Atlas of Seismic Stratigraphy. AAPG Studies in Geology # 27, V1
Galloway, W.E., 1989: Genetic Stratigraphic Sequences in Basin Analysis I: Architecture and Genesis of Flooding-Surface Bounded Depositional. AAPG Bulletin 73(2)
Embry, A., 2009; Practical Sequence Stratigraphy
Embry, A., Johannessen, E., Owen, Donald, Beauchamp, B., Gianolla, P., 2007: Sequence Stratigraphy as a “Concrete” Stratigraphic. Report of the ISSC Task Group on Sequence Stratigraphy
Hunt, D., Tucker, M.E., 1992, Stranded parasequences and the forced regressive wedge systems tract: deposition during base-level fall.

</td></tr>
</table>

	Sedimentary Geology 81, 1–9 6. Kendal, C, G, C., 2008: Sequence Stratigraphy – Introduction. 7. Matenco, L.C., and Haq, B.U., 2020: Multi-scale depositional successions in tectonic settings. Earth-Science Reviews 200 (2020) 102991 8. Posamentier, H.W., Allen, P.G., James, D.P and Tesson, M., 1992: Force Regressions in a Sequence Stratigraphic 9. Framework: Concept, Example and Exploration Significance. AAPG Bulletin, V 6, No. 11 10. SEPM. 2002, Sequence Stratigraphic Framework. 11. Octavian, C., 2017: Sequence Stratigraphy: Guidelines for a Standard Methodology. University of Alberta, Edmonton, AB, Canada 12. Veeken, P.C.H., 2007: Seismic Stratigraphy, Basin Analyses and Reservoir Characterization. Handbook of geophysical Exploration. Volume 37

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MODULE HANDBOOK

Module name	*Geostatistics*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802507
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Chia-Hsin Charlie Wu, M.Sc., Ph.D.
Lecturer	Chia-Hsin Charlie Wu, M.Sc., Ph.D.
Language	Indonesian
Relation to curriculum	Compolsury Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecturer Presentation, Demo, and Discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2 x 50 minutes per week Exercises and assignments: 2 x 60 = 120 minutes per week Independent study: 2 x 60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	Explain the geostatistic konsep for oil reservoir characterization with dynamics and statics data integration.
Content	▪ Introduction & Regression Analysis ▪ Descriptive Statistics & Uncertainties ▪ Simple Statistical Methods for Reservoir Correlation ▪ Inferential Statistical Method: T and F Tests for Reservoir Correlations ▪ Monte Carlo Simulation ▪ Markov Chains & Applications ▪ Geostatistics & Reserves Booking ▪ Spatial Interpretation ▪ Semivariogram ▪ Kriging ▪ Ordinary and Indicator Kriging

<table>
<tr><td></td><td>▪ Sequential Gaussian Simulation
▪ Sequential Indicator Simulation</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
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<tr><td>Media employed</td><td></td></tr>
<tr><td>Reading List</td><td>1. Isaak, E. H. and R. M. Srivastava, An Introduction to Applied Geostatistics, Oxford University Press, New York, 1989.
2. Chiles J. and P. Delfiner, Geostatistics : Modeling Spatial Uncertainty, John Wiley & Sons, New York, 1999</td></tr>
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MODULE HANDBOOK

Module name	*Geopotential Method*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802509
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	M. Syamsu Rosid Ph.D
Lecturer	M. Syamsu Rosid Ph.D
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Student Center Learning, Presentation and Discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	Identify and analyze gravity method Identify and analyze magnetotelluric (MT) method
Content	▪ Gravity method ▪ Gravity instrumentation and acquisition ▪ Gravity data analysis ▪ Gradiometry and microgravity ▪ Geomagnetic exploration ▪ Geomagnetic instrumentation and acquisition ▪ Data analysis and interpretation ▪ Seismic transmission ▪ Vp, Vs, Poisson ratio analysis ▪ Microseismic, ANT, RF ▪ Magnetotelluric (MT) method ▪ MT parameter physical interpretation

<table>
<tr><td></td><td>▪ Applications in exploration</td></tr>
<tr><td>Study and examination requirements and form of examination</td><td>The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
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2. Udias, Agustin, 1999, Principles of Seismology, Cambridge University Press, UK.
3. Telford, W.M., Geldart, L.P. and Sheriff, R.E., 1990, Applied Geophysics, Cambridge University Press, New York.
4. Mussett, A.E. and Khan, M.A., 2000, Looking Into the Earth: An Introduction to Geological Geophysics, Cambridge University Press, Oct 23, 2000.</td></tr>
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MODULE HANDBOOK

Module name	*Geothermal Geophysics 2*
Module level, if applicable	Graduate program
Code, if applicable	SCPH802609
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	M. Syamsu Rosid Ph.D
Lecturer	M. Syamsu Rosid Ph.D
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecturer Presentation and Discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	Usage of gravity method and MEQ (microearthquake) in geothermal exploration
Content	1. Introduction 2. Concept of gravity exploration 3. Gravity instrument and acquisition 4. Gravity data processing 5. Gravity data analysis 6. Gradiometry and microgravity 7. Concept of seismic transmission/earthquake 8. Vp, Vs, Poisson Ratio analysis 9. Hypocenter, epicenter and magnitude of earthquake 10. b-Value analysis 11. Seismic tomography 12. Applications in exploration
Study and examination requirements and form of	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:*

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2. Udias, Agustin, 1999, Principles of Seismology, Cambridge University Press, UK.
3. Telford, W.M., Geldart, L.P. and Sheriff, R.E., 1990, Applied Geophysics, Cambridge University Press, New York.
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</td>
</tr>
</table>

MODULE HANDBOOK

Module name	*Geothermal Drilling*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802604
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Dr. Eng. Yunus Dipl.Geotherm.Tech., M.Sc
Lecturer	Dr. Eng. Yunus Dipl.Geotherm.Tech., M.Sc
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Presentation and Discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	Identify and analyze geothermal drilling strategies, prognosis, methods, instruments, and data analysis
Content	▪ Geothermal drilling strategies ▪ Drilling planning and prognosis ▪ Drilling design (casing and cementing) ▪ Drilling fluid ▪ Drilling tools ▪ Instrumentation and logging ▪ Drilling problem-solving ▪ Drilling data analysis
Study and examination requirements and form of examination	*The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:* *Mid-test : 30 %* *Final test : 30 %* *Assignment : 40 %* *Total : 100 %*

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<tr><td>Media employed</td><td>EMAS/EMAS2</td></tr>
<tr><td>Reading List</td><td>
1. Finger, J. and Blankenship, D., Handbook of Best Practices for Geothermal Drilling, Sandia National Laboratories, 2010.
2. DiPippo, R., Geothermal Power Plants (2nd edition): Principles, Applications, Case Studies and Environmental Impact. Amazon, 2008.
3. Watson, A., Geothermal Engineering: Fundamentals and Applications. Springer, 2014.
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MODULE HANDBOOK

Module name	*Geothermal Reservoir Engineering*
Module level, if applicable	Postgraduate program
Code, if applicable	SCPH802605
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Dr. Jatmiko Prio Atmojo Ir. Riza Passiki, M.Si
Lecturer	Dr. Jatmiko Prio Atmojo Ir. Riza Passiki, M.Si
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped Class and Problem-based learning
Teaching methods	Lecture and group discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week Independent study: 2x60=120 minutes per week
Credit points	2 credit points
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	After receiving this course, students are expected to be able to identify model concept, character, and parameter of one geothermal reservoir along with its fluid thermodynamics' behavior
Content	▪ Overview of Geothermal System ▪ Fluid Flow in the Reservoir ▪ Estimation of Resource, Reserve and Electricity Potential ▪ Pressure Transient Analysis ▪ Reinjection ▪ Changes within the Reservoir Under Exploitation ▪ Reservoir Modelling & Simulation

<table>
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The final score is the composition of mid-test scores, quizzes, and assignments with the following weight:
Mid-test : 30 %
Final test : 30 %
Assignment : 40 %
Total : 100 %

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<tr>
<td>Media employed</td>
<td>Powerpoint presentation (PPT), Microsoft e-Learning Management System (EMAS)</td>
</tr>
<tr>
<td>Reading List</td>
<td>
1. Grant, M.A., Donaldson I.G., Bixley P.F (1982): Geothermal Reservoir Engineering, Academic Press, 369 pp.
2. D'Sullivan M.J & McKibbin R. (1989) : Geothermal Reservoir Engineering, a Manual for Geothermal Reservoir
3. Engineering Course at the Geothermal Institute – University of Auckland.
4. McGuinness, M. (1996): Interference Testing, Lecture Notes, Geothermal Institute - University of Auckland.
5. Grant, M. (1996): Geothermal Resource Management, Geothermal Energy New Zealand Limited, 131 pp
6. Handbook of Geothermal Energy,Editors: Edwards, L.M., Chilingar, G.V. et al. , Gulf Publishing Company, 1982, 6
7. Bodvarsson G.S. and Whiterspoon P.A. (1989): Geothermal Reservoir Engineering, Geotherm. Sci. & Tech., Volum2(1) pp. 1-68.
8. Sanyal, K.S. (2005): Geothermal Resource Characteristics, Development, Assessment and Management, Course Material of the 2005 World
</td>
</tr>
</table>

	Geothermal Conference. 9. Nenny Miryani Saptadji (2001): Teknik Reservoir Panas Bumi, Diktat Kuliah TM-ITB 10. O'Sullivan, M.J. (1987) Geothermal Reservoir Simulation. Applied Geothermics, John Wiley & Sons, Ltd., 111124. 11. DiPippo, R. (2008):Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact, Elsevier, Second Edition, 493 pp

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website: www.physics.ui.ac.id

MODULE HANDBOOK

Module name	*Geothermal Prospect Evaluation*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802606
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd semester
Person responsible for the module	Dr. Eng. Yunus Dipl.Geotherm.Tech., M.Sc
Lecturer	Dr. Eng. Yunus Dipl.Geotherm.Tech., M.Sc
Language	Indonesian
Relation to curriculum	Elective Course
Type of teaching, contact hours	Flipped Class and Problem-Based Learning
Teaching methods	Lecturer presentation and discussion
Workload (incl. contact hours, self-study hours)	Lectures: 2x50=100 minutes per week Exercise and assignments: 2x60=120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	
Module objectives/intended learning outcomes	Identify and analyze geothermal prospects from technical (exploration technology and drilling strategy), economic and environmental aspects
Content	▪ Strategic concept of geothermal prospects evaluation ▪ Technical aspects of geothermal prospects evaluation (geology, geochemistry, geophysics) ▪ Development of conceptual model of geothermal system and delimitation of prospect area ▪ Strategy for determining geothermal exploration drilling locations ▪ Calculation of potential geothermal energy resources and reserves ▪ Economic aspects in geothermal prospects evaluation ▪ Environmental aspects in geothermal prospects evaluation
Study and examination	*The final score is the composition of mid-test scores,*

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<td>Reading List</td>
<td>1. Harvey, C. And Beardsmore, G., Best Practices Guide for Geothermal Exploration, Sandia IGA Academy Book, 2014.
2. DiPippo, R., Geothermal Power Plants (2nd edition): Principles, Applications, Case Studies and Environmental Impact. Amazon, 2008.
3. Harvey, C. And Beardsmore, G., Geothermal Exploration – Global Strategies and Applications, IGA Academy Books, 2016.</td>
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MODULE HANDBOOK

Module name	*Geothermal Economics & Management*
Module level, if applicable	Graduate Program
Code, if applicable	SCPH802607
Subtitle, if applicable	
Courses, if applicable	
Semester(s) in which the module is taught	2nd Semester
Person responsible for the module	Surya Darma, Ph.D., Dipl. Geotherm. Tech.
Lecturer	Surya Darma, Ph.D., Dipl. Geotherm. Tech.
Language	Indonesian
Relation to curriculum	Elective course
Type of teaching, contact hours	Flipped class and problem based learning
Teaching methods	Student center learning, case study learning
Workload (incl. contact hours, self-study hours)	Lectures: 2x50 = 100 minutes per week Exercise and assignments: 2x60 = 120 minutes per week Independent study: 2x60 = 120 minutes per week
Credit points	2
Requirements according to the examination regulations	A student must have attended at least 75% of the lectures to sit in the exam
Recommended prerequisites	-
Module objectives/intended learning outcomes	▪ Able to apply management science and engineering economics as well as the application of analysis in carrying out activities and business development and utilization of geothermal energy in the work environment in the geothermal field. ▪ Able to identify geothermal business systems based on project management and analyze the economics of geothermal businesses on various geothermal systems and technologies.
Content	▪ Preliminary: Teaching concept ▪ Business, regulation, and management concepts. ▪ Management. ▪ Decision making process in management. ▪ Organization and organizational work relations. ▪ Project management in the form of Gant Chart—Bar Chart.

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▪ Managing projects.
▪ Engineering economics.
▪ Geothermal economic analysis.
▪ Project feasibility analysis (feasibility study).
▪ Analysis method.
▪ Functions of project financing components (direct costs, overhead, etc.).
▪ What is the geothermal investment climate?
▪ Geothermal investment risk analysis.
▪ Analysis and key determinants of geothermal electricity prices.
▪ Calculating geothermal economics.
▪ Effect of risk factors on geothermal economy.
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<tr><td>Reading List</td><td>
Required:
1. Mary H. Dickson and Mario Fanelli, 2004: What is Geothermal Energy, Istituto di Geoscienze e Georisorse, CNR , Pisa, Italy.
2. ARMSTEAD, H.C.H., 1983. Geothermal Energy. E. & F. N. Spon, London, 404 pp.
3. BROWN, K. L., 2000. Impacts on the physical environment. In: Brown, K.L., ed., Environmental Safety and Health Issues in Geothermal Development, WGC 2000 Short Courses, Japan,
</td></tr>
</table>

43—56.

4. Widjajono Partowidagdo, 2009: Migas dan Energi di Indonesia, Permasalahan dan Analisis Kebijakan, Development Studies Foundation, Pertamina, Jakarta.
5. Panasbumi: Energi Kini dan Masa Depan, Asosiasi Panas Bumi Indonesia – 2004, 232 hal.
6. Iman Soeharto (1995): Manajemen Proyek: Dari konseptual sampai Operasional, Penerbit Erlangga, 755 hal.
7. Ministry of Planning, 2014: Geothermal Handbook, for Indonesia
8. GeothermEx Inc., 2010. An Assessment Of Geothermal Resource Risks in Indonesia, [Online],
9. www.ppiaf.org/.../REPORT_Risk_Mitigation_Options_Indonesia.pdf.
10. Mansyur, 2010: Manajemen Pembiayaan Proyek, LaksBang Pressindo, Yogyakarta.
11. UU No.27 Tahun 2003 dan UU No.21/2014 tentang Panas bumi, PP59 Tahun 2007 serta UU No. 30 Tahun 2007 tentang Energi.
12. DiPippo, R. (2016): Geothermal Power Generation: Development and Innovation, Elsevier, First Edition, 822 pp
13. Surya Darma, (2022): Manajemen Proyek dan Keekonomian Geotermal – Best Practice Dalam Pengusahaan Panas bumi, Jakarta.

Addition:

1. AXELSSON, G. and GUNNLAUGSSON, E., 2000. Background: Geothermal utilization, management and monitoring. In: Long-term monitoring of high- and low enthalpy fields under exploitation, WGC 2000 Short Courses, Japan, 3-10
2. Amin Widjaja Tunggal, 2009: Pokok-pokok Manajemen Operasi, Meningkatkan Produktivitas dan Daya Saing Organisasi, Harvarindo, Jakarta.
3. DiPippo, R. (2008): Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact, Elsevier, Second Edition, 493 pp
4. Bromley, C.J. (2005): Advances in Environmental Management of Geothermal Developments, Proc. of 2005 , World Geothermal Congress 2005, Paper No. 0236, International Geothermal Association, Antalya-Turkey.
5. Geothermal Energy Association (GEA), 2009. Geothermal Energy and Induced Seismicity, Issue

Brief.

6. Hidayat, S. dan Maranatha Wijayanigtyas (2019). Manajemen Konstruksi Dalam Perspektif Administrasi Pembangunan dan Pemasaran (PDF). Surabaya: PT Muara Karya. hlm. 36. ISBN 978-602-53690-9-4.
7. Husnan, S., & Muhammad, S., 2000: Studi Kelayakan Proyek, UPP STIM YKPN, Yogyakarta, Edisi Keempat.
8. www.geoenergy.org/pdf/Geothermal_Energy_and _Induced_Seismicity_Issue_Brief.pdf.
9. U.S. Department of Energy, 2005. Factors Affecting Costs of Geothermal Power Development
10. Wahjosoedibjo, Anton, et al, 2012. Geothermal Fund for Hastening the Development of Indonesia's Geothermal Resources, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 30 – February 1, 2012.
11. https://www.blj.co.id/2015/04/15/lima-pendapat-p eter-drucker-untuk-manajemen/.
12. Peter Drucker – Wikipedia https://www.shortform.com/summary/the-7-habits -of-highly-effective-people-summary-stephen-cove y?gclid=CjwKCAjwi6WSBhA-EiwA6Niok9ZmT 5vqg43-o4GEQF4-S-UoIEZwa27HmxOz-IhlLPf QawVHnsl8uBoCGWEQAvD_BwE.
13. https://tomps.id/gantt-chart-manajemen-proyek-pe ngertian-manfaat-dan-cara-termudah-membuatny a/.

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Veritas, Probitas, Iustitia

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