MODUL HANDBOOK

Ma Biophysics

DEPARTEMENT OF PHYSICS
FACULTY OF MATHEMATICS & NATURAL SCIENCES
IPB UNIVERSITY
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Foreword

We extend our utmost gratitude to God Almighty for His blessings and guidance, which have enabled the successful compilation and publication of this Module Handbook for the Master's Degree in Biophysics Program. This handbook has been developed as a resource for students, lecturers, and other stakeholders to support the academic process in the Master's Degree in Biophysics Program at IPB University.

This handbook is structured to align with the Program Educational Objectives (PEO) and Program Learning Outcomes (PLO) of the Master's Degree in Biophysics Program. It has been prepared based on the most recent curriculum, adhering to the Indonesian National Qualification Framework (KKNI) and national higher education quality standards. Each module provides clear learning objectives, course descriptions, key topics, teaching strategies, and evaluation methods, all designed to help achieve the expected graduate competencies.

We hope that this handbook serves as a practical guide for lecturers in planning and executing an effective and efficient teaching process. For students, it is expected to clarify the goals and framework of each course, enabling them to plan their studies more strategically and effectively.

We express our heartfelt appreciation to all individuals and teams who contributed to the preparation of this handbook, including faculty members, administrative staff, and the leadership team of the Master's Degree in Biophysics Program. Constructive feedback and suggestions for further improvement of this handbook are highly welcomed and valued.

In conclusion, we hope that this handbook will provide significant benefits to enhance the quality of education within the Master's Degree in Biophysics Program and support the achievement of skilled and capable graduates in the field of biophysics

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Module Handbook – Biophysics Research Methods

Module designation	***Biophysics Research Methods***
Semester(s) in which the module is taught	*1st (first)*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*Common course (CC) in the first year (1st semester) Master's Degree*
Teaching methods	*Small Group Discussion, Role-Play & Simulation, Discovery Learning, Self-Directed Learning, Cooperative Learning, Collaborative Learning, Contextual Learning, Project Based Learning, and other equivalent methods*
Workload (incl. contact hours, self-study hours)	*Total workload is 119 hours per semester, which consists of 150 minutes lectures per week, 180 minutes structured activities per week, 180 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*3 SCH x (1.5) = 4.5 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	*1. Students are able to analyze the characteristics of research that meets scientific principles* *2. Students are able to apply scientific principles in designing research stages* *3. Students are able to apply scientific principles in analyzing and concluding research results* *4. Students have proficiency in scientific writing and presentation techniques as a means of disseminating research findings*

Content	*Philosophy of science and ethical principles in research and scientific publications, Characteristics of research according to scientific principles, Techniques for preparing research proposals, Techniques for data collection, analysis, and drawing conclusions, Stereotypes of scientific publications, Linguistics, numbers, symbols, terms, and scientific nomenclature, Illustration and citing literature and techniques for compiling a bibliography, English grammar in the preparation of international scientific publications, best practice in selecting journals, scientific presentation techniques*
Examination forms	*Problem based project*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (60%), mid semester exam (20%), and end semester exam (20%)*
Reading list	*1. Tim IPB. Pedoman Penulisan Karya Ilmiah Tugas Akhir Mahasiswa.. Edisi ke-4. IPB Press. 2019.* *2. Novikov, M.A, and Novikov, D.A. Research Methodology: From Philosophy of Science to Research Design. CRC Press. US. 2013*

Module Handbook – Orbital and Molecular Quantum Theory

Module designation	***Orbital and Molecular Quantum Theory***
Semester(s) in which the module is taught	*1st (first)*
Person responsible for the module	*Dr. rer.nat Hendradi Hardhienata*
Language	*Bahasa Indonesia*
Relation to curriculum	*Foundational Course (ACC) in the first year (1st semester) Master's Degree*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	1. *Students are able to understand quantum postulates and problems in wave function interpretation.* 2. *Students are able to analyze and solve quantum problems involving 1 D potential.* 3. *Students are able to apply quantum mechanical concepts to the interaction of light and matter and its applications in biophysics such as material characterization using spectroscopy or bioimaging.* 4. *Students are mastering basic knowledge and theory about orbital and molecular theory, especially the formation of hybridization levels.*

Content	*History of quantum physics, quantum postulates related to state functions, operators in quantum physics, quantum dynamics equations, hydrogen atomic theory, quantum harmonic oscillator, molecular orbital theory, interaction of metal molecules, quantum dot.*
Examination forms	*written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30), mid semester exam (35%), and end semester exam (35%)*
Reading list	*1. Blinder, S.M. Introduction to Quantum Mechanics: in Chemistry, Materials Science, and Biology. Academic Press. 2004* *2. Hardhienata, H. Tutorial Mekanika Kuantum, LIPI Repository. 2014.* *3. Griffiths, D.J. Introduction to Quantum Mechanics. Benjamin Cummings. 2004*

Module Handbook – Thermal Biophysics

Module designation	***Thermal Biophysics***
Semester(s) in which the module is taught	*1st (first)*
Personresponsible for the module	*Prof. Dr. Ir. Irzaman, M.Si*
Language	*Bahasa Indonesia*
Relation to curriculum	*Foundational Course (FC) in the first year (1st semester) Master's Degree*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	1. *Students are able to develop basic knowledge and theory regarding energy transformation in biological systems.* 2. *Students are able to develop basic knowledge and theory about the 1st and 2nd laws of thermodynamics in biological systems.* 3. *Students are able to identify applications of Gibbs free energy in biological cases.* 4. *Students are able to analyze static thermodynamics in biological*

	cases. 5. *Students are able to identify binding equilibria and reaction kinetics in biological cases.* 6. *Students are able to identify the application of current knowledge of biological thermodynamics in differential scanning calorimetry (DSC) tools and the application of information theory knowledge to biological cases.*
Content	*Energy transformations, first law of thermodynamics, second law of thermodynamics, Gibbs free energy theory, applications of Gibbs free energy, statistical thermodynamics, binding equilibrium, reaction kinetics, current knowledge of biological thermodynamics (Information Theory)*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	1. *Haynie, D.T. Biological Thermodynamics.2nd Ed. Cambridge University Press. 2016.* 2. *Sears, F.W. and. Salinger, G.L. Thermodynamics, kinetic and statistical mechanics. Addison-Wesley Publishing Co, Inc. 1975.* 3. *Gill, P, Moghadam, T.T, and Ranjbar, B. Differential Scanning Calorimetry Techniques: Applications in Biology and Nanoscience. Journal of Biomolecular Techniques 21:167–193. 2010.*

Module Handbook – Bioelectromagnetism

Module designation	***Bioelectromagnetism***
Semester(s) in which the module is taught	*1st (first)*
Person responsible for the module	*Dr. Agus Kartono, M.Si*
Language	*Bahasa Indonesia*
Relation to curriculum	*Foundational course (FC) in the first year (1st semester) Master's Degree*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	*1. Students are able to explain the basics of electricity and magnetism as an introduction to bioelectromagnetism* *2. Students are able to explain the electrical properties in nerve cells (neuron cells).* *3. Students are able to explain the wiring equation derived from the Hodgkin-Huxley neuron model.* *4. Students are able to explain the mechanical and electrical properties of the cardiac cycle.* *5. Students are able to explain techniques for monitoring nerve cell activity using the fluorescence method.* *6. Students are able to explain optogenetic concepts and techniques.* *7. Students are able to explain the latest research on monitoring the electrical properties of nerve cells.*

Content	*Introduction to Bioelectromagnetism, electrical properties of Nerve Cells (Neuron Cells), wiring equations (Hodgkin - Huxley neuron model), mechanics and electricity of the cardiac cycle, basic principles and applications of fluorescence sensing, basic concepts and techniques in optogenetics, research capita on monitoring the electrical activity of nerve cells*
Examination forms	*Written exam, project based*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (20%), and project-based (50%)*
Reading list	*1. Malmivuo, J, Plonsey, R. Bioelectromagnetism: Principles and Applications of Bioelectric and Biomagnetic Fields, Oxford University Press. 1995* *2. Ueno, S, Shigemitsu, T. Bioelectromagnetism: History, Foundations and Applications. 1st edition. CRC Press. 2022*

Module Handbook – Membrane and Cell Biophysics

Module designation	***Membrane and Cell Biophysics***
Semester(s) in which the module is taught	*2nd (second)*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*Academic core course (ACC) in the second year (2nd semester) Master's Degree*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	*1. Students are able to analyze basic biophysical concepts that o incur natural and artificial membranes.* *2. Students are able to understand various phenomena and application of biophysical theory that occur in membranes.* *3. Students are able to develop knowledge of membrane biophysics based on current research studies.*
Content	*Development of membrane technology, cell structure and function, models, properties and function of cell membranes, membrane transport, membrane machines, membrane bioelectricity, artificial membranes, membrane filtration processes, membrane synthesis, membrane characterization, membrane applications*
Examination forms	*Written exam*

Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	*1. Baker, R.W. Membrane Technology and application. 2nd Edition. John Wiley & Sons Ltd West Sussex, England. 2004.*

Module Handbook – Biocompatible Material

Module designation	***Biocompatible Material***
Semester(s) in which the module is taught	*2nd (second)*
Person responsible for the module	*Dr. Yessie Widya Sari*
Language	*Bahasa Indonesia*
Relation to curriculum	*Academic Common course (ACC) in the second year (2nd semester)* *Master's Degree*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*

Module objectives/intended learning outcomes	1. *Students are able to understand lecture contracts and the scope of biocompatible materials.* 2. *Students are able to detail the basic properties of materials.* 3. *Students are able to apply the concept of electronic materials as biocompatible materials.* 4. *Students are able to apply the concept of metal materials as biocompatible materials.* 5. *Students are able to apply the concept of polymer materials as biocompatible materials.* 6. *Students are able to apply the concept of ceramic materials as biocompatible materials.* 7. *Students are able to apply the concept of composite materials as biocompatible materials.* 8. *Students are able to analyze material characteristics of biocompatible materials.* 9. *Students are able to apply sterilization concepts to biocompatible materials.* 10. *Students are able to apply the concept of cell - biomaterial interactions to biocompatible materials.* 11. *Students are able to apply the drug delivery system concept.* 12. *Students are able to apply the concept of tissue engineering as a biocompatible material.* 13. *Students are able to apply the concept of biocompatible materials to various clinical applications.* 14. *Students are able to integrate basic concepts of biocompatible materials in various clinical case examples.*
Content	*Scope of biocompatible materials, basic properties of materials, electronic materials as biocompatible materials, metal materials as biocompatible materials, polymer materials as biocompatible materials, ceramic materials as biocompatible materials.*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*

Reading list	1. *Agrawal, C.M, Ong, J.L, Appleford, M.R, Mani, G. Introduction to Biomaterials: Basic Theory with Engineering Applications , 1st Edition, Cambridge University Press. 2013* 2. *Clement, C. Brain-Computer Interface Technologies: Accelerating Neuro-Technology for Human Benefit. 1st edition, Springer International Publishing. 2019* 3. *Sari, Y.W., Asisyah, N., Saputra, A., Abdurrahman B. Pengantar Biomaterial Untuk Kesehatan. PT Penerbit IPB Press. 2021*

Module Handbook – Biophysics and Complexity

Module designation	***Biophysics and Complexity***
Semester(s) in which the module is taught	*2nd (second)*
Person responsible for the module	*Prof. Dr. Husin Alatas*
Language	*Bahasa Indonesia*
Relation to curriculum	*Academic Common course (ACC) in the second year (2nd semester) Master's Degree*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*

Module objectives/intended learning outcomes	1. *Students can understand the importance of the complexity paradigm in reviewing physics and biology.* 2. *Students can understand and master the basic principles of networks and their applications in simple problems.* 3. *Students can understand and master important concepts in the formulation of statistical physics and thermodynamics, which can be used to understand the dynamics of complex systems.* 4. *Students can understand and master the human body and brain as a complex system.* 5. *Students can understand phenomena and master concepts related to complexity and emerging phenomena in biomolecules.* 6. *Students can understand phenomena and master concepts related to complex symptoms related to the biological functions of biomolecules (macromolecules).* 7. *Students can understand phenomena and master concepts related to dynamics and self-organization in living things, especially those related to health and disease.*
Content	*Basics of networking; important parameters in the network; Kinds of network and its classification; Micro and macro state of the system; Probability of the state of the system; Complex system entropy; The human body and brain as a complex system; The phenomenon of protein folding-unfolding and the Levinthal paradox; The principle of minimum energy and folding*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	1. *Turner, S, Hanel, R, Klimek, P. Introduction to the Theory of Complex Systems. Oxford University Press. 2018.* 2. *On the Dynamics of Self-Organization in Living Organisms https://www.tandfonline.com/doi/abs/10.1080/15368370802708272?journalCode=iebm20*

Module Handbook – Research Proposal

Module designation	***Research Proposal***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*Compulsory in the final year master's degree*
Teaching methods	*90 minutes structured activities per week, 90 minutes individual study per week*
Workload (incl. contact hours, self-study hours)	*Total workload is 90 hours per semester, which consists of 180 minutes structured activities per week, 180 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.67) = 3.34 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	*Students are able to write a research proposal that will be carried out as part of the final project properly and in accordance with scientific principles.*
Content	*1. Students design the research to be carried out in consultation with the supervisor* *2. Students write a research plan in the form of a proposal according to the rules of scientific writing adopted by IPB*
Examination forms	*Project based learning*
Study and examination requirements	*Students send a draft proposal that is based on standard scientific writing rules, then the study program will assess the feasibility of the proposal in terms of writing structure, content, depth of discussion, references and others.*
Reading list	*Main :* *Scientific journals* *Supporters :* *Textbook* *Related Resources*

Module Handbook – Colloquium

Module designation	***Colloquium***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*Compulsory in the final year master's degree*
Teaching methods	*90 minutes structured activities per week, 90 minutes individual study per week*
Workload (incl. contact hours, self-study hours)	*Total workload is 45 hours per semester, which consists of 90 minutes structured activities per week, 90 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*1 SCH x (1.67) = 1.67 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	*1. Students have the ability to put forward the substance and problems that will be the subject of thesis research through a scientific communication forum.* *2. Students can improve their scientific insight*
Content	*In this course, students make research proposals for the final project and present them in front of supervisors, examiners, and other fellow students. The review of the examiners and feedback from the ongoing discussion will be used to refine the student's research activity plan and final project.*
Examination forms	*Project based learning*
Study and examination requirements	*1. Systematics and writing techniques according to guidelines* *2. Introduction (title, problem formulation, objectives) and research hypothesis* *3. Substance* *4. Presentation of the research plan* *5. Discussion of the research plan (State of the Art, Research Objectives, Research Methods, Foundations of Physics Theory)*
Reading list	*Main :* *PPKI IPB edisi IV 2019* *Scientific journal* *Supporters :* *Textbook* *Related Resources*

Module Handbook – Characterization Methods in Biophysics

Module designation	***Characterization Methods in Biophysics***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Siti Nikmatin*
Language	*Bahasa Indonesia*
Relation to curriculum	*in-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*

Module objectives/intended learning outcomes	1. *Students can describe spectroscopic characterization methods in biophysics.* 2. *Students can describe and explain the characterization of diffraction in biophysics.* 3. *Students can explain the working principlesand analysis in biophysical characterization using a microscope.* 4. *Students can explain nanomaterial testing.* 5. *Students can describe and expl ɿin thermal properties in biophysical characterization.* 6. *Students can describe and explain mechanical properties in biophysical characterization.* 7. *Students can explain the properties of electricity and magnetism in biophysical characterization.*

	8. *Students can describe and explain papers in national and international journals in solving various forms of physics problems, especially the study of biophysical characterization methods.*
Content	*Spectroscopy, diffraction, microstructure with a microscope, nanomaterial thermal properties, mechanical properties, electrical and magnetic properties*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	1. *ASM Handbook, Volume 10: Materials Characterization. 2019* 2. *Niemantsverdriet, J.W. Spectroscopy in Catalysis, Wiley-VCH, New York. 2007* 3. *Nadeau, J.L. Introduction to Experimental Biophysics, CRC Press.. 2017* 4. *Kaltashov, I.A, Eyles, S.J. Mass Spectrometry in Biophysics, John Wiley & Sons, Inc. 2005* 5. *Arrondo, J.L.R. Advance Techniques in Biophysics, Springer Berlin, Heidelberg. 2010*

Module Handbook – Biophysics Modelling

Module designation	***Biophysics Modelling***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Agus Kartono, M.Si*
Language	*Bahasa Indonesia*
Relation to curriculum	*In-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*

Module objectives/intended learning outcomes	1. *Students are able to explain and be skilled at creating ordinary differential equation (PDB) model programs for biological network systems, such as nerve cells (neuron cells).* 2. *Students are able to explain and be skilled at creating partial differential equation model (PDP) programs to be applied to biological network systems.* 3. *Students are able to explain and be skilled at creating partial differential equation (PDP) model programs for biological network systems.* 4. *Students are able to explain and be skilled at creating partial differential equation model (PDP) programs to be applied to biological network systems.* 5. *Students are able to implement 3D protein structure prediction methods.* 6. *Students are able to use and practice Newton's laws in molecular dynamics simulations* 7. *Students are able to understand and examine molecular interactions from molecular dynamics simulation trajectories.*
Content	*Basic concepts of the numerical method of Ordinary Differential Equations (PDB), application of the numerical method of Ordinary Differential Equations (PDB), basic concepts of the numerical method of Partial Differential Equations (PDP) with a finite difference scheme, application of the numerical method of Partial Differential Equations (PDP) with a finite difference scheme, Protein structure: Experimental determination and prediction of 3D structure, introduction to force fields, solvent models and intermolecular interactions, basic principles of molecular dynamics simulations, application of molecular dynamics simulations to proteins and solvents, analysis of the trajectory of molecular dynamics simulation results.*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	1. *Koch, C. Biophysics of Computation: Information Processing in Single Neurons, Series Computational Neuroscience Series. Oxford University Press. 2004.* 2. *Setubal, C and Meidani, J. Introduction to Computational Molecular Biology 1st Edition, PWS Publishing. 1997*

Module Handbook – Bioelectronics and Biophotonics

Module designation	***Bioelectronics and Biophotonics***
Semester(s) in which the module is taught	*Any semesters*
Personresponsible for the module	*Prof. Dr. Akhiruddin*
Language	*Bahasa Indonesia*
Relation to curriculum	*In-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	*1.Students are able to analyze and understand the conventional concept of biophotonics* *2. Students are able to analyze and understand applications biophotonic in various fields.*
Content	*Interaction of light and matter, light waves on surfaces, optical imaging, biophotonics at the nanoscale, bio-recognition in enzymes, integration of bio-electronic devices, bioelectrical devices based on biomolecular activity and biological cells.*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (40%), mid semester exam (30%), and end semester exam (30%)*

Reading list	*1. Keiser, G. Biophotonics: Concept and Applications. Springer Singapore. 2016.*

	2. *Pethig, R.R, Smith, S. Introductory Bioelectronics: For Engineers and Physical Scientists. Wiley. 2012.*

Module Handbook – Contemporary Biophysics

Module designation	***Contemporary Biophysics***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Prof. Dr. Husin Alatas*
Language	*Bahasa Indonesia*
Relation to curriculum	*In-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	*1. Students are able to search for topics and study contemporary study in the field of Biophysics.* *2. Students are able to understand and explain specific Biophysics studies.* *3. Students are able to rewrite a specific Biophysics study in the form of a review manuscript.*
Content	*Search for the latest literature via the internet; Discusses current studies specifically related to Biophysics and explains them again comprehensively; Presentation again in the form of presentations and writing review papers*
Examination forms	*Oral Exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*

Reading list	*Various related international and national scientific papers*

Module Handbook – Bioinspiration Material

Module designation	***Bioinspiration Material***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Prof. Dr. Akhiruddin*
Language	*Bahasa Indonesia*
Relation to curriculum	*In-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	1. *Students are able to explain the significance of bioinspired materials* 2. *Students are able to explain the structure and function of natural materials* 3. *Students are able to analyze various types of bioinspired material designs* 4. *Students are able to analyze various bioinspired surface synthesis methods* 5. *Students are able to analyze bioinspired materials as structural materials* 6. *Students are able to analyze bioinspired materials for medical applications* 7. *Students are able to analyze bioinspired materials for device applications* 8. *Students are able to analyze molecular-based bioinspired materials*

Content	*History and development of bioinspired materials, physical properties of surfaces, Self assembly, hierarchy, and evolution, basic building blocks, biomineralization, surface design and biological materials, material synthesis: Soft lithography, imprinting, structural bioinspired materials*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	1. *Chun, H.J. et al. Bioinspired Biomaterials: Advances in Tissue Engineering and Regenerative Medicine.Springer Nature Singapore. 2020.* 2. *Pandikumar, E.A, Rameshkumar, P. Bioinspired Nanomaterials Synthesis and Emerging Applications. Materials Research Foundations. 2021.*

Module Handbook – Radiation Biophysics

Module designation	***Radiation Biophysics***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*in-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	1. *Students are able to explain the mechanism of interaction of ionizing radiation in living things.* 2. *Students are able to describe the process of radiation, the process of decay of atomic nuclei, the interaction of radiation with matter* 3. *Students are able to explain basic methods and instruments for radiation monitoring, detection and measurement*
Content	*Basic concepts of radiation biophysics, basic principles and radiation protection, radiation absorption in biology, cell survival curves, radiosensitivity and cell age in the mitotic cycle, radiation energy deposition, radiation as cancer therapy, basic methods and instruments for radiation monitoring, detection and measurement of radiation biophysics applications*
Examination forms	*Written exam*

Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	*1. Alpen, E.L. Radiation Biophysics, Academic Press, California. 1998.* *2. Hall, E.J. Radiobiology for the Radiobiologist. Lippincot Williams and Wilkins, Philadelphia. 2018.*

Module Handbook – Environmental Biophysics

Module designation	***Environmental Biophysics***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Ir. Irmansyah, M.Si*
Language	*Bahasa Indonesia*
Relation to curriculum	*in-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	1. *Students are able to show discipline and independence during the learning process* 2. *Students are able to explain physical phenomena related to mass and heat transport in the environment* 3. *Students are able to explain the parameters of the components of the physical environment, the processes that occur and how living things (humans, animals, plants) interact with the components of the physical environment.* 4. *Students are able to use models to explain the phenomena of mass and heat flow in the interaction of living things (humans, animals, plants) with the components of the physical environment*

Content	*General description of environmental physics including parameters of temperature, gas and water vapor, fluids, wind, heat and mass transfer, mass and heat conductance processes, heat flow in the soil, water flow in the soil, basics of radiation, radiation flux in nature , and animal and environmental interactions, human and environmental interactions, and the effect of light on plants.*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	*1. Campbell, G.S. and Norman, J.M. Introduction to Environmental Biophysics. Springer. 1998.* *2. Monteith, J.L. and Unsworth, M.H. Principles of Environmental Physics. 4th ed. Elsevier Ltd. 2013.*

Module Handbook – Surface Physics

Module designation	***Surface Physics***
Semester(s) in which the module is taught	*Any semesters*
Personresponsible for the module	*Dr. Faozan*
Language	*Bahasa Indonesia*
Relation to curriculum	*In-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	1. *Students are able to model surface structure.* 2. *Students are able to analyze surface properties based on electrical and optical properties.* 3. *Students are able to analyze surface interactions with adsorbates.* 4. *Students are able to explain surface interactions in catalytic and photocatalytic processes.* 5. *Students are able to explain surface interactions in sensor and solar cell applications.*
Content	*Basics of 2-dimensional crystallography, modeling, structure and energetics, electronic structure, structural defects, adsorption, catalytic reactions, reaction kinetics, surface optical properties, surface plasmon resonance, surface interactions in solar cells, surface synthesis methods.*
Examination forms	*Written exam and oral presentation exam*

Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	*1. Oura, K, Lifshits, V.G., Saranin, A, Zotov, A.V, Katayama, M. Surface Science. Springer Berlin Heidelberg. 2003.* *2. Grob, A. Theoretical Surface Science, Springer-Verlag Berlin Heidelberg. 2003.* *3. The Surface Science Society of Japan. Compendium of Surface and Interface Analysis. Springer Nature, Singapore. 2018.*

Module Handbook – Protein Physics

Module designation	***Protein Physics***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Setyanto tri Wahyudi, M.Si*
Language	*Bahasa Indonesia*
Relation to curriculum	*In-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	1. *Students are able to expand their knowledge and the basic theory about structure, function, folding protein and its interactions.* 2. *Students are able to master the technique and physics concept in various protein applications.* 3. *Students are able to applied the method and visualization technique of protein structure* 4. *Students are able to identify proteins to proteins and proteins to ligand interaction.* 5. *Students are able to construct and modify 3d protein structure.*

Content	*Synthesis and the function of protein, protein structure Hierarchy, protein structure characterization, determination of 3d protein structure, BInding energy, force between molecule and proteins stability, thermodynamic and kinematics protein folding, APlications of protein as a functional material and sensors, Schoring function concepts in proteins - protein interaction and protein-ligand interactions. protein structure visualization. prediction of protein 3D structures.geometry optimization concept on substrate/ligand protein, protein-protein docking practicum, protein-ligand docking practicum.*
Examination forms	*Written exam*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (30%), mid semester exam (35%), and end semester exam (35%)*
Reading list	*1. Finkelstein, A and Ptitsyn, O. Protein Physics. 2nd Ed. Academic Press. 2016.* *2. Fersht, A. Structure and Mechanism in Protein Science. W.H. Freeman and Company. 1998.*

Module Handbook – Sustainable Energy Physics

Module designation	***Sustainable Energy Physics***
Semester(s) in which the module is taught	*Any semesters*
Personresponsible for the module	*Prof. Dr. R. Tony Ibnu Sumaryada WP*
Language	*Bahasa Indonesia*
Relation to curriculum	*In-depth (IC) course*
Teaching methods	*100 minutes lectures and 120 minutes structured activities perweeks*
Workload (incl. contact hours, self-study hours)	*Total workload is 79 hours per semester, which consists of 100 minutes lectures per week for 14 weeks, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.5) = 3 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	1. *Students are aware of the energy crisis, the need for sustainability and consideration of limited natural resources.* 2. *Students are aware of global energy security and policy affecting Indonesia.* 3. *Students are able to master the basic concept and utilization of various renewable energy resources* 4. *Students are able to analyze various alternative renewable energy resources*

Content	1. *Awareness of Sustainability in various ways, Environmental and energy crisis as well as non-renewable energy sources. Energy policy* 2. *Basic concept and example of utilization of solar energy, photovoltaic solar cells, thermovoltaic, solar thermal, solar chimney.* 3. *Basic concept and example of utilization of wind energy, various wind turbine designs, utilization of ocean wave energy in various designs.* 4. *Indonesia's Geothermal Potential and its utilization technology.* 5. *Basic concept and example of utilization of nuclear energy, radiation protection, advantages and disadvantages of nuclear power plants.* 6. *Basic concept and example of utilization of Biomass Energy, Biomass derivative products.* 7. *Basic concept and example of conversion of carbohydrate-rich biomass, Conversion of lignocellulosic rich biomass, Oil-rich biomass conversion* 8. *Basic concept and example of conversion of biomass into natural fiber, Utilization of energy through biorefinery microalgae*
Examination forms	*Written exam and/or Case Based Learning/Project*
Study and examination requirements	*Minimum attendance at lectures is 80% (according to IPB regulation). Final score is evaluated based on assignment and presence (20%), mid semester exam (40%), and end semester exam (40%)*
Reading list	1. *Tester, J.W, Drake, E.M, Driscol, M.J, Golay M.W, and Peters, W.A. Sustainable energy, MIT Press. 2012.* 2. *Evans, R.L. Fueling Our Future: An Introduction to Sustainable Energy, Cambridge University Press. 2007.*

Module Handbook – Seminar

Module designation	***Seminar***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*Compulsory in the final year master's degree*
Teaching methods	*90 minutes structured activities per week, 90 minutes individual study per week*
Workload (incl. contact hours, self-study hours)	*Total workload is 45 hours per semester, which consists of 90 minutes structured activities per week, 90 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*1 SCH x (1.67) = 1.67 ECTS*
Required and recommended prerequisites for joining the module	1. Students have attended the general lecture seminar 2. Before conducting seminars, students must attend seminars at least 31 (thirty-one) times, at least 13 times in their scientific group and 4 times in each other scientific group (16 times), 1 general lecture seminar (equivalent to 2 times). 3. Students can also attend international or national seminars and scientific orations of IPB professors as evidenced by certificates of attendance. The number of attendances that can be claimed is a maximum of 12 times. One activity is recognized 1 time of attendance.
Module objectives/intended learning outcomes	1. Students are able to present thesis research results in an SPs scientific forum or other scientific forums according to the provisions set by SPs to disseminate research results, both in writing and orally, absorbing input from the forum for thesis improvement. 2. Students are able to add scientific insights, and improve scientific communication competencies.
Content	*In this lecture, students explained the results of the research they had conducted to test their validity and feasibility scientifically and their suitability with KKNI level 8 and the Learning Outcome Program from the IPB Physics graduate Program in front of supervisors, examiners and other fellow students. Reviews from examiners are used to improve the Final Project.*
Examination forms	Assessment is based on the quality of the seminar paper (accuracy of the seminar paper submission schedule, paper writing format) and student performance during the seminar (quality of paper presentation, and

	quality of presenter's answers to questions and comments from seminar participants) using the assessment form provided by the Graduate School of IPB.
Study and examination requirements	*Presentation of research results* *Discussion of research results*
Reading list	*Main :* *PPKI IPB edisi IV 2019* *Scientific journal* *Supporters :* *Textbook* *Related Resources*

Module Handbook – Thesis

Module designation	***Thesis***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*Compulsory in the final year master's degree*
Teaching methods	*360 minutes structured activities per week, 360 minutes individual study per week*
Workload (incl. contact hours, self-study hours)	*Total workload is 252 hours per semester, which consists of 540 minutes structured activities per week, 540 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*6 SCH x (1.67) = 10.02 ECTS*
Required and recommended prerequisites for joining the module	Have completed major courses in semesters 1 - 3
Module objectives/intended learning outcomes	*1. Students are able to search scientific literature and to manage scientific reference resourses* *2. Students are able to formulate the state of the art of a research topic* *3. Students are able to design simple research* *4. Students are able to formulate simple research hypotheses* *5. Students master the tools and methods used in research and are able to use them to obtain research data* *6. Students are able to visualize research data and their tools* *7. Students are able to analyze research data descriptively or predictively* *8. Students are able to write research results in the form of scientific papers* *9. Students master the basics of physics theory that underlie research*
Content	*This course provides testing and assessment of the quality of all final project activities that have been completed by students as reflected in the form of a thesis document (Final Project) in accordance with KKNI level 8 and the Learning Outcomes Program of the Master Program. Testing of students' understanding of the basic concepts of physics related to their Final Project is carried out through a bachelor's exam in front of examiners appointed by the study program and is closed.*

Examination forms	*Project based learning*
Study and examination requirements	1. *Systematics and writing techniques according to guidelines* 2. *Introduction (title, problem formulation, objectives) and research hypothesis* 3. *Substance* 4. *Data methods and analysis* 5. *Drawing conclusions*
Reading list	*Main :* *PPKI IPB edisi IV 2019* *Scientific journal* *Supporters :* *Textbook* *Related Resources*

Module Handbook – Publication

Module designation	***Publication***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*Compulsory in the final year master's degree*
Teaching methods	*90 minutes structured activities per week, 90 minutes individual study per week*
Workload (incl. contact hours, self-study hours)	*Total workload is 90 hours per semester, which consists of 180 minutes structured activities per week, 180 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.67) = 3.34 ECTS*
Required and recommended prerequisites for joining the module	*No prerequisites required*
Module objectives/intended learning outcomes	Students are able to publish thesis research results according to the standards set by IPB graduate school
Content	Students report the results of research conducted during their studies in the form of scientific papers and published in journals in accordance with the rules of IPB graduate school
Examination forms	Project based learning
Study and examination requirements	1. Aspects of journal status include accredited national journals, international journals, and scopus-indexed international seminar proceedings. 2. The publication status aspect relates to the position of the paper that has been submitted to the editor of the journal.
Reading list	*Main :* *Scientific journals* *Supporters :* *Textbook* *Related Resources*

Module Handbook – Thesis Exam

Module designation	***Thesis Exam***
Semester(s) in which the module is taught	*Any semesters*
Person responsible for the module	*Dr. Mersi Kurniati*
Language	*Bahasa Indonesia*
Relation to curriculum	*Compulsory in the final year master's degree*
Teaching methods	*90 minutes structured activities per week, 90 minutes individual study per week*
Workload (incl. contact hours, self-study hours)	*Total workload is 90 hours per semester, which consists of 180 minutes structured activities per week, 180 minutes individual study per week, in total is 14 weeks per semester, excluding mid exam and final exam.*
Credit points	*2 SCH x (1.67) = 3.34 ECTS*
Required and recommended prerequisites for joining the module	1. students have conducted seminars 2. students have publications as a requirement for graduation 3. students have fulfilled the required number of credits
Module objectives/intended learning outcomes	Students are able to defend the material contained in the thesis and is the decisive qualification/ability test for obtaining a degree.
Content	Writing a draft thesis and students' comprehensive knowledge related to competence (scientific and methodological), thinking (analysis, synthesis), communication and solutions that are directly and indirectly related to the thesis.
Examination forms	*Presentation and exam on understanding the concept of biophysical theory*
Study and examination requirements	*1. Mastery of knowledge 25% (Ability to express the basic theory, The quality of answer, in-depth understanding of the substantive materials written in the thesis draft, Confidence in answering the question).* *2. Ability to construct the methodology 30% (Systematical thinking (analysis, synthesis dan design, ability to formulate the problems and the research objectives, Clear logical frame work to response the research problems, Ability to formulate the hypothesis, Ability to design the research (data collection & analysis)* *3. Depth of results and discussion 25% (Ability to use the common senses, Logical thinking capability (syllogism, deduction, induction, Capability to find the correlation between empirical facts and theoretical approach).*

	4. *Communication Skill 20% (Quality of presentation, ability to answer the question clearly, Ability to use Bahasa properly, Attitude during presentation and answering the question, Punctual in presentation, Ethics of students in interaction and communication with supervisors.*
Reading list	*Main :* *PPKI IPB edisi IV 2019* *Scientific journals* *Supporters :* *Textbook* *Related Resources*