UNIVERSITAS GADJAH MADA
Faculty of Mathematics and Natural Sciences
Department of Mathematics
Sekip Utara Bulaksumur Yogyakarta 55281 Telp: +62 274 552243 Fax: +62 274 555131 Email: math@ugm.ac.id Website: http://math.fmipa.ugm.ac.id

Doctor in Mathematics

Telp : +62 274 552243
Email : maths3@ugm.ac.id; kaprodi-s3-matematika.mipa@ugm.ac.id
Website : http://s3math.fmipa.ugm.ac.id/

MODULE HANDBOOK

Module Name	*Mathematical Modelling and Computation*
Module level, if applicable	*Doctoral Program*
Code, if applicable	*MMM-7318*
Subtitle, if applicable	
Semester(s) in which the module is taught	*1st or 2nd (first or second semester)*
Person responsible for the module	*Chair of the Lab. of Applied Mathematics*
Lecturer(s)	*Lecturer appointed by the Lab. of Applied Mathematics*
Language	*Bahasa Indonesia*
Relation to curriculum	~~*Compulsory*~~ / ***Elective*** / ~~*Specialisation*~~ *Names of other study programmes with which the module is shared: -*
Teaching methods	*lecture, discussion, presentation, Project-based learning, case-based learning*
Workload (incl. contact hours, self-study hours)	- *Total workload is 232 hours per semester, which consists of 50 minutes lectures per week, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.*
Credit points in Credit Units	*3*
Required and recommended prerequisites for joining the module	*Before taking this course, the students must have a good understanding of fundamental concepts in mathematics related to the research topic.*

Module objectives/intended learning outcomes	*After completing this course, the students should have ability to:* *CO 1. classify the mathematical model related to the research topic.* *CO 2. combine theories in mathematics and related disciplines to understand and solve a simple problem related to the research being carried out.* *CO 3. interpret the mathematical results to the real problems related to the research being carried out.*
Content	***Deterministic models:*** *discrete, exponential, and logistic population growth models, spring and pendulum oscillations, compartmental models, model fitting, interpretation.* ***Probabilistic models:*** *Review on probability theory and statistics (random variables, density functions, estimation), some examples in probabilistic models, parameter estimation, model fitting, interpretation* ***Stochastic models:*** *Review on stochastic processes (random variables, Markov chain, simulation), some examples in stochastic models, simulation, interpretation*
Examination forms	*Presentation, Written Report*
Study and examination requirements	*To pass the course, students are expected to get a minimum grade of B. The final mark will be weighted as follows:* *No Assessment methods — Weight (percentage)* *1. Project: Discussion and presentation — 60* *2. Project: Written Report — 40*
Media employed	*Boards, projectors, Laptop/Computer*
Reading list	*1. Haberman, R., 1977, Mathematical Models: Mechanical Vibrations, Population Dynamics and Traffic Flow. Prentice-Hall, Inc., Englewood Cliffs.* *2. Illner, R., Bohun, C.S., McCollum, S., and van Roode, T., 2005, Mathematical modeling: a case studies approach, American Mathematical Society*

CO-PLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
CO 1	√	√				
CO 2	√	√	√			√
CO 3	√				√	√

Last Modified Date : 10 August 2022

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MODULE HANDBOOK

Module designation	*Mathematical Modeling*
Code, if applicable	MMM 7318
Subtitle, if applicable	*Dynamical Systems*
Semester(s) in which the module is taught	*1st or 2nd (first or second semester)*
Person responsible for the module	*Chair of the Lab. of Applied Mathematics.*
Language	*Bahasa Indonesia (or English, if necessary)*
Relation to curriculum	*~~Compulsory~~ / **Elective** / ~~Specialisation~~* *Names of other study programmes with which the module is shared: -*
Teaching methods	*Project-based learning, case-based learning*
Workload (incl. contact hours, self-study hours)	Total workload is 232 hours per semester, which consists of 50 minutes lectures per week, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.
Credit points in Credit Units	3
Required and recommended prerequisites for joining the module	*Before taking this course, the students must have a good understanding of fundamental concepts in mathematics, especially Ordinary Differential Equations related to the research topic.*

Module objectives/intended learning outcomes	*After completing this course, the students should have ability to:* *CO1. develop knowledge of Linear and Nonlinear Dynamical Systems to the research problems.* *CO2. implement the concepts of invariant structures and bifurcations to analyze and solve the problems.* *CO3. interpret the solutions of the dynamical system in geometrical point of view based on the research problems.*
Content	*a. Linear Dynamical System and Nonlinear Dynamical Systems (general solution, stability of an equilibrium point and a fixed point).* *b. Formal Definitions of Dynamical System* *c. Global stability of an equilibrium point (First Integral and Lyapunov Function)* *d. Invariant structures (global stability of an equilibrium point, periodic solution and periodic point, and invariant manifolds)* *e. Bifurcation on continuous and discrete systems* *f. Some applications of Dynamical System.*
Examination forms	*Presentation, Written Report*
Study and examination requirements	*To pass the course, students are expected to get a minimum grade of B. The final mark will be weighted as follows:* *No Assessment methods — Weight (percentage)* *1. Project: Discussion and presentation — 60* *2. Project: Written Report — 40*
Reading list	1. Wiggins, S., *Introduction to Applied Nonlinear Dynamical Systems and Chaos*, 2nd Ed., Springer- Verlag New York, Inc, 2003 2. Verhulst, F., *Nonlinear Differential Equations and Dynamical Systems*, Springer-Verlag Berlin Heidelberg, 1996. 3. Kuznetsov, Y., *Elements of Applied Bifurcation Theory*, 2nd ed, Applied Mathematical Sciences 112, Springer-Verlag New York, Inc, 1998

CO-PLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
CO 1	√	√				
CO 2	√	√	√			√
CO 3	√				√	√

Last Modified Date : 11 September 2023

UNIVERSITAS GADJAH MADA

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MODULE HANDBOOK

Module designation	Mathematical Modelling
Code, if applicable	MMM 7318
Subtitle, if applicable	Advance Mathematical Modelling
Semester(s) in which the module is taught	*1st or 2nd (first or second semester)*
Person responsible for the module	*Chair of the Lab. of Applied Mathematics*
Language	*Bahasa Indonesia*
Relation to curriculum	*~~Compulsory~~ / **Elective** / ~~Specialisation~~* *Names of other study programmes with which the module is shared: -*
Teaching methods	*project based learning, case based learning*
Workload (incl. contact hours, self-study hours)	*Total workload is 232 hours per semester, which consists of 50 minutes lectures per week, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.*
Credit points in Credit Units	*3*
Required and recommended prerequisites for joining the module	*Before taking this course, the students must have a good understanding of fundamental concepts in mathematics related to the research topic.*
Module objectives/intended learning outcomes	*After completing this course, the students should have ability to:* *CO 1. classify the mathematical model related to the research topic.* *CO 2. combine theories in mathematics and related disciplines to understand and solve a simple problem related to the research being carried out.* *CO 3. interpret the mathematical results to the real problems related to the research being carried out.*

Content	***Deterministic models:*** *discrete, exponential, and logistic population growth models, spring and pendulum oscillations, compartmental models, model fitting, interpretation.* ***Probabilistic models:*** *Review on probability theory and statistics (random variables, density functions, estimation), some examples in probabilistic models, parameter estimation, model fitting, interpretation* ***Stochastic models:*** *Review on stochastic processes (random variables, Markov chain, simulation), some examples in stochastic models, simulation, interpretation*
Examination forms	*Presentation, Written Report*
Study and examination requirements	*To pass the course, students are expected to get a minimum grade of B. The final mark will be weighted as follows:* *No Assessment methods — Weight (percentage)* *1. Project: Discussion and presentation — 60* *2. Project: Written Report — 40*
Reading list	*1. Haberman, R., 1977, Mathematical Models: Mechanical Vibrations, Population Dynamics and Traffic Flow. Prentice-Hall, Inc., Englewood Cliffs.* *2. Illner, R., Bohun, C.S., McCollum, S., and van Roode, T., 2005, Mathematical modeling: a case studies approach, American Mathematical Society*

CO-PLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
CO 1	√	√				
CO 2	√	√	√			√
CO 3	√				√	√

Last Modified Date: 1 September 2023

UNIVERSITAS GADJAH MADA
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MODULE HANDBOOK

Module designation	Topics in Mathematical Modelling
Code, if applicable	*MMM-7318*
Subtitle, if applicable	Advanced Biomathematics (Bio-Matematika Lanjut)
Semester(s) in which the module is taught	*1st or 2nd (first or second semester)*
Person responsible for the module	*Chair of the Lab. of Applied Mathematics*
Language	*Bahasa Indonesia*
Relation to curriculum	***Elective***
Teaching methods	*Lecture, classroom discussion, Presentation, project-based learning learning*
Workload (incl. contact hours, self-study hours)	*Total workload is 232 hours per semester, which consists of 50 minutes lectures per week, 120 minutes structured activities per week, 120 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.*
Credit points in Credit Units	*3*
Required and recommended prerequisites for joining the module	*Before taking this course, students should have been familiar with Mathematical Modeling in Differential Equations.*
Module objectives/intended learning outcomes	*After completing this course, the students should have ability to:* • *CO 1. Create preliminary models of problems related to the topic of the dissertation* • *CO 2. Overcome the preliminary models and prepare a manuscript for publication.*

Content	*Introduction: SIR, SIRS, SEIR model. Stability of Equilibrium Point and Linearization method. Direct Methods: Lyapunov Function, La Salle Theorem. First Integral. Basic Reproduction Number. Global Stability. Additional qualitative theories and methods which are necessary to overcome problems related to the topic dissertation. Project: Create and overcome preliminary models of problem related to the dissertation topic, a manuscript for publication*
Examination forms	*Presentation, Written Report*
Study and examination requirements	*To pass the course, students are expected to get a minimum grade of B.* *The final mark will be weighted as follows:* *No Assessment methods (components, activities) — Weight (percentage)* *1 Final Examination (Manuscript) — 40%* *2 Examination (report) — 30%* *3 Other Activities: Oral Presentation — 30%*
Reading list	1. Braurer F. and Castillo-Chavez C., 2012, *Mathematical Models in Population Biology and Epidemiology,* Second Edition, Springer Science+Business Media, LLC, New York. 2. Castillo-Chavez C., Feng Z., and Huang W., 2002, On the Computation of *R*0 and Its Role on Global Stability, *Mathematical Approaches for Emerging and Reemerging Infections Diseases: Models, Methods and Theory,* Volume I, Springer-Verlag, New York. 3. Diekmann, O., and Heesterbeek, J. A. P., 2002, *Mathematical Epidemiology of Infectious Diseases: Model Building, Analysis and Interpretation,* John Wiley & Sons, New York. 4. Korobeinikov, A., and Maini, P. K., 2004, A Lyapunov Function and Global Properties for SIR and SEIR Epidemiological Models with Non-Linear Incidence, *Mathematical Biosciences and Engineering,* Volume I, Number1, June 2004. 5. Murray J. D., 1993, *Mathematical Biology,* Springer-Verlag, Berlin. 6. Perko L., 1991, *Differential Equations and Dynamical Systems,* Springer-Verlag, New York. 7. Other textbooks or articles related to the topic of the dissertation.

CO-PLO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6
CO 1	√		√		√	√
CO 2			√		√	

Last Modified Date: 4 September 2023