UNIVERSITAS ISLAM NEGERI MAULANA MALIK IBRAHIM MALANG
Faculty of Science and Technology
Mathematics Study Program
Jl. Gajayana No. 50 Malang 65144 Telp. / Fax. (0341) 558933, website : www.matematika.uin-malang.ac.id, e-mail : matematika@uin-malang.ac.id

Mathematics Study Program
Telp : (0341) 558933
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Website : www.matematika.uin-malang.ac.id

MODULE HANDBOOK

Module name	Numerical Analysis
Module level, if applicable	Bachelor
Code, if applicable	22060111D19
Courses, if applicable	Numerical Analysis
Semester(s) in which the module is taught	5
Person responsible for the module	Head of Applied Mathematics Consortium
Lecturers	1. Ari Kusumastuti, M.Pd, M.Si 2. Muhammad Khudzaifah, M.Si 3. Juhari, M.Si 4. Dr. Heni Widayani, M.Si
Language	Indonesian
Relation to curriculum	5th semester compulsory subject
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken Numerical Analysis courses at least 80% of the meetings.
Recommended prerequisites	Algorithm and programming, introduction to computer science 1, introduction to computer science 2
Module objectives/intended learning outcomes	CO1 Students are able to understand the concept of numerical methods from each given problems CO2 Students are able to create algorithms for given numerical methods CO3 Students are able to apply algorithms to software and to solve given problems CO4 Students are able to draw conclusions from the numerical analysis carried out
Content	In this course students study Errors, NonLinear Roots, SPL Solutions, Interpolation, Functional Approaches, Numerical Integrals, Derivative Functions, MNA, MNB, Finite Differences for PDP numerical solutions, Fourier series
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. Assessment Method Weight 1 Final Test 40%

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	2 Midle Test 40% 3 Quiz, Tasks 20% The final grade is determined by the following criteria: **Range** / **Grade** [85 – 100] A [75 – 85) B+ [70 – 75) B [65 – 70) C+ [60 – 65) C [50 – 60) D
Media employed	Whiteboard, Projector, Laptop
Reading List	1. Lindfield, G, dan Penny,J . 1995. Numerical Methods Using Matlab. 2. Ellis Horwood and Other Relevant References. 3. Rinaldi Munir. 2003. *Metode numerik*. Bandung : Informatika

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO 1			v								
CO 2									v		
CO 3								v			
CO 4										v	

Date of Last Amendment :
November 20th, 2023

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MODULE HANDBOOK

Module name	Mathematical Modeling
Module level, if applicable	Bachelor
Code, if applicable	22060111D21
Courses, if applicable	Mathematical Modeling
Semester(s) in which the module is taught	5
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Pd, M.Si 2. Dr. Usman Pagalay, M.Si 3. Juhari, M.Si 4. Dr. Heni Widayani, M.Si
Language	Indonesian
Relation to curriculum	5th semester compulsory subject
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have attended the Mathematical Modeling course at least 80% of the meetings.
Recommended prerequisites	Calculus I, Calculus II, Ordinary Differential Equation
Module objectives/intended learning outcomes	CO1. Students are able to explain simple modeling concepts, both using differential equations and difference equations CO2. Students are able to make a simple model of the given problem accompanied by assumptions that build the model CO3. Students are able to obtain analytical solutions and/or numerical solutions from the simple models provided CO4. Students are able to present analytical solutions and simulation results from models as well as interpretations and conclusions from models that have been constructed
Content	In this course, you will learn about process modeling, compartmental diagrams, single species modeling, interacting species, Bernoulli's equation, SPL, systems of non-linear equations, Eq. Lotka Volterra, Modeling in epidemiology, immune system

<table>
<tr><td>Study and examination requirements and forms of examination</td><td>The final grade will be weighted as follows:

No. | Assessment Method | Weight
1 | Final Test | 40%
2 | Midle Test | 40%
3 | Quiz, Tasks | 20%

The final grade is determined by the following criteria:

<table><tr><th>Range</th><th>Grade</th></tr><tr><td>[85 – 100]</td><td>A</td></tr><tr><td>[75 – 85)</td><td>B+</td></tr><tr><td>[70 – 75)</td><td>B</td></tr><tr><td>[65 – 70)</td><td>C+</td></tr><tr><td>[60 – 65)</td><td>C</td></tr><tr><td>[50 – 60)</td><td>D</td></tr></table></td></tr>
<tr><td>Media employed</td><td>Whiteboard, Projector, Laptop</td></tr>
<tr><td>Reading List</td><td>1. Barnes, Belinda and Fulford, G. Robert. 2009. Mathematical Modelling With Cases Studies : A Differential Equations Approach Using Maple and Matlab 2nd Ed. Taylor & Francis Group. London.
2. Giordano, F. R., Fox, W.P., Horton, S.B. 2014. A First Course in Mathematical Modeling 5th Ed. Cengange Learning, USA
3. Tamin, Ofyzar.Z. 2003. Perencanaan dan Pemodelan Transportasi: Contoh Soal dan Aplikasi. Penerbit ITB. Bandung
4. Widayani, Heni, Modul Ajar Pemodelan Matematika</td></tr>
</table>

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v	v							
CO2						v					
CO3							v		v		
CO4										v	

Date of Last Amendment :
November 20th, 2023

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MODULE HANDBOOK

Module name	Ordinary Differential Equations
Module level, if applicable	Bachelor
Code, if applicable	22060111D10
Courses, if applicable	Ordinary Differential Equations
Semester(s) in which the module is taught	4
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Pd, M.Si 2. Dr. Usman Pagalay, M.Si 3. Dr. Heni Widayani, M.Si
Language	Indonesian
Relation to curriculum	4th semester compulsory subject
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test andfinal test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Ordinary Differential Equation course at least 80% of the meeting.
Recommended prerequisites	Multivariable Calculus
Module objectives/intended learning outcomes	CO1 Students know the types of differential equations given CO2 Students are able to get analytical solutions from differential equations CO3 Students are able to get analytical solutions from systems of differential equations of order 1 CO4 Students know the application of differential equations in the fields of science and technology
Content	In this course, you will study first-order linear differential equations (PD), Bernoully PD, Logistic PD, Homogeneous PD, Nonhomogeneous PD, Airy Equation, Chaucy Equation, linear PD system and non-linear as well as some basic methods for solving PD such as the Indeterminate Coefficient Method, Parameter Variation Method, and Power Series Method will be studied.
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. / Assessment Method / Weight 1 / Final Test / 40% 2 / Midle Test / 40% 3 / Quiz, Tasks / 20%

<table>
<tr><td></td><td>The final grade is determined by the following criteria:

<table>
<tr><th>Range</th><th>Grade</th></tr>
<tr><td>[85 – 100]</td><td>A</td></tr>
<tr><td>[75 – 85)</td><td>B+</td></tr>
<tr><td>[70 – 75)</td><td>B</td></tr>
<tr><td>[65 – 70)</td><td>C+</td></tr>
<tr><td>[60 – 65)</td><td>C</td></tr>
<tr><td>[50 – 60)</td><td>D</td></tr>
</table></td></tr>
<tr><td>Media employed</td><td>Whiteboard, Projector, Laptop</td></tr>
<tr><td>Reading List</td><td>1. Ayres, Frank. Persamaan Diferensial, Jakarta : Erlangga
2. Persamaan Diferensial dengan Penerapan Modern</td></tr>
</table>

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2							v		v		
CO3							v		v		
CO4										v	

Date of Last Amendment :
November 20th, 2023

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MODULE HANDBOOK

Module name	Partial Differential Equation
Module level, if applicable	Bachelor
Code, if applicable	22060111D20
Courses, if applicable	Partial Differential Equation
Semester(s) in which the module is taught	5
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Pd, M.Si 2. Dr. Heni Widayani, M.Si
Language	Indonesian
Relation to curriculum	5th semester compulsory subject
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including Midle Test and Final Test..
Credit points	3
Requirements according to the examination regulations	Students have attended the Partial Differential Equations course at least 80% of the meeting.
Recommended prerequisites	Ordinary Differential Equation
Module objectives/intended learning outcomes	CO1 Students understand first-order, and second-order partial differential equations both linear, quasi-linear and nonlinear CO2 Students can analyze the solving of initial value problems and boundary condition problems CO3 Students are able to analyze graphs solution and interpret it based on the modeled phenomena
Content	This course will discuss Brownian Motion, Diffusion Equation, Telegraph Equation, Wave Equation, Laplace Equation and Green Function, Characteristic Method, D'Alembert Solution, Quasi Linear PDP, Monge Cone Equation, Eiconal equation, Second Order Linear PDP, shape canonical, Telegraph and Klein Gordon Equations, Sturm-Liouville Problem, Heat Propagation and Laplace Equation, Finite Fourier Transformation, Hyperbolic Equation, Poisson Equation, Heat Equation and Laplace Equation
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. Assessment Method Weight

	1 Final Test 40% 2 Midle Test 40% 3 Quiz, Tasks 20% The final grade is determined by the following criteria: **Range** / **Grade** [85 – 100] A [75 – 85) B+ [70 – 75) B [65 – 70) C+ [60 – 65) C [50 – 60) D
Media employed	Whiteboard, Projector, Laptop
Reading List	Erich Zauderer, Partial Differential Equations of Applied Mathematics, Third Edition

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2							v		v		
CO3										v	

Date of Last Amendment :
November 20th, 2023

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MODULE HANDBOOK

Module name	Applied Capita Selecta
Module level, if applicable	Bachelor
Code, if applicable	22060112E81
Courses, if applicable	Applied Capita Select
Semester(s) in which the module is taught	5
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Dr. Heni Widayani, M.Si 2. Dr. Usman Pagalay, M.Si
Language	Indonesian
Relation to curriculum	5th semester elective courses
Type of teaching, contact hours	50 minutes of face-to-face and 180 minutes of structured activity per week
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including Midle Test and Final Test.
Credit points	3
Requirements according to the examination regulations	Students have attended the Applied Capita Select course at least 80% of the meetings.
Recommended prerequisites	Ordinary Differential Equation, Partial Differential Equation, Multivariable Calculus
Module objectives/intended learning outcomes	CO1 Students are able to understand research methodology in the field of applied mathematics interest CO2 Students are able to distinguish a scientific writing CO3 Students can write one scientific paper properly and correctly
Content	Drafting proposals, collecting bibliography, develop a methodology, presentation, research draft
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. Assessment Method Weight 1 Final Test 40% 2 Midle Test 40% 3 Quiz, Tasks 20% The final grade is determined by the following criteria:

Range	Grade
[85 – 100]	A
[75 – 85)	B+
[70 – 75)	B
[65 – 70)	C+
[60 – 65)	C
[50 – 60)	D

Media employed	Whiteboard, Projector, Laptop
Reading List	Current research article of applied mathematics

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1											v
CO2				v							
CO3											v

Date of Last Amendment :
November 20th, 2023

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MODULE HANDBOOK

Module name	Dynamic System
Module level, if applicable	Bachelor
Code, if applicable	22060112E84
Courses, if applicable	Dynamic System
Semester(s) in which the module is taught	5
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Dr. Usman Pagalay, M.Si 2. Dr. Heni Widayani, M.Si
Language	Indonesian
Relation to curriculum	5th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the System Dynamics course at least 80% of the meeting.
Recommended prerequisites	Ordinary Differential Equation
Module objectives/intended learning outcomes	CO1 Students are able to understand the concept of mathematical model construction of each given problem CO2 Students are able to create algorithms for given mathematical models CO3 Students are able to apply algorithms to software to simulate mathematical models obtained CO4 Students are able to draw conclusions from the models and simulations carried out
Content	In this course students will study the concept of dynamic systems, especially discrete dynamical systems and the concept of mathematical fractal geometry construction. In particular, the material to be studied is Discrete Dynamic Systems: Motivation and a brief history of system dynamics. Definition and examples of dynamic systems. Iterations, orbits, types of orbits. Graphic analysis, orbit analysis, phase portrait. Fixed point and periodic, fixed point theorem and periodic point. Bifurcation, saddle point bifurcation, period double

	bifurcation. The dynamics of the family of quadratic functions. Continuous Dynamic System: Linear and Nonlinear Differential Equations (PD), Linear Systems, Theory of Stability, Definition of Dynamic Systems and examples, Invariant structures (equilibrium points, periodic solutions, and invariant manifolds), Nonlinear Systems : linearization, stability from the equilibrium point, First Integrals and Lyapunov Functions, Poincare Mapping (introduction).
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. Assessment Method Weight 1 Final Test 40% 2 Midle Test 40% 3 Quiz, Tasks 20% The final grade is determined by the following criteria: Range – Grade [85 – 100] – A [75 – 85) – B+ [70 – 75) – B [65 – 70) – C+ [60 – 65) – C [50 – 60) – D
Media employed	Whiteboard, Projector, Laptop
Reading List	1. Vu, H.V. and Esfandiari, R.S. 1998. Dynamic Systems: Modeling and Analysis. Singapore: McGraw-Hill. 2. Burton, T.D. 1994. Introduction to Dynamic Systems Analysis. Singapore: McGraw-Hill. 3. Ogata, K. 1998. System Dynamics. 3rd ed. New Jersey: Prentice-Hall. 4. ose, C.M. and Frederick, D.M. 1993. Modeling and Analysis of Dynamic Systems. 2nd ed. Boston: Houghton Mifflin. 5. Shearer, J.L. Kulakowski, B.T. and Gardner, J.F. 1997. Dynamic Modeling and Control of Engineering Systems. 2nd ed New Jersey: Prentice-Hall. 6. W.L. Luyben, 1973, *Prosess Modelling, Simulasi and Control for Chemical Engineers*, International Student Edition, Mc. Graw Hill.

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v			v					

CO2									v		
CO3								v			
CO4										v	

Date of Last Amendment :
November 21th, 2023

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MODULE HANDBOOK

Module name	Mathematical Simulation and Computation
Module level, if applicable	Bachelor
Code, if applicable	22060112E82
Courses, if applicable	Mathematical Simulation and Computation
Semester(s) in which the module is taught	4
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Mohammad Nafie Jauhari, M.Si 2. Muhammad Khudzaifah, M.Si
Language	Indonesian
Relation to curriculum	4th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Mathematical Simulation and Computation course at least 80% of the meeting.
Recommended prerequisites	Calculus
Module objectives/intended learning outcomes	CO1 Students are able to understand the basic utilization of some mathematical software such as MAPLE and MATLAB CO2 Students are able to create algorithms of a simple mathematic problem using mathematical software CO3 Students are able to use mathematical software to simulate simple algorithm CO4 Students are able to draw conclusions based on simulation results
Content	In this course, the use of several mathematical software such as MAPLE and MATLAB is studied to provide illustrations for mathematical concepts or problems. Specifically the material to be studied is the MAPLE Introduction Material: windows, maple organization, command construction and execution, number computing, expressions, function notation, derivatives, integrals, limits, matrices, eigenvalues and vectors, systems of linear equations, two- and three-dimensional graphics, animation, programming. MATLAB working environment, how to work with MATLAB, file and

	directory management, M-File scripts and functions, basic MATLAB operators: mathematical variables and operations, program inputs and outputs, common mathematical functions, array and matrix operations; program control, two- and three-dimensional graphics.
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. Assessment Method Weight 1 Final Test 40% 2 Midle Test 40% 3 Quiz, Tasks 20% The final grade is determined by the following criteria: **Range** / **Grade** [85 – 100] A [75 – 85) B+ [70 – 75) B [65 – 70) C+ [60 – 65) C [50 – 60) D
Media employed	Whiteboard, Projector, Laptop
Reading List	1. R. M. Corless, "Essential MAPLE: An introduction to scientific programmers," Springer–Verlag, New York, 1995. 2. A. Gilat, "Matlab : an introduction with applications". NJ: John Wiley and Sons, 2011

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO 1			v								
CO 2									v		
CO 3								v			
CO 4										v	

Date of Last Amendment :
July 27th, 2023

UNIVERSITAS ISLAM NEGERI MAULANA MALIK IBRAHIM MALANG
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MODULE HANDBOOK

Module name	Numerical Partial Differential Equation
Module level, if applicable	Bachelor
Code, if applicable	22060112E88
Courses, if applicable	Numerical Partial Differential Equation
Semester(s) in which the module is taught	6
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Si 2. Dr. Heni Widayani, M.Si 3. Dr. Usman Pagalay, M.Si
Language	Indonesian
Relation to curriculum	6th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Numerical Partial Differential Equation course at least 80% of the meeting.
Recommended prerequisites	Partial Differential Equation, Numerical Analysis
Module objectives/intended learning outcomes	CO1 Students are able to understand the concept and analysis of different methods up to each problem given CO2 Students are able to create algorithms for finite different methods up to those given CO3 Students are able to apply algorithms to software and produce numerical solution simulations CO4 Students are able to draw conclusions from the simulations carried out
Content	In this course, numerical methods for solving partial differential equations (PDP) will be discussed, especially with the finite difference method. In addition to being given definition, construction and analysis of finite difference schemes, learning is integrated with computational calculations. At the end of the lecture, students will be given a big assignment. In particular, the material studied is Finite difference scheme introduction, cutting error and stability analysis. Use of finite different methods to solve PDP. Three general types were studied, namely parabolic PDP (classical and

<table>
<tr><td></td><td>implicit explicit finite diffuse methods, weighted mean/Theta, hyperbolic (FTBS, FTFS, FTCS, Upwind, Lax-Wendroff, Leap-Frog) and elliptic (ADI methods) including standard problems of heat, wave and Laplace equations. Make papers and presentations on problems in the PDP.</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td>The final grade will be weighted as follows:
<table>
<tr><td>No.</td><td>Assessment Method</td><td>Weight</td></tr>
<tr><td>1</td><td>Final Test</td><td>40%</td></tr>
<tr><td>2</td><td>Midle Test</td><td>40%</td></tr>
<tr><td>3</td><td>Quiz, Tasks</td><td>20%</td></tr>
</table>
The final grade is determined by the following criteria:
<table>
<tr><th>Range</th><th>Grade</th></tr>
<tr><td>[85 – 100]</td><td>A</td></tr>
<tr><td>[75 – 85)</td><td>B+</td></tr>
<tr><td>[70 – 75)</td><td>B</td></tr>
<tr><td>[65 – 70)</td><td>C+</td></tr>
<tr><td>[60 – 65)</td><td>C</td></tr>
<tr><td>[50 – 60)</td><td>D</td></tr>
</table></td></tr>
<tr><td>Media employed</td><td>Whiteboard, Projector, Laptop</td></tr>
<tr><td>Reading List</td><td>1. Sri Redjeki Pudjaprasetya. 2013. Catatan Kuliah Persamaan Diferensial Parsial. Institut Teknologi Bandung
2. Morton, K., & Mayers, D. (2005). Numerical Solution of Partial Differential Equations: An Introduction (2nd ed.). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511812248</td></tr>
</table>

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2									v		
CO3								v			
CO4										v	

Date of Last Amendment :
November 21h, 2023

UNIVERSITAS ISLAM NEGERI MAULANA MALIK IBRAHIM MALANG
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MODULE HANDBOOK

Module name	Special Function
Module level, if applicable	Bachelor
Code, if applicable	22060112E83
Courses, if applicable	Special Function
Semester(s) in which the module is taught	5
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Si 2. Dr. Heni Widayani, M.Si 3. Dr. Usman Pagalay, M.Si
Language	Indonesian
Relation to curriculum	5th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Special Function course at least 80% of the meeting.
Recommended prerequisites	Ordinary Differential Equations
Module objectives/intended learning outcomes	CO1 Students are able to explain the concept of various special functions CO2 Students are able to recognize, analyze and apply properties and concepts related to special functions. CO3 Students are able to explain concepts and prove the properties of special functions.
Content	In this course, students will learn how to solve differential equations using power series. Students also learn some special functions derived from some differential equations and their uses. In addition, orthogonal function series (trigonometry) are also studied to approach a periodic function. In particular, the material to be studied is the derivation of some special functions and understanding how to approach a function using a series of orthogonal functions. Material Gamma Function and Beta Function, Solving PD with power series: Frobenius method, Legendre PD and properties of Legendre polynomials, Bessel PD and its properties, First form Bessel

<table>
<tr><td></td><td>function, and second form Bessel function, Hypergeometric function, Fourier series, Euler formula, Even/odd function, Fourier series Fourier series Sinus, and Cosinus Fourier series, Halfrange expansion, Orthogonal function and orthogonality eigen function.</td></tr>
<tr><td>Study and examination requirements and forms of examination</td><td>The final grade will be weighted as follows:
<table><tr><td>No.</td><td>Assessment Method</td><td>Weight</td></tr><tr><td>1</td><td>Final Test</td><td>40%</td></tr><tr><td>2</td><td>Midle Test</td><td>40%</td></tr><tr><td>3</td><td>Quiz, Tasks</td><td>20%</td></tr></table>
The final grade is determined by the following criteria:
<table><tr><th>Range</th><th>Grade</th></tr><tr><td>[85 – 100]</td><td>A</td></tr><tr><td>[75 – 85)</td><td>B+</td></tr><tr><td>[70 – 75)</td><td>B</td></tr><tr><td>[65 – 70)</td><td>C+</td></tr><tr><td>[60 – 65)</td><td>C</td></tr><tr><td>[50 – 60)</td><td>D</td></tr></table></td></tr>
<tr><td>Media employed</td><td>Whiteboard, Projector, Laptop</td></tr>
<tr><td>Reading List</td><td>1. Andrews, G. E.; Askey, R.; and Roy, R. Special Functions. Cambridge, England: Cambridge University Press, 1999.
2. Arscott, F. M. "The Land Beyond Bessel: A Survey of Higher Special Functions." In Ordinary and Partial Differential Equations (Ed. W. N. Everitt and B. D. Sleeman). New York: Springer-Verlag, 1981.
3. Luke, Y. L. The Special Functions and their Approximations, Vol. 1. New York: Academic Press, 1969.</td></tr>
</table>

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2				v							
CO3							v				

Date of Last Amendment :
February 16th, 2023

Mathematics Study Program
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MODULE HANDBOOK

Module name	Introduction to Optimization Theory
Module level, if applicable	Bachelor
Code, if applicable	22060112E89
Courses, if applicable	Introduction to Optimization Theory
Semester(s) in which the module is taught	6
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Si 2. Dr. Heni Widayani, M.Si 3. Dr. Usman Pagalay, M.Si
Language	Indonesian
Relation to curriculum	6th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Introduction to Optimization Theory course at least 80% of the meeting.
Recommended prerequisites	Calculus II, Linear Algebra, and Computer Programming
Module objectives/intended learning outcomes	CO1 Students are able to understand the concept of numerical optimization methods of each given problem CO2 Students are able to create algorithms for given numerical optimization methods CO3 Students are able to apply algorithms to software CO4 Students are able to draw conclusions from the analysis of numerical optimization methods carried out
Content	In this course, students will learn how to generalize optimization problems from 2R, 3R to nR, solve optimization problems numerically, and create programs to solve nonlinear optimization problems computationally. Specifically the material to be studied is Euclidean space nR , convex sets, convex functions, quadratic forms. Real variable functions, gradients, directional derivatives, local/global extremes. Extremes without constraints. Extremes with constraints in the form of equations with the Lagrange multiplier method. Extremes with constraints in the form of inequality, Kuhn-Tucker conditions. Quadratic Program. Numerical method: direct

	method, gradient method. Numerical method n variables, Numerical method optimization problems: direct search method (three-point interval method, Fibonacci method, Golden ratio method), gradient method, Newton-Raphson method, numerical method for problems with n variables, numerical method for optimization problems with constraints.
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. / Assessment Method / Weight 1 Final Test 40% 2 Midle Test 40% 3 Quiz, Tasks 20% The final grade is determined by the following criteria: Range / Grade [85 – 100] A [75 – 85) B+ [70 – 75) B [65 – 70) C+ [60 – 65) C [50 – 60) D
Media employed	Whiteboard, Projector, Laptop
Reading List	1. Edwin K.P Chong, Stanislaw H. Zak, *An Introduction To Optimization*, Weley Interscience,1995 2. D.G Luenberger, *Linier and Nonlinier Programming*, Addison, Wesley, 1984

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2									v		
CO3								v			
CO4										v	

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UNIVERSITAS ISLAM NEGERI MAULANA MALIK IBRAHIM MALANG
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MODULE HANDBOOK

Module name	Introduction to Wave Theory
Module level, if applicable	Bachelor
Code, if applicable	22060112E85
Courses, if applicable	Introduction to Wave Theory
Semester(s) in which the module is taught	5
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Si 2. Dr. Heni Widayani, M.Si 3. Dr. Usman Pagalay, M.Si
Language	Indonesian
Relation to curriculum	5th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Introduction to Introduction to Wave Theory course at least 80% of the meeting.
Recommended prerequisites	Partial Diffferential Equation
Module objectives/intended learning outcomes	CO1 Students are able to understand the concept of wave modeling and various simple wave equations CO2 students are able to create algorithms for given wave equations CO3 Students are able to apply algorithms to software CO4 Students are able to draw conclusions from the wave equation analysis carried out
Content	This course discusses the basic concepts of wave modeling and propagation analysis. In particular, this course will discuss monochromatic mode, dispersion relations, phase velocity, group velocity, two-wave superposition, multi-wave superposition, translational equations as simple wave equations, dissipation, nonlinear waves, Burger equations, wave modeling: Boussinesq, Korteweg de Vries, nonlinear Schrödinger.

<table>
<tr><td>Study and examination requirements and forms of examination</td><td>The final grade will be weighted as follows:
<table>
<tr><td>No.</td><td>Assessment Method</td><td>Weight</td></tr>
<tr><td>1</td><td>Final Test</td><td>40%</td></tr>
<tr><td>2</td><td>Midle Test</td><td>40%</td></tr>
<tr><td>3</td><td>Quiz, Tasks</td><td>20%</td></tr>
</table>
The final grade is determined by the following criteria:
<table>
<tr><th>Range</th><th>Grade</th></tr>
<tr><td>[85 – 100]</td><td>A</td></tr>
<tr><td>[75 – 85)</td><td>B+</td></tr>
<tr><td>[70 – 75)</td><td>B</td></tr>
<tr><td>[65 – 70)</td><td>C+</td></tr>
<tr><td>[60 – 65)</td><td>C</td></tr>
<tr><td>[50 – 60)</td><td>D</td></tr>
</table>
</td></tr>
<tr><td>Media employed</td><td>Whiteboard, Projector, Laptop</td></tr>
<tr><td>Reading List</td><td>1. Knobel, Roger. 1999. An Introduction to the Mathematical Theory of Waves. : Providence: American Mathematical Society
2. Wazwaz, Abdul-Majid. 2009. Partial Differential Equations and Solitary Waves Theory. Heidelberg: Springer Berlin</td></tr>
</table>

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2									v		
CO3								v			
CO4										v	

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MODULE HANDBOOK

Module name	Mathematical Image Processing
Module level, if applicable	Bachelor
Code, if applicable	#N/A
Courses, if applicable	Mathematical Image Processing
Semester(s) in which the module is taught	4
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Si 2. Dr. Heni Widayani, M.Si 3. Dr. Usman Pagalay, M.Si
Language	Indonesian
Relation to curriculum	th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Introduction to Mathematical Image Processing course at least 80% of the meeting.
Recommended prerequisites	Calculus
Module objectives/intended learning outcomes	CO1 Students are able to understand and develop mathematical concepts in basic image processing techniques CO2 Students are able to understand mathematical algorithms in image processing and implement them with programming languages CO3 Students are able to apply image processing techniques for more complex image processing applications individually or in groups in the form of presentations or papers
Content	This course will discuss the methods used in digital image processing. The lecture material consists of an introduction to image processing such as the application of image processing methods, how to work and the implementation of image processing methods on real problems. In particular, the material covered is Introductory Material on Image Processing, Intensity Transformation: negative image, log transformation, Gamma transformation, contrast stretching, histogram processing, Spatial Filter: basic spatial filter, lowpass spatial filter, highpass spatial filter, Filter in Frequency Domain: Discrete Fourier transform, basic filtering on

	frequency domain, image smoothing with filter on frequency domain, image sharpening with filter on frequency domain, Perona Malik Diffusion filter: diffusion equation, discretization Perona Malik Diffusion filter, Image processing morphology: erosion and dilation, opening and closing operations, basic morphology algorithm, Image segmentation: thresholding, region growing, region splitting and merging, segmentation by clustering, segmentation by snake method, level set method.
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. / Assessment Method / Weight 1 Final Test 40% 2 Midle Test 40% 3 Quiz, Tasks 20% The final grade is determined by the following criteria: Range / Grade [85 – 100] A [75 – 85) B+ [70 – 75) B [65 – 70) C+ [60 – 65) C [50 – 60) D
Media employed	Whiteboard, Projector, Laptop
Reading List	1. K. Bredies, D. Lorenz. 2018. Mathematical Image Processing. Birkhäuser Cham 2. G. Aubert, P. Kornprobst. 2002. Mathematical Problems in Image Processing: Partial Differential Equations and the Calculus of Variations. Springer New York, NY

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v	v							
CO2								v	v		
CO3										v	v

Date of Last Amendment :
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MODULE HANDBOOK

Module name	Mathematical Biology
Module level, if applicable	Bachelor
Code, if applicable	22060112E87
Courses, if applicable	Mathematical Biology
Semester(s) in which the module is taught	6
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Si 2. Dr. Heni Widayani, M.Si 3. Dr. Usman Pagalay, M.Si
Language	Indonesian
Relation to curriculum	6th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Introduction to Introduction to Wave Theory course at least 80% of the meeting.
Recommended prerequisites	Ordinary Differential Equation, Mathematical Modelling
Module objectives/intended learning outcomes	CO1 Students are able to understand the concept of mathematical models in biological processes CO2 Students are able to determine algorithms to solve biological modeling problems given CO3 Students are able to apply algorithms to software CO4 Students are able to make conclusions from the interpretation of the analyzed biological model
Content	In this course, students get to know the Mathematical model that concerns biological processes in population development, genetics, pharmacology, and disease spread problems. Specifically, the biological problems to be studied are Discrete population growth and differential equations, Species Resilience and Extinction, Genetic problems, Problems in pharmacology (medicine), Continuous population growth of one and two species (two-species competition model and predatorprey model), Problems of Disease Spread (Epidemiology)

Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. / Assessment Method / Weight 1 / Final Test / 40% 2 / Midle Test / 40% 3 / Quiz, Tasks / 20% The final grade is determined by the following criteria: **Range** / **Grade** [85 – 100] / A [75 – 85) / B+ [70 – 75) / B [65 – 70) / C+ [60 – 65) / C [50 – 60) / D
Media employed	Whiteboard, Projector, Laptop
Reading List	1. Murray, J. D. (2002). *Mathematical Biology I. An Introduction* (Vol. 17). New York: Springer. 2. Shonkwiler, R.W., Herod, J. (2009). Biology, Mathematics, and a Mathematical Biology Laboratory. In: Mathematical Biology. Undergraduate Texts in Mathematics. Springer, New York, NY.

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2									v		
CO3								v			
CO4										v	

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MODULE HANDBOOK

Module name	Boundary Value Problems
Module level, if applicable	Bachelor
Code, if applicable	22060112E86
Courses, if applicable	Boundary Value Problems
Semester(s) in which the module is taught	6
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Ari Kusumastuti, M.Si 2. Dr. Heni Widayani, M.Si 3. Dr. Usman Pagalay, M.Si
Language	Indonesian
Relation to curriculum	6th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Introduction to Boundary Value Problems course at least 80% of the meeting.
Recommended prerequisites	Ordinary Differential Equation, Partial Differential Equation
Module objectives/intended learning outcomes	CO1 Students are able to understand the concept of solving methods for the problem of limit requirements given CO2 Students are able to analyze the right method for the problem of the conditions given CO3 Students are able to apply the methods provided to find solutions to the problems of the limits given CO4 Students are able to draw conclusions from the numerical analysis carried out
Content	In this course, students will learn differential equations and problems of non-homogeneous boundary conditions, Vibration problems in semi-infinite strings without or with initial speed, Double Fourier Series, vibrations in circular membranes, Fourier-Legendre series and their applications, Laplace transform and its applications.
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. Assessment Method Weight

	1 Final Test 40% 2 Midle Test 40% 3 Quiz, Tasks 20% The final grade is determined by the following criteria:
Media employed	Whiteboard, Projector, Laptop
Reading List	1. Kreyszig, E. (1983). *Advanced Engineering Mathematics*, New York : John Wiley & Sons 2. Ross, S.L. (1980). *Introduction To Ordinary Differential Equation 3rd Edition*. New York : John Wiley & Sons 3. Zachmanoglou, E.C, Dale, W.Thoe.(1986). *Introduction to Partial Differential Equations With Applications*. New York : Dover Publications, Inc 4. Edwards, C.H. and Penney, D.E. and Calvis, D. 2008. Differential Equations and Boundary Value Problems: Computing and Modeling. Pearson Prentice Hall 5. Asmar, Nakhle H. 2016. Partial Differential Equations with Fourier Series and Boundary Value Problems: Third Edition (Dover Books on Mathematics). Dover Publications Inc.

Range	Grade
[85 – 100]	A
[75 – 85)	B+
[70 – 75)	B
[65 – 70)	C+
[60 – 65)	C
[50 – 60)	D

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2									v		

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MODULE HANDBOOK

Module name	Advanced Operations Research
Module level, if applicable	Bachelor
Code, if applicable	22060112E90
Courses, if applicable	Advanced Operations Research
Semester(s) in which the module is taught	6
Person responsible for the module	Head of the Applied Mathematics consortium
Lecturers	1. Hawzah Sa'adati, M.Si 2. Juhari, M.Si
Language	Indonesian
Relation to curriculum	6th semester elective courses
Type of teaching, contact hours	150 minutes of face-to-face and 180 minutes of structured activity per week.
Workload	The total lecture load is 136 hours per semester, consisting of 150 minutes of lectures per week for 14 weeks, 180 minutes of structured activities per week, 180 minutes of independent study per week, for a total of 16 weeks per semester including midle test and final test.
Credit points	3
Requirements according to the examination regulations	Students have taken the Introduction toAdvanced Operation Research course at least 80% of the meeting.
Recommended prerequisites	Elementary Linear Algebra, Discrete Mathematics
Module objectives/intended learning outcomes	CO1 Students are able to understand the concept of optimization from real cases with the method in question CO2 Students are able to solve optimization problems by compiling algorithms CO3 Students are able to implement algorithms on software
Content	In this course, students will be explained how to use the theory of Optimization Engineering to solve real problems. In particular, the material studied in this course is network theory, CPM/PERT and its applications, Decision analysis: introduction to decision theory, decision matrix, expectation value, decision tree, Dynamic program: recursive solution approach, back and forth calculation, Markov chain: introduction to Markov chain, transition opportunities, steady state condition, Simulation: introduction, analytical model and simulation model, Goal Programming: Introduction to Goal programming, constraint functions and goal functions
Study and examination requirements and forms of examination	The final grade will be weighted as follows: No. Assessment Method Weight

	1	Final Test	40%
	2	Midle Test	40%
	3	Quiz, Tasks	20%

The final grade is determined by the following criteria:

Range	Grade
[85 – 100]	A
[75 – 85)	B+
[70 – 75)	B
[65 – 70)	C+
[60 – 65)	C
[50 – 60)	D

Media employed	Whiteboard, Projector, Laptop
Reading List	1. Bhunia, Asokekumar & Sahoo, Laxminarayan & Shaikh, Ali. (2019). Advanced Optimization and Operations Research. 10.1007/978-981-32-9967-2. 2. Michael Carter, Camille C. Price, Ghaith Rabadi. 2008. Operations Research: A Practical Introduction *Advances in Applied Mathematics. CRC Press*

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2									v		
CO3								v			

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MODULE HANDBOOK

Module name	Operation Research
Module level, if applicable	Bachelor
Code, if applicable	22060111D22
Subtitle, if applicable	-
Courses, if applicable	Operation Research
Semester(s) in which the module is taught	6th (sixth)
Person responsible for the module	Lecture of Applied Mathematics
Lecturer(s)	Hawzah Sa'adati., M.Si.
Language	Indonesian
Relation to curriculum	Elective course in the third year (6th semester) Bachelor Degree
Type of teaching, contact hours	150 minutes lectures and 180 minutes structured activities per week for seven weeks 100 minutes lectures , 100 minutes work in the laboratory and 180 minutes structured activities per week for 7 weeks
Workload	Total workload is 141 hours per semester, which consists of 150 minutes lectures per week for 7 weeks, 100 minutes lectures per week for 7 weeks, 100 minutes work in the laboratory for 7 weeks, 180 minutes structured activities per week, 180 minutes individual study per week, in total is 16 weeks per semester, including mid exam and final exam.
Credit points	3(1)
Requirements according to the examination regulations	Students have taken Operation Research course and have an examination card where the course is stated on.
Recommended prerequisites	Students have taken the module of Linear Algebra and have participated in the final exam of the module.
Module objectives/intended learning outcomes	CO 1. Students are able to identify and formulate models in operation research. CO 2. Students are able to solve the models by their algorithms or technique. CO 3. Students are able to analyze and apply the models in real problems.

Content	Model, linear programming, application and algorithm for transportation, transshipment, assignment, and travelling salesman problem. Network models: shortest path problem, minimum spanning tree, maximum flow and critical path method.
Study and examination requirements and forms of examination	The final mark will be weighted as follows: No Assessment methods (components, activities) Weight (percentage) 1. Final Examination 35 % 2. Mid-Term Examination 35 % 3. Homework and Presentation 30 % The initial cut-off points for grades A, B, C, and D should not be less than 80%, 65%, 45%, and 35%, respectively.
Media employed	Projector, board, computer, e-learning via http://elearning.uin-malang.ac.id , LINGO.
Reading List	1. Hamdy A. Taha, 2007, *Operation Research: an introduction*, Collier Mac Milan International Edition. 2. David R. Anderson, Dennis J. Sweeney, and Thomas A. William, 1985, *An Introduction to Management Sciences : Qualitative Approach to Decision Making, Fourth Edition*, South Western Educational Publishing 3. Wayne L. Winston, 2004, *Operation Research Application and Algorithms*, Ruxbury Press. 4. John A. Lawrence and Barry A. Pasternack, 2006, *Applied Management Science*, John Wiley &Sons Inc.

PLO and CO Mapping

	PLO 1	PLO 2	PLO 3	PLO 4	PLO 5	PLO 6	PLO 7	PLO 8	PLO 9	PLO 10	PLO 11
CO1			v								
CO2									v		
CO3								v			

Date of Last Amendment :
July 27th, 2023