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

Master in Mathematics

Telp : +62 274 552243
Email : maths2@ugm.ac.id; kaprodi-s2-matematika.mipa@ugm.ac.id
sekprodi-s2-matematika.mipa@ugm.ac.id
Website : http://s2math.fmipa.ugm.ac.id/

MODULE HANDBOOK

Module Name	*Control Theory of Bilinear Systems*
Module level, if applicable	*Master's degree*
Code, if applicable	*MMM -6311*
Subtitle, if applicable	-
Courses, if applicable	*Control Theory of Bilinear Systems*
Semester(s) in which the module is taught	*1st (first)*
Person responsible for the module	*Chair of the Lab. of Applied Mathematics*
Lecturer(s)	*Dr. Solikhatun, M. Si.*
Language	*Bahasa Indonesia*
Relation to curriculum	*Elective course in the first year (1st semester) Master in Mathematics.*
Teaching methods	*Lectures, structured activities (assignments, quizzes, team-project), oral presentation*
Workload (incl. contact hours, self-study hours)	*Total workload is 136 hours per semester, which consists of 150 minutes lectures per week for 14 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*
Required and recommended prerequisites for joining the module	*Students should be have good knowledge in linear algebra and differential equations.*

<table>
<tr><td>Module objectives/intended learning outcomes</td><td>After completing this course, the students have ability to:

CO 1. construct the model from the real problem into state space form of bilinear systems.

CO 2. evaluate the solution of bilinear systems by using Lie algebra and Volterra series.

CO 3. analyze the properties of bilinear systems consist of stability, controllability and observability.

CO 4. design the controller for bilinear systems consist of linear and quadratic state feedback, sliding mode controller and optimal control.</td></tr>
<tr><td>Content</td><td>Modelling in state space form of bilinear systems by directly and Carlemen bilinearization. Approximation solution of bilinear systems by Lie algebra and Volterra series. Properties of bilinear systems consist of stability, controllability and observability. Observer. Control theory of bilinear systems: linear and quadratic state feedback, sliding mode controller and optimal control. Advanced topics.</td></tr>
<tr><td>Examination forms</td><td>Written assignments, written exams, quizzes and project based assignments.</td></tr>
<tr><td>Study and examination requirements</td><td>To pass the course, the minimum grade is C.
The final mark will be weighted as follows:
<table>
<tr><th>No</th><th>Assessment methods (components, activities)</th><th>Weight (percentage)</th><th>Cognitive</th><th>Project Base</th></tr>
<tr><td>1.</td><td>Final Examination (written exams)</td><td>35 %</td><td>20 %</td><td>15 %</td></tr>
<tr><td>2.</td><td>Mid-Term Examination</td><td>35 %</td><td>25 %</td><td>10 %</td></tr>
<tr><td>3.</td><td>Quiz, Homework (Written and case based assignments)</td><td>30 %</td><td>15 %</td><td>15 %</td></tr>
<tr><td></td><td>Total</td><td>100 %</td><td>60 %</td><td>40 %</td></tr>
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<tr><td>Media employed</td><td>Projector, board, computer, e-learning via http://elok.ugm.ac.id, simaster, online lecture via Zoom.</td></tr>
<tr><td>Reading list</td><td>[1] Elliot, D., 2009, Bilinear Control Systems: Matrices in Action, Springer.

[2] Amato, F., Cosentino, C., Fiorillo, A. and Merola,A., 2009, Stabilization of Bilinear Systems via Linear State-Feedback Control, IEEE Transaction on Circuits and Systems-II: Express Briefs via 56 (1).

[3] Solikhatun, 2016, Robus H∞ controller for bilinear systems by linear matrix inequalities, Doctoral Dissertation, Institut Teknologi Bandung.

[4] Al-Shamali, S., Crisalle, O.D., and Latchman, H., Sliding Mode Control for A Class of Bilinear Systems, Proceedings of the 46th IEEE Conference on Decision and Control New Orleans, LA, USA, Dec. 12-14, 2007.</td></tr>
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CO and PLO Mapping

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

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Modified Date	**:**	**9 August 2022**