UNIVERSITAS GADJAH MADA
Faculty of Mathematics and Natural Sciences
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Doctoral Program in Mathematics

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MODULE HANDBOOK
Master in Mathematics

Module name:	**Advanced Linear Algebra ("Aljabar Linear Lanjut")**
Code, if applicable:	**MMM 5201**
Semester(s) in which the module is taught:	**1st Semester (1st Year)**
Person responsible for the module:	**Chair of Algebra Research Group**
Lecturer(s):	1. Prof. Dr. Sri Wahyuni 2. Dr. Diah Junia Eksi Palupi 3. Dr. Indah Emilia Wijayanti 4. Dr. Ari Suparwanto 5. Dr. Budi Surodjo 6. Dr. Yeni Susanti 7. Dr. Al. Sutjijana
Language:	Bahasa Indonesia
Relation to curriculum:	Master Degree in Mathematics, Compulsory Course
Credit points:	3 Semester Credit Unit
Type of teaching, contact hours:	**3x50 minutes** lectures, **3x50 minutes** structured activities.
Workload:	• **3x50 minutes lectures,** • **3x50 minutes structured activities,** • **3x50 minutes individual study,** • **In 16 weeks per semester (including mid-term and final examinations).** • **Total Workload: 144x50 minutes per semester.**
Requirements according to the examination regulations:	NONE
Recommended prerequisites:	• Linear Algebra is the theory of vector spaces and linear maps. A vector space is formed by abstracting the two basic operations of addition and scalar-multiplication with vectors, while a linear map between two vector spaces is a map which respects these two basic operations. • These fundamental ideas turn out to be some of the most widespread notions in mathematics, and linear algebra has become the language to think about many mathematical problems and applications. It is therefore essential for every student of mathematics to master the theory of linear algebra. • There are two main objectives of this course. The first is to provide a thorough and conceptual treatment of the mathematical theory generally referred to as "Linear Algebra". The other equally important objective is for students to learn to read and write mathematical proofs. It aims at introducing the general concept of vector spaces, subspaces, dimensions, inner product spaces, etc. The

	course prepares the foundation on linear algebra for students' future study in mathematics and other disciplines. Many examples of applications will be drawn on different subject areas. • The recommended prerequisites: o Familiarity with elementary logic and basic mathematical notions, such as sets, maps, equivalence relations, etc.; o Knowledge of basic concepts of matrix algebra, such as vectors, matrices, and how to compute with them;
Module objectives/intended learning outcomes:	On successful completion of this course, students should be able to: **CO 1:** identify, describe, and apply fundamental concepts of linear algebra, consisting abstract vector space over general field, linear independence, generator, basis, dimension (including the infinite one). Linear transformations/operators, vector space of linear transformations, and dual space of a given vector spoace; and relate the calculations of linear transformations to that of matrices by choosing particular basis for diagonalization of a square matrix under appropriate conditions. **CO 2:** identify, describe, and apply the notions of inner product space over field of complex number and construct an orthonormal basis for an inner product space. Construct the adjoints of operators. Linear operators on inner product space: adjoints of operators, orthogonal/unitary operators, orthogonal/unitary diagonalization of self-adjoint/normal operators, symmetric bilinear form and quadratic form **CO 3:** develop specific mathematical skills, competencies and thought processes sufficient to support further study or work in this or related fields (especially skill on abstraction, generalization, and analogy), construct rigorous mathematical proofs and counterexamples
Content:	Vector space, subspace and its properties,Bases, Dimension of a vector space, Direct Sum, Linear Transformation (kernel, image of linear transformation), The rank Plus Nullity Theorem, The matrix of linear transformation, Change of bases for linear transformations, equivalence of matrices, Eigen Value and eigen vector, Dual bases, Inner product spaces, Norm and distance, Orthogonal and orthonormal bases, The projection Theorem and Best Approximations, The Riesz Representations theorem
Study and examination requirements and forms of examination:	The final mark will be weighted as follows: No Assessment methods (components, activties) Weight (percentage) 1 Final Examination 40% 2 Mid-Term Examination 30% 3 Class Activities: Quiz, Homework, etc 30%
Media employed:	Board, LCD Projector, Laptop/Computer
Reading List:	1. Bruce N. COOPERSTEIN, 2015, "Advanced Linear Algebra", Second Edition, Chapman and Hall/CRC 2. Morton L. CURTIS; 1999; "Abstract Linear Algebra"; Springer-Verlag, New York.

	3. Stephen WEINTRAUB**, "A Guide to Advanced Linear Algebra", MAA Mathematical Association of America.** 4. S. Roman, *Advanced linear algebra*, 2nd ed., Grad. Text in Math. 135, Springer-Verlag, 2005. 5. P.D. Lax, *Linear algebra and its applications*, 2nd ed., John Wiley & Sons, 2007.

Mapping of The COs and PLOs

	PLO – 1 S3 Mat	PLO – 2 S3 Mat	PLO – 3 S3 Mat	PLO – 4 S3 Mat	PLO – 5 S3 Mat	PLO –6 S3 Mat
CO 1			v			
CO 2			v			
CO 3		V		v	v	

Programme Learning Outcomes (PLO) Doctoral Programme in Mathematics

PLO-1	:	**Attitude:** Devote to God Almighty, uphold the humanity values, internalize academic values and ethics, responsible in working in the area of expertise independently.
PLO-2	:	**Knowledge:** Mastering philosophy of mathematics and one of the fields in mathematics (algebra, analysis, applied mathematics, statistics, computational mathematics, computational statistics).
PLO-3	:	**Knowledge:** Able to think logically, analytically, inductively, deductively, and structured; having the ability to manage, lead, and develop research programs independently, and able to communicate the thoughts as well as his work to the scientific community and the general public.
PLO-4	:	**Skill:** Creating new concepts and / or new methods (original) in the field of mathematics that are recognized nationally and internationally.
PLO-5	:	**Skill:** Able to apply mathematics according to their field of expertise to solve problems including those that require a multidisciplinary, cross-disciplinary, or trans-disciplinary approach.
PLO-6	:	***Life Long Learning:*** Having lifelong learning skills and adaptive to the development of science and technology, especially in fields related to Mathematics and its applications.