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MODULE HANDBOOK

Module Name	*Advanced Linear Algebra*
Module level, if applicable	*Master Programme*
Code, if applicable	*MMM-5201*
Subtitle, if applicable	-
Courses, if applicable	*Advanced Linear Algebra*
Semester(s) in which the module is taught	*1st Semester*
Person responsible for the module	*Chair of the Algebra Laboratory*
Lecturer(s)	*1. Prof. Dr. Sri Wahyuni* *2. Prof. Dr. Indah Emilia Wijayanti* *3. Dr. Ari Suparwanto, M.Si.* *4. Dr. Budi Surodjo, M.Si.* *5. Dr. Yeni Susanti, M.Si.* *5. Dr. Sutopo, M.Si.* *6. Uha Isnaini, M.Sc., Ph.D.*
Language	*Bahasa Indonesia*
Relation to curriculum	*Compulsory for Master of Mathematics*
Teaching methods	*lecture, case based*
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	1. *Students should be familiar to elementary logic and basic mathematical notions, such as sets, maps, equivalence relations, etc.* 2. *Students should have 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). Jumlah langsung dan 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 counter examples*

Content	*The study material for Advanced Linear Algebra can be divided into 2 groups, namely the Abstract Vector Space and the Inner Product Space.* *A. Abstract Vector Space over Any Field (before mid exam)* *Vector Spaces, Subspace, Existence of Bases (Generator, Linear-independent, Base including Infinite Dimensions), Product (Product), Direct Sum (including infinite index), Linear Transformation (Kernel, Image, Rank, Rank and Nullity Theorem), Vector Space of all linear transformations, Composition linear transformations, and inverse linear transformations, Matrix Representation of Linear Transformations. Base Change (Equivalence Relationship and Similarity Relation of two matrices), Linear Transformation Vector Space Isomorphism and Matrix Vector Space, Eigenvalue and EigenVector Linear Transformation, and Diagonalization, Dual Space, basis dual space, and isomorphism of vector space and dual space of its dual space .* *B. Inner Product Space over the complex number field C (after mid exam)* *Inner Product, Inner Product Space (IPS), Norm, Angle and Distance of two Vectors, Orthogonality, Orthonormal Basis, and Their Properties, Matrix of Representation of Linear Transformations in Inner Product Space, Gram-Schmidt Process to get Orthonormal Bases, Projections, and Idempotent Transformations, Dual Space of Inner Product Space, Adjoins of Linear Transforms of Inner Product Spaces, Riesz's Representation Theorem: Minimizing the distance of a vector to the subspace, Application to the determination of a function on a set of data: least squares approximation.*
Examination forms	*written task, oral presentation, mid and final exam*
Study and examination requirements	*The final mark will be weighted as follows:* *No Assessment methods (components, activities) — Weight (percentage)* *1. Final Examination — 25-40%* *2. Mid-Term Examination — 25-40%* *3. Quiz/Presentation — 20-30%* *4. Homework — 10-20%* *Minimum final mark to pass : 50 (grade C)*
Media employed	*Board, LMS eLOK UGM, LCD projector*

Reading list	*[1] Roman, S, 2005, Advanced linear algebra, 2nd ed., Grad. Text in Math. 135, Springer-Verlag.* *[2] Weintraub, S.H., 2011. A Guide to Advanced Linear Algebra (No. 44). MAA.* *[3] Lax, P.D., 2007, Linear algebra and its applications, 2nd ed., John Wiley & Sons.* *[4] Curtis, M.L., 2012. Abstract linear algebra. Springer Science & Business Media.* *[5] Cooperstein, B., 2010. Advanced linear algebra. CRC Press.*

CO-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

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