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

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MODULE HANDBOOK
Doctoral in Mathematics

Module name:	Real Functions
Module level, if applicable:	Doctoral Program
Code, if applicable:	MMM 5107
Semester(s) in which the module is taught:	1st (first) or 2nd (second)
Person responsible for the module:	Chair of Analysis Research Group
Lecturer(s):	Atok Zulijanto, S.Si.,M.Si.,Ph.D
Language:	Indonesian
Relation to curriculum:	Doctoral Degree in Mathematics, Elective Course
Credit points:	3 Semester Credit Unit
Type of teaching, contact hours:	3x50 minutes lectures, 3x60 minutes structured activities.
Workload:	• 3x50 minutes lectures, • 3x60 minutes structured activities, • 3x60 minutes individual study, • In 16 weeks per semester (including assignments and examinations)
Recommended prerequisites:	Before taking this course, students must have a good understanding about the completeness property of $\mathbb{R}$ and the concepts and properties in metric spaces.
Module objectives/intended learning outcomes:	After completing this course, the students should have: • CO 1. Ability to understand, analyze, and use the concepts and properties of limit superior and limit inferior to solve problems in mathematical analysis. • CO 2. Ability to understand, analyze, and use the concepts and properties of semi-continuous functions to solve problems in mathematical analysis. • CO 3. Ability to analyze, prove, and use the properties of Baire-1 functions and understand some recent development related to Baire-1 functions. • CO 4. Ability to understand, analyze, and use the concept and properties of Darboux functions to solve problems in mathematical analysis.
Content:	1. Limit superior and limit inferior of real functions. 2. Semi-continuous functions: the definition, properties, and characterization of upper and lower semi-continuous functions. 3. Baire class on functions: the classical definition and basic properties of Baire-1 functions, uniform limit of sequences of Baire-1 functions, and some characterization of Baire-1 functions. Some recent development related to Baire-1 functions. 4. Darboux functions: some properties of Darboux functions, characterization of Darboux functions, and some Darboux functions which are continuous.

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. 40% 2 Mid-term examination 30% 3 Other activities: presentation, homework, etc. 30% Final grade will be determined as follows: Grade Criteria The initial cut-off points for grades A, B, C, and D should not be less than 85%, 65%, 50%, and 40%, respectively.
Media employed:	Board, LCD Projector, Laptop/Computer
Reading List:	1. E.J. Mc Shane, *Integration*, Princeton University Press, 1947. 2. R.A. Gordon, *The integrals of Lebesgue, Denjoy, Perron and Henstock*, American Mathematical Society, 1994. 3. I.P. Natanson, *Theory of Functions of a Real Variable*, Vol 2, Frederick Ungar Publishing Co, New York, 1964. 4. A.B. Kharazishvili, *Strange Functions in Real Analysis*, Chapman & Hall/CRC, Boca Raton, 2006. 5. A.M. Brucner, J.B. Brucner, and B.S. Thomson, *Real Analysis*, Prentic Hall. Inc,New Jersey, 1997. 6. P.Y.Lee, W.-K.Tang, D. Zhao, An equivalent definition of functions of the first Baire class, Proc. Amer. Math. Soc. (2001), 129, 2273-2275. 7. Some recent papers related to Baire-1 functions.

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**			**V**	**V**
CO 2		**V**	**V**	**V**		**V**
CO 3		**V**	**V**	**V**	**V**	**V**
CO 4			**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.