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MODULE HANDBOOK

Module name	Introduction to Ergodic Theory
Module level, if applicable	Bachelor
Code, if applicable	MMM-4303
Subtitle, if applicable	-
Courses, if applicable	Introduction to Ergodic Theory
Semester(s) in which the module is taught	7th (seventh)
Person responsible for the module	Chair of the Lab. Mathematical Computation
Lecturers	Prof. Dr.rer.nat. Widodo, M.S.
Language	Bahasa Indonesia
Relation to curriculum	Elective course in the fourth year (7th semester) Bachelor Degree
Type of teaching, contact hours	150 minutes lectures and 180 minutes structured activities per week.
Workload	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
Requirements according to the examination regulations	Students have taken Introduction to Ergodic Theory course (MMM-4303), have attendance at least 75%, and have an examination card where the course is stated on.
Recommended prerequisites	Students have taken Dynamical System course (MMM-3306) and have participated in the final exam of the module.
Module objectives/intended learning outcomes	After completing this course, the students should have ability: CO 1. Understanding measure, general measure spaces, integral with respect to general measure, signed measure, Radon-Nikodym Theorem, Cesaro, Weak, and Strong Convergence on L^{p}. CO 2. Explaining Markov Operator, Perron-Frobenius Operator and Koopman Operator, Ergodicity, Mixing, Exactnes and Its Classifcation, CO 3. Explaining Classification of Functions with Perron-Frobenius Operators and Koopman Operator. CO 4. Explain and prove the Asymtotical Stability of Markov Operator and Asymtotical Stability of Frobenius-Perron Operator Induced by Expanding Piecewise Liner Functions. CO 5. Understanding and Explaining Boltzman Entropy. Boltzman Entropy H(P^{n}f) with Markov Operator P. Boltzman Entropy H(P^{n}f) with Perron-Frobenius Operator P. Explaining the Behavior H(P^{n}f) on Boltzman Entropy H(P^{n}f).
Content	Measure and general measure spaces, integral with respect to general measure, signed measure and Radon-Nikodym Theorem, Cesaro, Weak, and Strong Convergence on L^{p}. Markov Operator, Perron-Frobenius Operator and Koopman Operator. Ergodicity, Mixing, Exactnes and Its Classifcation. Classification of Functions with Perron-Frobenius Operators and Koopman Operator. Asymtotical Stability of Markov Operator. Asymtotical Stability of Frobenius-Perron Operator Induced by Expanding Piecewise Linear Functions. Boltzman Entropy. Boltzman Entropy H(P^{n} f) with Markov Operator P. Boltzman Entropy H(P^{n}f) with Perron-Frobenius Operator P. Behavior H(P^{n}f) on Boltzman Entropy H(P^{n}f).

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 Class Activities: Quiz, Homework, etc. 30% The initial cut-off points for grades A, B, C, and D should not be less than 80%, 70%, 50%, and 40%, respectively.
Media employed	White Board, LCD Projector, Laptop/Computer, MATLAB or Worlframalpha
Reading List	Compulsory Reading: 1. Lasota, A., and Mackey, M.C., 1994, Chaos, Fractals, and Noise, Stochastic Aspect of Dynamics, second edition, Springer-Verlag New York Inc. 2. Walters, P., 1982, An Introduction to Ergodic Theory, Graduate Text in Mathematics, Springer-Verlag New York Inc. Recommended Reading: 3. Royden, H.L.,1989, Real Analysis, Third edition, Macmillan Publishing Company, New York. 4. Smyth, M.R.F., 2002. A Spectral Theoritic Proof of Perron-Frobenius. Mathematical Pro-ceedings of The Royal Irish Academy, 102 A. 5. Taylor, S.R., 2004, Probabilistic Properties of Delay Differential Equations, A Ph.D Thesis Presented to the University of Waterloo in Fulfillment of the Thesis Requirement for the Degree of Doctor of Philosophy in Applied Mathematics, Waterloo, Ontorio, Canada. http://www.math.uwaterloo.ca/~sr2taylo 6. Ding, J., 1998. The Point Spectrum of Frobenius-Perron and Koopman Operators. Proceeding of the American Mathematical Society Vol. 126, No. 5, 1355-1361. http://www.ams.org./1998-126-05/S0002-9939-98-04188-4/home.html 7. Jablonski, M., 1984. On Convergence of Iterates of The Frobenius-Perron Operator. http://www.im.uj.edu.pl/actam/pdf/24-7-13.pdf 8. Widodo, 2012. Diktat Kuliah Teori Ergodik (Ergodic Theory). Departemen Matematika FMIPA UGM.

PLO and CO Mapping

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