

Course Category	TBA	Credits	2
Subject Code	TBA	Taking Year	1 <sup>st</sup> Grade, 2 <sup>nd</sup> Grade
Course Title (Japanese)	微分方程式の安定性理論	Course Period	1 <sup>st</sup> Semester
Course Title	Stability Theory of Ordinary Differential Equations	Day of the week / Hour	Thursday / The fifth period
Registration Code	TBA	Compulsory / Elective	Elective
Instructor(s)	Jitsuro Sugie	Course Qualification	Students of Postgraduate Mathematics Course

Course Style	Lecture
Course Aim	When performing mechanical design, it is required that a gap from the favorable state (the equilibrium state) disappears with time. Amplification of the gap may cause the destruction of the machine. To avoid this risk, the stability theory of differential equations is necessary. The need of the stability theory is not limited to mechanical design. Natural phenomena, life phenomena, social phenomena are often described by differential equations. It is very important to discuss mathematically whether the equilibrium state of such a differential equation is stable. In this course, Lyapunov stability theory is mainly learned. This theory has been named after Alexander Lyapunov who is a Russian mathematician. The purpose of this course is to introduce the basic idea of Lyapunov stability theory.
Goals and Objectives (Level of Achievement)	The achievement targets are 1. to understand how to proceed with the proofs of theorems; 2. to develop the ability to make full use of the $(\epsilon, \delta)$ -definition of limit through the concrete proofs; 3. to learn the basics knowledge of phase plane analysis.
Course Plan	1. Guidance and mental attitude in this course 2. Linear systems with constant coefficients and phase plane analysis 3. Definition of stability and attraction 4. Definition of global asymptotic stability 5. Definition of boundedness 6. Presentation about the related contents (No.1) 7. The meaning of the direct method of Lyapunov 8. Lyapunov's stability theorem 9. Chetaev's instability theorem 10. Lyapunov's asymptotic stability theorem 11. Presentation about the related contents (No.2) 12. Boundedness theorem by Yoshizawa 13. Application to Liénard's equation 14. Invariant set and global asymptotic stability 15. Presentation about the related contents (No.3)
Teaching Methods	The reports are imposed as appropriate. Students attending this course must announce the contents of self-learning sometimes. Additional presentation might be carried out outside of class time.
Key Words	Ordinary differential equations, Dynamical Systems, Stability Theory, Lyapunov's Direct (Second) Method, Lyapunov functions, Phase Plane Analysis, Trajectory (or Orbit), Presentation
Texts	None
Reference Books	[1] Yoshizawa, T., Stability Theory by Liapunov's Second Method, Publications of the Mathematical Society of Japan, Tokyo, 1966. [2] Yoshizawa, T., Stability Theory and the Existence of Periodic Solutions and Almost Periodic Solutions, Appl. Math. Sci. No.14, Springer-Verlag, New York, 1989. [3] Rouche, N., Habets, P. and Laloy, M., Stability Theory by Liapunov's Direct Method, Appl. Math. Sci. No. 22, Springer-Verlag, New York, 1977.

	<p>[4] LaSalle, J. and Lefschetz, S., Stability by Liapunov's Direct Method, Math. Sci. Eng. No. 4, Academic Press, New York, 1961.</p> <p>[5] Perko, L., Differential Equations and Dynamical Systems, Texts Appl. Math. No. 7, Springer-Verlag, New York, 1991.</p> <p>[6] 山本稔, 常微分方程式の安定性, 実教出版, 1979.</p> <p>[7] 马知恩, 周义仓, 常微分方程定性方法与稳定性方法, 科学出版社, 2001.</p> <p>[8] 廖晓昕, 稳定性的理论, 方法和应用 (第2版), 华中师范大学出版社, 2011.</p>
Other Teaching Materials	Further references and materials will be given in this course.
Performance Evaluation	Evaluation is based up on reports (35%), class attendance (15%) and presentation (50%).
Notes on the Course	Basic knowledge about linear ordinary differential equations is required in this course. The knowledge of linear algebra is also necessary. Moreover, a high learning level of the $(\epsilon, \delta)$ -definition of limit is required.
Office Hour	Wednesday evening (about 16:00~), Room No. 607 or No. 608, Building No. 3, Interdisciplinary Faculty of Science and Engineering
Other Notes	None