Course Category	TBA	Credits	2
Subject Code	TBA	Taking Year	1st Grade, 2nd Grade
Course Title (Japanese)	応用遅延微分方程式論	Course Period	2nd Semester
Course Title	Delay Differential Equations with Applications	Day of the week / Hour	Tuesday / The fifth period
Registration Code	TBA	Compulsory / Elective	Elective
Instructor(s)	Yukihiko Nakata Jitsuro Sugie	Course Qualification	Students of Postgraduate Mathematics Course

Course Style	Lecture
Course Aim	This course is intended to be an introduction to the theory of delay differential equations and applications. A delay equation describes a rule for extending the unknown function based on the history (the state at a past time) and is particularly important in many disciplines. We study the functional analysis framework and relevant dynamical system theories to analyze delay equations. Concrete examples from population biology will be given.
Goals and Objectives (Level of Achievement)	We study an introductory part of the theory of delay differential equations. We analyze qualitative properties such as asymptotic behavior of solutions by the way of examples. Relevant dynamical system theories and functional analysis approaches will be discussed.
Course Plan	1. Introduction: examples of delay equations 2. The simplest delay equation: stability and oscillation 3. Stability and the characteristic equation 4. Analysis of a mathematical model: equilibrium 5. Analysis of a mathematical model: asymptotic behavior 6. Fundamental theory 1 7. Fundamental theory 2 8. Introduction to dynamical systems 9. The characteristic equation revisited 10. Global dynamics: the Wright equation 1 11. Global dynamics: the Wright equation 2 12. Periodic solutions by Kaplan and Yorke 13. Delay equation formulation for structured population dynamics 1 14. Delay equation formulation for structured population dynamics 2 15. Presentation
Teaching Methods	Homeworks will be given during the course.
Key Words	Delay differential equation, Dynamical system, Stability theory, Mathematical modeling, Population dynamics
Texts	H. Smith, An introduction to delay differential equations with applications to the life sciences, Text in Applied Mathematics 57, Springer Verlag (2010).
Reference Books	[1] Y. Kuang, Delay Differential Equations with Applications in Population Dynamics, Mathematics in Science and Engineering 191, Academic Press Inc., Boston MA (1993). [2] J. K. Hale, S. M. V. Lunel, Introduction to Functional Differential Equations, Applied Mathematical Sciences 99, Springer (1993) [3] O. Diekmann, S. A. van Gils, S. M. V. Lunel, H-O. Walther, Delay equations: Functional, Complex, and Nonlinear Analysis, Applied Mathematical Sciences 110, Springer (1995).
Other Teaching Materials	Additional references will be suggested during the course.
Performance Evaluation	The course evaluation will be based on the performance during the course.
Notes on the Course	None
Office Hour	Upon appointment
Other Notes	None