View Syllabus Information

Course Information

Year	2024	School	School of Fundamental Science and Engineering		
Course Title	Differential Equations A English-based Undergraduate Program				
Instructor	OHNAWA, Masashi				
Term/Day/Period	spring semester Fri.5				
Category	Restricted Elective Courses in the Major	Eligible Year	4th year and above	Credits	2
Classroom	63-04-22	Campus	Nishi-Waseda(Former: Okubo)		
Course Key	26MA033004	Course Class Code	01		
Main Language	English				
Class Modality Categories	[On-campus] Hybrid (over 50% of classes on-campus)				
Course Code	MATX33ZL				
First Academic disciplines	Mathematics				
Second Academic disciplines	Mathematics				
Third Academic disciplines	Analysis				
Level	Advanced, practical and specialized	Types of lesson	Lecture		

Syllabus Information

Latest Update：2024/02/15 11:45:28

Course Outline	In this course, students learn ordinary differential equations (ODE) of initial value problems (IVP). We begin with the construction of solutions for a general class of ODEs. After we learn solution formulae and properties of linear systems of constant coefficients, we explore the analysis of typical nonlinear systems appearing e.g., in engineering, biology, and medicine. Through the analysis of these examples, students will realize the usefulness of theories of ODEs.
Objectives	Learn methods and theories to analyze the solutions to ODEs which appears in natural sciences and engineering.
before/after course of study	Students are expected to read the material in advance and review the lecture in detail every week.
Course Schedule	1: Overview of initial value problems(IVPs) We overview the course and recall preliminary knowledge. 2: Theorem on unique existence of solutions to IVPs We prove basic theorem which assures the unique existence of the solution to IVPs. 3: General theory for linear systems of ODEs We study general properties of the solutions to linear systems of ODEs. 4: Solution formulae and properties of linear systems of constant coefficients We consider homogeneous linear systems of ODEs and learn the solution formula making use of the diagonalization. 5: Exponential functions of matrices and examples We study the way to compute exponential functions of matrices owing to spectral decomposition. 6: Asymptotic behavior of solutions to 2x2 linear systems of constant coefficients We study the behavior of the solutions to possibly nonlinear systems as time tends to infinity making use of the knowledge we learned for linear systems. 7: Analysis of nonlinear ODEs through linearization We consider autonomous systems analyze the behavior of solutions around equilibrium points. 8: Stability analysis via the Lyapunov functions We consider the stability of equilibrium points by constructing suitable functions called Lyapunov functions. 9: Hamiltonian systems We study special class of ODEs called the Hamiltonian systems which appear in many physical systems. 10: Lotka-Volterra type equations (I) We apply methods in previous sections to analyze prey-predator models in biology. 11: Lotka-Volterra type equations (II) We introduce additional standard techniques to analyze two-species competition model equations in biology. 12: Poincaré-Bendixson's theorem and limit cycles We consider ODEs of two variables and study sufficient conditions called the Poincaré-Bendixson theorem on the existence of periodic solutions. 13: Boundedness of the solution We show boundedness of solutions to typical ODEs in the previous lectures so that we can apply the Poincaré-Bendixson theorem. 14: Numerical solution of initial value problems We study the way to numerically compute solutions to ODEs and learn the properties of the numerical solutions such as convergence to exact solutions.
Textbooks	No textbook is specified.
Reference	A list of reference textbooks will be given in the lecture.
Evaluation	The evaluation will fully be based on two or three reports which will be presented during the course.
Note / URL	The lecture will be given either on site (no less than seven lectures) or online.