## Term Information

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| **Effective Term** | Autumn 2016 |

## General Information

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| **Course Bulletin Listing/Subject Area** | Mathematics |
| **Fiscal Unit/Academic Org** | Mathematics - D0671 |
| **College/Academic Group** | Arts and Sciences |
| **Level/Career** | Graduate |
| **Course Number/Catalog** | 7412.02 |
| **Course Title** | Ordinary Differential Equations II |
| **Transcript Abbreviation** | Ordin Differ Eqs 2 |
| **Course Description** | Topological equivalence of nonlinear systems; normal forms of Poincare-Dulac-Birkhoff; classification of vector fields near critical points; local bifurcation theory; topological dynamics; limit sets; flows on the torus. |
| **Semester Credit Hours/Units** | Fixed: 3 |

## Offering Information

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| **Length Of Course** | 14 Week |
| **Flexibly Scheduled Course** | Never |
| **Does any section of this course have a distance education component?** | No |
| **Grading Basis** | Satisfactory/Unsatisfactory |
| **Repeatable** | No |
| **Course Components** | Lecture |
| **Grade Roster Component** | Lecture |
| **Credit Available by Exam** | No |
| **Admission Condition Course** | No |
| **Off Campus** | Never |
| **Campus of Offering** | Columbus |

## Prerequisites and Exclusions

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|---|---|
| **Prerequisites/Corequisites** | By permission of the instructor. This course section is open only to mathematics post-candidacy students. |
| **Exclusions** | |

## Cross-Listings

**Cross-Listings**

## Subject/CIP Code

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|---|---|
| **Subject/CIP Code** | 27.0103 |
| **Subsidy Level** | Doctoral Course |
| **Intended Rank** | Doctoral |

## Requirement/Elective Designation

The course is an elective (for this or other units) or is a service course for other units

## Course Details

**Course goals or learning objectives/outcomes**

- Students will acquire the theoretical understanding and problem solving skills in ordinary differential equations that will enable them to use techniques in this field in conducting mathematical research in related areas.

**Content Topic List**

- Topological equivalence of nonlinear systems
- Normal forms of Poincare-Dulac-Birkhoff
- Classification of vector fields near critical points
- Local bifurcation theory
- Topological dynamics
- Limit sets
- Flows on the torus
- Second order linear equations: transport, Laplace, heat, wave equations
- First order equations: characteristics, conservation laws, Hamilton-Jacobi equations
- Other solution methods: separation of variables, similarity solutions, Fourier transform method, Laplace transform method, Hopf-Cole transformation, Legendre transform, singular perturbation
- Cauchy-Kovalevskaya Theorem

## Attachments

- MATH_7412.02_Syllabus.pdf: 7412.02 Syllabus

*(Syllabus. Owner: Kerler,Thomas)*

## Comments

- This course request relates to our course change request for Math 7412.01.
(See that request for explanations and rationale) *(by Kerler,Thomas on 11/27/2015 09:09 PM)*

## Workflow Information

| Status | User(s) | Date/Time | Step |
|---|---|---|---|
| Submitted | Kerler,Thomas | 12/01/2015 01:59 PM | Submitted for Approval |
| Approved | Husen,William J | 12/01/2015 02:02 PM | Unit Approval |
| Approved | Haddad,Deborah Moore | 12/01/2015 03:11 PM | College Approval |
| Pending Approval | Nolen,Dawn<br>Vankeerbergen,Bernadette Chantal<br>Hanlin,Deborah Kay<br>Jenkins,Mary Ellen Bigler<br>Hogle,Danielle Nicole | 12/01/2015 03:11 PM | ASCCAO Approval |

**Math 7412.02** Syllabus **Autumn 2016**

# Ordinary Differential Equations II

## Instructor and Class Information


**Lecturer:** Ovidiu Costin
**Office:** MW404
**Phone:** 2-7844
**Email:** costin.9@osu.edu


**Course Num.:** 7412
**Lecture Room:**
**Lecture Times:**
**Office Hours:**

## About Course Goals

### Format

The course will meet three times a week for 55 minutes each meeting. Instructions will be mainly by lecture delivered by the instructor. It may also include occasional in-class discussion as well as short student presentations, particularly, by post-candidacy students.

### Description & Goals

The course will focus on: Topological and analytic equivalence of nonlinear systems; normal forms of Poincare-Dulac-Birkhoff; the Poincare-Dulac theorem; integrability and chaos; Painleve systems; the Riemann-Hilbert problem; solving integrable systems.

### Prerequisites

This section is open only to mathematics post-candidacy students and requires, in addition, the permission of the instructor. Expected preparations include elementary theory of ODEs, real analysis, and complex analysis.

## Textbook

### Main Reference

I will provide course notes for most topics, based on the additional references below.

### Additional References

E.A. Coddington and N. Levinson: *"Theory of Ordinary Differential Equations",* McGraw-Hill, New York, (1955).

V.I. Arnold: *"Geometrical Methods in the Theory of Ordinary Differential Equations",* 2nd edition, Springer, (1996).

## Assessments

### Reading, Participation, and Attendance

Students are required to read scheduled textbook materials and actively participate in class room discussions that arise from lecture material. Students are expected to attend all classes.

### Research Oriented Presentation

Post-candidacy students in this section are required to deliver a half hour presentation that both synthesizes lecture material and connects it to relevant research questions, more advanced

theoretical topics, or applications in other fields of mathematics. The topic and required independent reading will be determined by the instructor individually in negotiation with the student. Presentations may also be replaced by respective research papers upon the request of the student.

## Grading

### COURSE GRADE

This course section is graded satisfactory/unsatisfactory. A satisfactory outcome will require continued active participation in class (weighed about 20%) and be further based on the student's performance during the presentation (weighed about 80%).

## Weekly Schedule

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| **Week 1** | Review of properties of differential equation. Lower order systems, phase portraits. |
| **Week 2** | Singularities of the first and second kind. Overview of the theory of linear systems. Frobenius theory. Asymptotic solutions. |
| **Week 3** | Anosov and circle diffeomorphisms. Flows on the torus. |
| **Week 4** | Topological and analytic equivalence. |
| **Week 5** | KAM techniques. Homological equations. The Siegel and Brjuno conditions |
| **Week 6** | Equivalence to the linear part. The Poincare domain. Kolmogorov's iteration. |
| **Week 7** | Analysis of the iteration under the Siegel condition. The Poincare-Dulac theorem. |
| **Week 8** | Resonance and resonant monomials. The extended system. |
| **Week 9** | Applications and examples. Connection to the Frobenius theory. |
| **Week 10** | Integrable and chaotic systems. Criteria of solvability. The Painleve property. |
| **Week 11** | Local bifurcation theory. |
| **Week 12** | Topological dynamics; limit sets. |
| **Week 13** | Integrable systems. Painleve equations. |
| **Week 14** | The Riemann-Hilbert problem. Solving the Painleve equations. |

## General Policies

### ACADEMIC MISCONDUCT

It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. The term “academic misconduct” includes all forms of student academic misconduct wherever committed; illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct (http://studentaffairs.osu.edu/info_for_students/csc.asp).”

### DISABILITY SERVICES

Students with disabilities that have been certified by the Office for

Disability Services will be appropriately accommodated and should inform the instructor as soon as possible of their needs. The Office for Disability Services is located in 150 Pomerene Hall, 1760 Neil Avenue; telephone 292-3307, TDD 292-0901; http://www.ods.ohio-state.edu/.