Independent Study

Independent study enables a student to pursue for course credit a research or other academic topic of interest under the supervision of a faculty member. Independent study is of two types:

- Independent Study (non-research)
- Research Independent Study

Courses entitled **Independent Study** provide opportunities for individual non-research directed study in a field of special interest on a previously approved topic taken under the supervision of a faculty member and resulting in an academic and/or artistic product. Courses entitled **Research Independent Study** provide opportunities for individual research in a field of special interest under the supervision of a faculty member, the central goal of which is a substantive paper or written report containing significant analysis and interpretation of a previously approved topic.

Policies

The following policies apply to both types of independent study:

- **Approval** — The independent study must be approved by the instructor(s) involved as well as by the Division Chair and the student's Academic Advisor.
- **Faculty appointment** — The instructor of record (supervising faculty member) must hold a regular rank faculty appointment at Duke Kunshan University in the academic unit sponsoring the independent study. In some cases, there may be an additional instructor who mentors the bulk of the independent study and holds an appointment outside the sponsoring academic unit. If this is the case, the supervising faculty member is responsible for submitting the final grade, and ensuring that the instructor adheres to academic standards, policies, and procedures pertaining to undergraduate students at Duke Kunshan University.
- **Course Content / Quality** — The independent study must provide a rigorous academic experience equivalent to that of any other undergraduate DKU course. Independent study courses may not duplicate available course offerings in the semester or summer term in which the independent study is being taken, nor may independent study be used simply to provide low-level support for other projects or to observe or shadow the work of others.
- **Meeting schedule** — The student will meet with the instructor of the independent study at least once a week for a 7-week course and during the summer or every two weeks for a 14-week course. In addition, the individual effort of the student normally entails:
    - For a 4-credit course: ~20 hours per week for a 7-week course or ~10 hours per week for a 14-week course.
    - For a 2-credit course: ~10 hours per week for a 7-week course or ~5 hours per week for a 14-week course.

- **Final product** — The student will produce a final academic and/or artistic product to be completed during the semester for which the student is registered for the course.
- **Grading** — The instructor will evaluate the work, offer midterm feedback and evaluate the final product associated with the independent study, and submit a grade by the end of the course period. If the instructor is someone other than the supervising faculty member, the instructor will consult on the final grade with the supervising faculty member from the sponsoring academic unit, who will submit the final grade.
- **Credit toward a major** — The Dean of Undergraduate Studies, in consultation with the appropriate Division Chair, will determine whether an independent study course successfully completed will count toward the major.

Note: Though uncommon, it is not prohibited for a student to take more than one independent study course in a semester. Students may not receive academic credit for work (e.g., in a laboratory, an internship, etc.) for which they receive monetary compensation.

Procedures

- If you wish to register for an independent study or research independent study, you must first find and make arrangements with a faculty member having expertise in the desired area. It is best to begin this process in the semester before you intend to enroll as there will be many details to work out.
- You and your faculty instructor should agree on the course title, plan of study, objectives and expectations, as well as on the nature of the final product and evaluation criteria.
- Then you need to complete and submit the signed Independent Study Permission Form. Your instructor (or the supervising faculty member from a sponsoring academic unit) will provide you with a course number, section number, and permission number which you will then use to enroll. You should complete your enrollment by the end of the drop/add period.

Detailed Description of the Independent Study including Final Product; Scheduled Meetings and Work Expectations; Grade Basis, etc.

1. Title and Description of Proposed Study

Provide a detailed description of the proposed study, including topic, general course goals, a rationale for independent study as opposed to regular course work, etc.

The proposed 2-credit independent study, **Introduction to Symplectic Geometry**, offers an opportunity for an in-depth exploration of a foundational area of modern mathematics. Symplectic geometry is central to various domains, including classical mechanics, where it originated, and more recent advances in string theory, particularly in the context of mirror symmetry.

Building upon the material covered in MATH 408 Differential Geometry, this course will delve deeper into the study of symplectic geometry by examining the mathematical framework that involves symplectic forms on manifolds. Topics will include the symplectic formulation of classical mechanics, the properties of symplectic manifolds, Hamiltonian systems, and the role of symmetries in simplifying dynamics through symplectic reduction.

This independent study is essential because symplectic geometry is not currently covered by the existing curriculum at DKU. The self-directed nature of this course allows for a focused investigation into this rich area of mathematics, which will not only enhance my understanding of the subject but also contribute to my preparation for a possible Signature Work project in this field.

As part of the course, I will produce a comprehensive report on a topic within symplectic geometry and present my findings through informal whiteboard sessions. These tasks will further refine my scientific writing and presentation skills, both of which are critical for my academic development and future professional pursuits.

2. Learning Objectives

List the learning objectives for the course. The objectives should be specific and measurable, and should clearly state what students will be able to do after successfully completing the course.

After successfully completing this course, the student will be able to:

- State the definitions of basic concepts of symplectic geometry (such as symplectic forms, symplectic manifolds, Hamiltonian systems, Hamiltonian group actions, moment maps, etc.).
- Reproduce the proofs of selected theorems of symplectic geometry (such as the Darboux theorem, Marsden-Weinstein theorem, etc.).
- Apply the main results and techniques of symplectic geometry (such as symplectic reduction, the convexity theorem, the Delzant construction, etc.).

3. Research / Readings to be conducted

List the required texts or resources that students will need to purchase or access, including textbooks, software, lab manuals, or equipment such as safety goggles, clickers, etc., and sources

where they can be obtained. Briefly describe the research/readings to be conducted (for example, writing (specific type of paper), laboratory investigations, do library research, deliberate about ethical dilemmas, etc.).

The course will be based on the following book, available in the Duke Library:

> Ana Cannas da Silva, **Lectures on Symplectic Geometry**, Lecture Notes in Mathematics, 1764, Springer (2001).

The course will cover the following topics from the book each week:

- Week 1: Part I, Symplectic Manifolds (Ch. 1, 2)
- Week 2: Part II, Symplectomorphisms (Ch. 3, 4)
- Week 3: Part III, Local Forms (Ch. 6, 7, 8)
- Week 4: Part VII, Hamiltonian Mechanics (Ch. 18, 19)
- Week 5: Part VIII, Moment Maps (Ch. 21, 22)
- Week 6: Part IX, Symplectic Reduction & Part X, Moment Maps Revisited (Ch. 23, 27)
- Week 7: Part XI, Symplectic Toric Manifolds (Ch. 28, 30)

4. Nature of the Final Product

Describe the nature and length of the final product (e.g. academic paper, artistic product, research report, etc.)

The final product will be a self-contained and comprehensive report of at least 10 pages on a specific topic in symplectic geometry. The report will be written using LaTeX on Overleaf (document will be shared with the instructor).

5. Scheduled Meetings and Work Expectations

Provide information on frequency and length of meetings with instructor, and expected work commitments and / or timetables.

The course will be based on the seven topics we have chosen (see under "Research / Readings to be conducted") which will be covered successively in the seven weeks of session 2. There will be a weekly meeting of about one hour to one hour and a half, and each week the student will present the contents for of the corresponding topic on the board. The overall work commitment for the student will be about 10 hours per week including also self-study, presentation preparation, homework assignments, and report writing.

6. Grade to be based on

Provide information on how your work in the course is to be evaluated.

The final grade will be based on:

- 20%, **final product (report)** that will be submitted in the final exam week.
- 20%, **oral exam** that will take place in the final exam week.

- 20%, **homework assignments** that will be assigned weekly.
- 40%, **exposition of the course material** during the seven course meetings.