

Term Information

Effective Term Spring 2023

General Information

Course Bulletin Listing/Subject Area Mathematics
Fiscal Unit/Academic Org Mathematics - D0671
College/Academic Group Arts and Sciences
Level/Career Graduate
Course Number/Catalog 7821.01
Course Title Geometric Group Theory
Transcript Abbreviation Geom Group Theory
Course Description Caley graphs, Quasi-isometries, Fundamental Lemma of GGT, Bass-Serre theory, Free groups, amalgams, surface groups, Universal covers, Hyperbolic space, Nonpositive curvature and CAT(0) geometry, Hyperbolic groups, Simple complexes of groups, Coxeter groups, Artin groups, Graph products of groups, Actions on CAT(0) cube complexes. Examples of group actions on contractible polyhedra.
Semester Credit Hours/Units Fixed: 3

Offering Information

Length Of Course 14 Week, 12 Week
Flexibly Scheduled Course Never
Does any section of this course have a distance education component? No
Grading Basis Letter Grade
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

Prerequisites/Corequisites MATH 6801
Exclusions Not open to students with credit for 7821.02
Electronically Enforced No

Cross-Listings

Cross-Listings

Subject/CIP Code

Subject/CIP Code 27.0101
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

- Acquire basic concepts and skills in Geometric Group Theory in preparation for research in this and related areas.

Content Topic List

- Cayley graphs, quasi-isometries and fundamental lemma of GGT.
 - Bass-Serre theory: actions on trees, graph of spaces/groups, amalgamations and HNN extensions.
 - Higher-dimensional generalizations of Bass-Serre theory: complex of groups, wall-spaces and cubulation.
 - Curvature of metric spaces/groups: Gromov-hyperbolicity, quasi-geodesic combings and semi-hyperbolicity, CAT(0) spaces.
 - Specific examples of groups/spaces: Coxeter groups, Artin groups, Bestvina-Brady groups, Thompson groups, graph products and right-angled buildings, Tits buildings, Davis buildings.
 - Special cube complexes: canonical completion and retraction, residual properties of groups
- No

Sought Concurrence

Attachments

- MATH7821.01_GGT_SyllabusNew.pdf: Math 7821.01 Sample Syllabus

(Syllabus. Owner: Kerler, Thomas)

Comments

- Mathematics splits each of its 7000-level courses into a .01 and .02 section, to be taught by the same instructor in the same class, but different expectations.
.01-sections are for pre-candidacy students and non-math graduate students. They are letter graded, and require standard homework/exam assignments.
.02-sections are for math post-candidacy students only. They are S/U graded and generally require the completion of a project or presentation determined by the instructor.
This allows out post-candidacy students to receive supplementary training without diverting too much time from their dissertations. *(by Kerler, Thomas on 04/22/2022 12:14 PM)*

Workflow Information

| Status | User(s) | Date/Time | Step |
|------------------|---|---------------------|------------------------|
| Submitted | Kerler, Thomas | 04/22/2022 08:25 PM | Submitted for Approval |
| Approved | Husen, William J | 04/23/2022 08:36 AM | Unit Approval |
| Approved | Vankeerbergen, Bernadette Chantal | 05/02/2022 11:53 AM | College Approval |
| Pending Approval | Cody, Emily Kathryn Jenkins, Mary Ellen Bigler Hanlin, Deborah Kay Hilty, Michael Vankeerbergen, Bernadette Chantal Steele, Rachel Lea | 05/02/2022 11:53 AM | ASCCAO Approval |

Geometric Group Theory

Instructor and Class Information

| | |
|-----------|----------------|
| Lecturer: | Course Num.: |
| Office: | Lecture Room: |
| Phone: | Lecture Times: |
| Email: | Office Hours: |

Course Information

COURSE GOALS

Students will acquire knowledge on the basics of geometric group theory, as well as have a sense of several topics in the frontier of this subject. This will enable them to conduct research in geometric group theory and related area.

COURSE DESCRIPTION

The course will begin with the introduction or review of topological concepts such as Cayley graphs, Quasi-isometries, Fundamental Lemma of GGT, Bass-Serre theory, free groups, amalgams, surface groups, and universal covers. This is followed by geometric notions such as hyperbolic space and nonpositive curvature and CAT(0) geometries. Topics related to groups and group actions are hyperbolic groups, Simple complexes of groups, Coxeter groups, Artin groups, graph products of groups, and actions on CAT(0) cube complexes. Examples of group actions on contractible polyhedra will be emphasized.

FORMAT

The course will meet three times a week for 55 minutes each meeting.

PREREQUISITES

MATH 6801, or permission of instructor.

Textbooks

MAIN REFERENCES (REQUIRED)

M. Bridson and A. Haefliger, *Metric spaces of non-positive curvature*, Springer 1999. ISBN 3-540-64324-9

SUPPLEMENTARY TEXTS (RECOMMENDED)

M.W. Davis, *The geometry and topology of Coxeter groups*, Princeton Univ. Press, 2008. ISBN-10: 0-691-13138-4

C. Druţu and M. Kapovich, *Geometric group theory*. With an appendix by Bogdan Nica. American Mathematical Society Colloquium Publications, 63. American Mathematical Society, Providence, RI, 2018. xx+819 pp. ISBN: 978-1-4704-1104-6

M. Gromov, *Hyperbolic Groups*, in *Essays in group theory*, MSRI publications, vol 8, Springer, 1987.

Assessments

HOMEWORK ASSIGNMENTS (60% OF THE GRADE)

There will be a homework assignment approximately every other week. Due dates will be provided by the instructor at least two weeks ahead of time.

EXAMS (40% OF THE GRADE)

There will be one midterm (20% of the grade) in the 7th week of instruction and a final exam (20% of the grade) during the regular, comprehensive final exam period as assigned by the registrar.

Content Topic Lists

1. Cayley graphs, quasi-isometries and fundamental lemma of GGT;
2. Bass-Serre theory: actions on trees, graph of spaces/groups, amalgamations and HNN extensions.
3. Higher-dimensional generalizations of Bass-Serre theory: complex of groups, wall-spaces and cubulation.
4. Curvature of metric spaces/groups: Gromov-hyperbolicity, quasi-geodesic combings and semi-hyperbolicity, CAT(0) spaces.
5. Specific examples of groups/spaces: Coxeter groups, Artin groups, Bestvina-Brady groups, Thompson groups, graph products and right-angled buildings, Tits buildings, Davis buildings.
6. Special cube complexes: canonical completion and retraction, residual properties of groups

Weekly Schedule

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|---------|--|
| Week 1 | Cayley graphs |
| Week 2 | Quasi-isometries, Fundamental Lemma of GGT |
| Week 3 | Actions on trees (Serre theory) |
| Week 4 | Free groups, amalgams, surface groups |
| Week 5 | Universal covers |
| Week 6 | Hyperbolic space, Nonpositive curvature |
| Week 7 | Hyperbolic groups |
| Week 8 | Simple complexes of groups |
| Week 9 | Coxeter groups, Artin groups |
| Week 10 | Graph products of groups |
| Week 11 | Bestvina-Brady groups |
| Week 12 | Actions on CAT(0) cube complexes |
| Week 13 | Right-angled Coxeter groups, Artin groups and buildings |
| Week 14 | Special cube complexes and embeddings into right-angled Artin groups |

General Policies

ACADEMIC MISCONDUCT

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the University's Code of Student Conduct, and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the University's Code of Student Conduct and this syllabus may constitute Academic Misconduct.

The Ohio State University's Code of Student Conduct (Section 3335-23-04) defines academic misconduct as: Any activity that tends to compromise the academic integrity of the University, or subvert the educational process. Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another student, and possession of unauthorized materials during an examination. Ignorance of the University's Code of Student Conduct is never considered an excuse for academic misconduct, so I recommend that you review the Code of Student Conduct and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by University Rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the University's Code of Student Conduct (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the University.

DISABILITY SERVICES

The university strives to make all learning experiences as accessible as possible. In light of the current pandemic, students seeking to request COVID-related accommodations may do so through the university's request process (slds.osu.edu/covid-19-info/covid-related-accommodation-requests/), managed by Student Life Disability Services. If you anticipate or experience academic barriers based on your disability (including mental health, chronic, or temporary medical conditions), please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. SLDS contact information: slds@osu.edu; 614-292-3307; slds.osu.edu; 098 Baker Hall, 113 W. 12th Avenue.