

LTCC Basic Course

- Title: Geometric group theory
- Lecturer Details:
 - Lecturer: Prof. Ian Chiswell (QMUL)
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- Course Description:
 - Syllabus:
 - Free groups, normal form theorem, presentations of groups, Tietze transformations.
 - Free products with amalgamation, HNN-extensions, normal form theorems and applications.
 - CW -complexes and graphs, realisation of a group presentation by a 2-dimensional CW -complex, Cayley graph.
 - Introduction to the Bass-Serre theory of groups acting on trees, Nielsen-Schreier and Kurosh subgroup theorems.
 - Some groups arising in geometry (hyperbolic groups, Coxeter groups, Artin groups, braid groups).
 - Prerequisites: a basic course on algebra which discusses group theory, including subgroups, cosets, quotient groups, homomorphisms and isomorphism theorems. A knowledge of the definition of the fundamental group of a topological space is desirable, but not essential.
 - Recommended reading: the following contain material relevant to the course.
 1. D. L. Johnson, *Topics in the theory of group presentations*, London Mathematical Society Lecture Note Series 42, Cambridge University Press 1980. (There is also an earlier version, number 22 in this series, called *Presentations of groups*.)
 2. W.S. Massey, *Algebraic topology: an introduction*, Springer 1977. (originally published by Harcourt Brace and World in 1967.)
 3. R.C. Lyndon and P.E. Schupp, *Combinatorial group theory*, Springer 1977.
 4. J.-P. Serre, *Trees*, Springer 1980.
 - Additional reading:

For presentations and basic constructions

 1. H. S. M. Coxeter and W. O. J. Moser, *Generators and relations for discrete groups*, Springer 1972.
 2. W. Magnus, A. Karrass and D. Solitar, *Combinatorial group theory*, second revised edition, Dover Publications, New York, 1976 (originally published by John Wiley).

For basic constructions and Bass-Serre theory

1. D. E. Cohen, *Combinatorial group theory: a topological approach*, London Mathematical Society Student Texts 14, Cambridge University Press 1989.

For hyperbolic groups and spaces

1. M. Coornaert, T. Delzant and A. Papadopoulos, *Géométrie et théorie des groupes*, Lecture Notes in Mathematics 1441, Springer 1990.
2. E. Ghys and P. de la Harpe, *Sur les groupes hyperboliques d'après Mikhael Gromov*, Birkhäuser 1990.
3. H. Short (ed.), "Notes on word hyperbolic groups". In: *Group theory from a geometrical viewpoint* (eds. E. Ghys, A. Haefliger and A. Verjovsky), World Scientific 1991.

For CAT(0) and hyperbolic spaces

1. M. R. Bridson and A. Haefliger, *Metric spaces of non-positive curvature*, Springer 1999.

For Coxeter and Artin groups

1. M. W. Davis, *The geometry and topology of Coxeter groups*, London Mathematical Society Monographs Series 32, Princeton University Press 2008.
2. J. E. Humphreys, *Reflection groups and Coxeter groups*, Cambridge Studies in Advanced Mathematics 29, Cambridge University Press 1990.
(Also, the book of Coxeter and Moser above, and texts on buildings.)

For braid groups

1. J. S. Birman, *Braids, links, and mapping class groups*, Annals of Mathematics Studies 82, Princeton University Press 1974.
(I don't know a good modern text which discusses important new progress such as orderability and linearity of the braid groups.)