

YULIA'S DREAM FALL 2022 - SPRING 2023: KNOT THEORY

MENTOR: JULIUS BALDAUF*

MIT DEPARTMENT OF MATHEMATICS
CAMBRIDGE, MA

SYLLABUS

Meetings take place via Zoom ([link](#)).

Topics	Sections	Chapter exercises	Date
Definition, composition, Reidemeister moves	1.1 - 1.3	1.1, 1.2*, 1.3, 1.4*, 1.5*, 1.9*, 1.10*	Oct 1
Links	1.4	1.13*, 1.14*, 1.15*, 1.16*, 1.17*	Oct 8
Tricolorability, knots & sticks	1.5 - 1.6	1.21, 1.22*, 1.23*, 1.24, 1.25*, 1.26*, 1.27*, 1.29*, 1.30, 1.31*, 1.33, 1.34*	Oct 15
Dowker notation for knots	2.1 - 2.2	2.2*, 2.3*, 2.4*, 2.5*, 2.6*, 2.7*	Oct 22
Conway's notation for knots, tangles	2.3	2.10*, 2.11*, 2.12*, 2.13*, 2.14*, 2.16*	Oct 29
Tangles, mutations	2.3	2.18*, 2.19*, 2.21*, 2.22*, 2.23*, 2.24*	Nov 5
Planar graphs	2.4	2.29*, 2.31*	Nov 12
Unknotting number, crossing number	3.1, 3.3	3.1*, 3.2*, 3.3*, 3.7*, 3.15*	Dec 3
Surfaces without boundary	4.1	4.1*, 4.2*, 4.3, 4.4*, 4.5*, 4.6*	Dec 10
Surfaces without boundary II	4.1	4.7*, 4.8*, 4.9*, 4.10*, 4.11*	Jan 18
Surfaces with boundary	4.2	4.13*, 4.14*	Jan 25
Surfaces with boundary II	4.2	4.15*, 4.16*, 4.17*	Feb 3
Genus and Seifert surfaces	4.3	4.20*, 4.22*, 4.23*, 4.27*	Feb 8
Torus knots	5.1	5.1*, 5.2*, 5.3*, 5.5*, 5.6	Feb 15
Satellite knots	5.2	5.13*, 5.14*	Feb 22
Hyperbolic knots	5.3	5.15*	Mar 1
Braids	5.4	5.16*, 5.17*, 5.18*, 5.19*, 5.21*, 5.26*	Mar 17

*Supported in part by the National Science Foundation. *E-mail:* juliusbl@mit.edu

Topics	Sections	Chapter exercises	Date
Bracket & Jones polynomial	6.1	6.1*, 6.2*, 6.3*, 6.5*, 6.7*, 6.8*	Mar 22
Polynomials of alternating knots	6.2	6.9*, 6.10*, 6.11*, 6.12*	Apr 12
Alexander polynomial	6.3	6.14*, 6.15*, 6.16*	Apr 19
HOMFLY polynomial	6.3	6.17*, 6.18*, 6.19*, 6.20*, 6.21*	Apr 26
Amphicheirality	6.4		May 3

Exercises. Solutions are due the week after the corresponding chapter is covered in lecture; solutions marked with an asterisk * should be sent to juliusbl@mit.edu, in the format of a single PDF file. The solutions can be typed up in \LaTeX or handwritten/drawn, but should be clearly legible. Start the homeworks early; if you are unfamiliar with \LaTeX , it can take longer than expected to write up a solution.

REFERENCES

- [A] Adams, C. C. (2004). *The Knot Book: An Elementary Introduction to the Mathematical Theory of Knots*. American Mathematical Society.