

## Proposed syllabus for Math 544-546

The course follows books “Introduction to topological manifolds” (ITM) and “Introduction to smooth manifolds (ISM)” by John M. Lee

**Math 544:** Chapters 5–13 in ITM.

(There are other sources as well, for example lecture notes by Oscar Randal-Williams, <https://www.dpmms.cam.ac.uk/or257/teaching/notes/at.pdf>.)

- Introduction, motivation, and finite cell complexes.
- Homotopy and the fundamental group.
- Covering spaces, including the Galois correspondence and universal cover.
- Free groups and presentations, amalgamations.
- Seifert-Van Kampen theorem, the effect of attaching a cell, fundamental groups of compact topological surfaces.
- Simplicial complexes and simplicial homology. Computations.

**Math 545:** Chapters 1–9 in ISM.

- Smooth manifolds, smooth maps, tangent vectors and tangent bundle.
- Submersions, immersion and embeddings. Submanifolds.
- Sard’s theorem, the Whitney embedding theorem.
- Lie groups.
- Vector fields, integral curves and flows.

**Math 546:** Chapters 10–17 in ISM.

- Vector bundles, the cotangent bundle.
- Tensors.
- Riemannian metrics.
- Differential forms.

- Orientations and integration on manifolds, the Stokes theorem.
- De Rham cohomology (if time allows).