## METU Department of Math. Spring 2014 Math422 Instructor: Sergey Finashin

Syllabus

1. Homeomorphisms, topological invariants: connected components, compactness. Examples: intervals, polygons, letters. Simply connectedness, Riemann theorem. Invariance of open sets.
2. Constructions: product, disjoint union, wedge. Cutting and pasting, contracting (naïve approach).
3. Homotopic maps, contractibility, deformation retraction. Invariants: from Betti numbers to groups.
4. Simple closed curves: TOP, PL, DIF. Jordan and Shoenflies theorems. Parametric and implicit. Peano curve.
5. Isotopy & regular homotopy. Winding number (via integral). Turning number (degree of Gaussian map).
6. Plane vector fields and path integrals, invariance. Index of a curve and indices of zeros.
7. Writhe of a knot diagram, linking number (via integral or Seifert surfaces). Examples, the sum of knots.
8. Submanifolds, Implicit function theorem. Sphere, torus, topological groups: GL(n), SL(n), SO(n).
9. Moebius band, orientable surfaces, classification. Connected sums, boundary sums.
10. Quotient topology: gluing, mapping torus, cylinder. Projective plane as a quotient and via coordinates.
11. Euler’s formula for polyhedra and graphs. Flat torus, graphs on it. The Euler characteristic. Triangulations. The Poincare-Hopf theorem.
12. Gluing of surfaces from polygons.
13. Degree of a map to a sphere.
14. No-existence of a retraction to the boundary. Fixed-point theorems.
15. Chain complexes and their homology. The case of graphs.
16. Affine and Projective transformations. Baricentric coordinates. Simplicial spaces.
17. Simplicial homology. Invariance. Induced homomorphism. Baricentric subdivision, simplicial approximation.
18. Cellular homology. Calculation for surfaces, spheres and wedges.
19. Periodic fixed point free homeomorphisms, group actions. Quotient spaces, Galois coverings.