

Notice: The programme shows when will go through each topic. With each topic appears a list of recommended exercises to be worked out. Remember: to learn maths is to do maths!

You will find extra material, included Exercises, on spherical geometry, quaternions and applications in the LISAM virtual classroom of the course.

Exercises on Euclidean and projective geometry are found in **Cederberg's book**.

Programme for TATA49: Geometry with Applications. Fall 2024

Sections

Euclidean and Affine Geometries: Model, Transformations and Applications Weeks 1-2 (v. 38-39):

Seminar 1. Affine Plane: a model. Affine Transformations and Isometries

Seminar 2. Isometries and their Classification

Seminar 3. Exercises on Euclidean Plane and Isometries

Euclidean plane: 3.5.1, 3.5.2, 3.5.5, 3.5.10, 3.5.13, 3.5.14, 3.6.1, 3.6.3, 3.6.8

Euclidean isometries: 3.7.1, 3.7.2, 3.8.1, 3.8.2, 3.8.5, 3.8.7, 3.8.18, 3.8.8, 3.9.2, 3.9.11, 3.9.12, 3.9.14

Seminar 4. Similarities. Affine Transformations.

Seminar 5. Applications: Robotics, Instancing

Seminar 6. Exercises on Transformations and Applications

Similarity : 3.12.7, 3.12.8, 3.12.14, 3.12.16

Affine transformations: 3.13.1, 3.13.6, 3.13.7, 3.13.11, 3.13.13

Use also old examination exercises sheet I to work with transformations of the Euclidean plane.

Spherical Geometry, Polyhedra and Quaternions with Applications to 3D Weeks 3-5 (v. 40-42):

Seminar 7. Stereographic Projection. Generalised Circles. Spherical Distance.

Seminar 8. Spherical Geometry, Moving on Earth. No Ideal Map. Quaternions

Seminar 9. Exercises on Spherical Geometry and Quaternions

Stereographic projection: 13.8.1, 13.8.2, 13.8.4

Spherical geometry: 5.3.1, 5.3.2, 5.3.3 (first part), 5.1.3, 5.1.4

Quaternions: 6.2.1, 6.2.2, 6.2.3, 6.2.7, 6.2.4

Wednesday, October 9th, 13:15, Hand-in Examination, Exercises Part I.

Seminar 10. Quaternions and Isometries in 3D. Animation and CAD (rotation surfaces)

Seminar 11. Polyhedra

Seminar 12. Exercises on Isometries in 3D and Polyhedra

Polyhedra (extra material): 5.5.1, 5.5.2, 5.5.4, 5.5.3

Exercises on quaternions and 3D-symmetries are found in extra material in the corresponding chapter. See also 6.3.3, 6.3.4

Use also old examination exercises sheet II to work with transformations in 3D (and any book in Linear Algebra for 3D), quaternions and spherical geometry.

Seminar 13. Presentation of Hand-in Exercises Part I

Projective Geometry: Model of Projective Plane and Projective Line. Cross-ratios. Collineations and Polarities Week 5-7 (v. 45-48):

Seminar 14. Viewing Pipeline and Analytical Model of the Projective Plane and Geometry Line.

Seminar 15. Projectivities

Friday November 8th (13:15) Hand-in Examination, Exercises Part II.

Seminar 16. Exercises on Projective Planes and Lines

Projective Plane: 4.2.1, 4.2.2, 4.2.3, 4.7.1, 4.7.10 (the plane of exercises 4.2.3 and 4.7.10 is much used in combinatorics and coding) 4.7.4, 4.7.5, 4.7.6, 4.7.8, 4.7.9

Projectivities: 4.8.1, 4.8.2, 4.8.4, 4.8.5, 4.8.6

Seminar 17. Cross Ratios. Collineations I.

Seminar 18. Collineations and Perspectivities

Seminar 19. Exercises on Cross-ratios and Collineations

Harmonic sets (cross-ratios): 4.9.1, 4.9.2, 4.9.4, 4.9.10

Collineations: 4.10.3, 4.10.4, 4.10.6

Perspectivities: 4.10.8 (also with $a=1$), 4.10.12, 4.10.13

Seminar 20. Correlations (Polarities), Conics. Polars and Poles

Seminar 21. Presentation of Hand-in exercises Part II

Seminar 22. Polarities, cont

Seminar 23. Exercises on Polarities

Correlations and Polarity: 4.11.1, 4.11.4, 4.11.5, 4.11.6, 4.11.8, 4.11.11, 4.11.15, 4.11.18, 4.11.17

Use also old examination exercises sheet III to work with projective geometry.

Finite Projective Spaces with Applications, Introduction to Hyperbolic Geometry, Weeks 10-11 (v. 48-50):

Seminar 24. Latin Squares and Finite Projective Planes

Seminar 25. Hyperbolic Geometry

Seminar 26. Exercises on Finite Projective Spaces and Hyperbolic Geometry

Finite Projective Planes: 1.3.1, 1.3.8, 1.3.11, 1.3.12, 1.3.13

Hyperbolic Plane: 2.4.3, 2.5.5, 2.6.2, 2.6.7, 2.7.4

Monday, December 9th (13:00), Hand-in Examination, Exercises Part III.

Seminar 27. Introduction to Metric Spaces, or Finite Projective Planes and Codes, or Tessellations.

Seminar 28. Presentation of Hand-in Exercises Part III