LINKÖPINGS UNIVERSITET
Matematiska Institutionen
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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 2025

Sections

Euclidean and Affine Geometries: Model, Transformations and Applications Weeks 1-2 (v. 37-38):
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. 39-41):
Seminar 7. Stereographic Projection. Generalised Circles. Spherical Distance.
Seminar 8. Spherical Geometry, Moving on Earth. No Ideal Map. Quaternions
Friday, September 26th, 13:15, Hand-in Examination, Exercises Part I.
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
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.

Projective Geometry: Model of Projective Plane and Projective Line. Cross-ratios. Collineations and Polarities Week 6-9 (v. 42 & v. 45-48):

Seminar 13. Viewing Pipeline and Analytical Model of the Projective Plane and Geometry Line (**Monday October 13th**).

Seminar 14. Presentation of Hand-in Exercises Part I (Friday October 17th)

Friday October 17th (13:15) Hand-in Examination, Exercises Part II.

Seminar 15. Projectivities
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 (Wednesday November 19th)

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 10-12 (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 8th (13:15), 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