Analytic geometry.
First half-term.
April 2023.
1. Axioms of geometry and basic theorems derived from them (without proofs).
2. Vectors: directed segments and abstract (free)vectors. **Addition of vectors. Multiply vector by number.**
3. Product od vectors. **Dot product** of vectors, definition and basic properties. Left and right triplets of vectors. **Cross product** of vectors, definition and basic properties. **Mixed product** of vectors. definition and basic properties.
3. Expansion of vectors on plane and in space. **Coordinates of vector**. **Basis vectors**.
4. Coordinate system with right orthonormal basis on plane and in space. **Formulas for dot, cross and mixed products**. Radius vector. **Coordinates of point**.
5. Polar, cylindrical and spherical coordinates.
6. Vectors in skew-angular basis. Linearly dependent and independent systems of vectors. Basis vectors as linearly independent system. Example: **analytic geometry on a single line**.
7. Dot product in skew-angular basis. **Gram matrix**.
8. Cross and mixed products in skew-angular basis. Oriented volume of basis. **Effectivised formulas for mixed and cross products**
9. The product of two mixed products
10. **Triple product. Jacobi identity**.
11. Analytic geometry of points on plane and in space: **distance form the origin, distance between two points**.
12. Analytic geometry of the segment on plane and in space: **division ratio, inclination and slope on plane**. **Direction cosines in space**.
13. **Area of polygon**
14. Equation of the locus. Degrees of freedom.
15. Steps to discuss and plot locus. Intersection of curves.
16. **Vectorial equations of straight line on plane in parametric and normal form**.
17. Coordinate parametric equations.
18. **Canonical equation of line and its forms**: line passing through two given points, line passing through the origin.
19. Explicit equations of the line in slope-point and slope-intercept form.
20. Double intercept equation of the line
21. **General equation of the line in orthonormal basis**. Explanation of coefficients. **Angle between lines**. Parallel and perpendicular lines
22. Normal form of the equation. **Measure of distances from the line**.
23. **Bundles (beams) of lines**. Intersection of three lines in a point.
24. Line in polar coordinates.
25. General equation of the line in arbitrary basis. Dual basis and covariant coordinates on plane. Transformation of bases on plane. Explanation of the coefficients in general equation of line.
26. Generalization of the explicit equations of line for any skew-angular basis. **General formula for angle coefficient (slope)**. **General formula to measure angle between lines**. Parallel and perpendicular lines.
27. Transformation of coordinate system. General definitions. Example: Rotation matrix. **Example: Transformation to coordinates expressed with equations of perpendicular lines**.
28. Plane in space. Vectorial equatins: parametric and normal.
29. Plane in space. **Canonic equation in vector and coordinate forms**.
30. **General equation of plane**. Explanation of coefficients. Covariant coordinates and dual basis in space. **Angle between planes**.
31. **Equation of the plane passing through three points**.
32. Normal equation of the plane in right orthonormal basis. **Measuring distances**.
33. **Triple intercept equation of the plane**.

34. Beams and bundles of planes. **Equation of the plane from proper beam**. **Equation of the plane from proper bundle**.