Medical University – Plovdiv
Faculty of Pharmacy
Department of Medical Physics and Biophysics

Head of Department.....
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Syllabus in Advanced Mathematics

Part I.

1. Definition of the determinant of the second and third order; minor and adjugate matrix element of the determinant.
2. Properties of determinants.
3. Matrix of type $m \times n$: definition, types.
4. Matrix operations: comparison and addition of matrices, matrix multiplication by a number.Properties of these operations.
5. Operations with matrices, matrix multiplication – definition and properties.
6. Inverse matrix of a matrix – definition, existence and methods for finding (of the adjugate matrix and the Gauss-Jordan method, application in solving linear matrix equations.
7. System of m linear equations with n variables – definition; decision of the system; (in-) homogeneous, (in-) compatible, (in-) determinate systems.
8. Methods for solving systems of linear equations: Cramer's, by a matrix equation and the method of Gauss.
9. Polynomial – definitions (argument, term, degree, coefficients, zero polynomial). Equal polynomials.
10. Addition, subtraction and multiplication of polynomials. Properties.
11. Division of polynomials – definition. Simple and multiple zero of the polynomial, the number of zeros of polynomials and representation of the polynomial by its zeros.
12. Methods for dividing polynomials: the direct division; of indeterminate coefficients; Horner's. Examples.
13. Vector, directed line segment, length of the vector, collinear vectors, zero vector, opposite vector of a vector. Operations with vectors and properties. Unit vector. Linearly (in-) dependent vectors, linear combination of vectors.
14. Cartesian coordinate systems on the line, in the plane and in space. Coordinates of the point, of the vector, directed line segment and a linear combination of vectors.
15. Scalar product of vectors – definition, vanishing, properties, applications. Calculation on a Cartesian coordinate system in the plane and in space.
16. Equations of a line in the plane: vector parametric, scalar parametric, canonical, through two points, general, Cartesian and interceptional.
17. Applications of equations of lines: angle between two lines, the intersectional point of lines.
18. Equations of Conic Sections – Second-order curves. Definition of their parameters and their properties. Circle.
19. Eigenvalues, eigenvectors, and matrix diagonalization. Eigenvalues and eigenvectors of a square matrix of order 2 - spectrum, eigensubspaces. Eigenvalues and eigenvectors of a symmetric matrix. Diagonalization of a matrix – non-singular and symmetric.

Part II.

20. Function - definition and ways of setting. Types of functions - even, odd, periodic, monotonic, limited.
21. Reverse and reversible functions - definitional intervals. Napier's constant, natural logarithm, exponential function.
22. Limit of a function (left, right), limit point. Properties. Some basic limits. Indeterminate forms. Asymptotes.
23. Continuity of function - (dis-) continuous function at a point.
24. Derivative of a function - definition, geometric and mechanical interpretation.
25. Differential function. Derivatives and differentials of higher order.
26. L'Hôpital's theorems for evaluation of the limit of function. Applying for indeterminate forms.
27. Representation of a function by Taylor's and Maclaurin's series. An example of the exponential function An example of the exponential function.
28. Criteria for constancy and monotony of function.
29. Convexity, concavity, and inflection point of the function.
30. Local and global extrema of the function.
31. Functions of two variables. Total and partial rates of change. Limit and continuity of a function of two variables. Partial derivatives of first and second order.
32. Local extrema of a function of two variables.

Part III.

33. Indefinite integrals, primitive function (antiderivative), basic rules for integration.
34. Integration by importing under the sign of the differential; by substitution.
35. Integrating a rational function; of trigonometric function.
36. Definite integrals – definition and geometric interpretation.
37. Basic properties of definite integrals.
38. Main theorems for definite integrals: for mean value; for integration by parts; by substitution.
39. Improper integral. Applications.
40. Ordinary differential equations of first order: with separable variables, homogeneous, linear.

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