Mathematics

List of possible questions (10 will be selected from each group):

1a: Give the main operators of Boolean algebra.

1b: List the main number sets used in mathematical analysis.

1c: Give the main operations with number sets.

2a: What is transpose matrix, identity matrix and inverse matrix?

2b: Explain the matrix multiplication.

2c: Explain the rule of Sarrus for determinants evaluation.

3a: Explain three situations in the solution of linear equations systems (depending on the relationship between the number of unknowns and number of equations).

3b: Explain the Cramer's rule for the solution of linear equations systems.

3c: Explain the Gaussian elimination method for the solution of linear equations systems.

4a: Explain the basic features of the Cartesian coordinate system.

4b: Explain the basic features of the cylindrical coordinate system.

4c: Explain the basic features of the spherical coordinate system.

5a: Explain the scalar multiplication (product) of two vectors.

5b: Explain the vector multiplication (product) of two vectors.

5c: Explain the mixed multiplication (product) of two vectors.

6a: Explain the monotonicity of a function.

6b: Explain the various extremes of a function.

6c: Explain difference between even and odd functions.

7a: Plot examples of basic polynomial, exponential and logarithm functions.

7b: Plot examples of basic trigonometric functions (with their inverse variants).

7c: Plot examples of basic hyperbolic functions (with their inverse variants).

8a: Describe what is a limit of a continuous function.

8b: Explain the 4 basic methods for limits of functions evaluation.

8c: What is the difference between sequences and series. What is the difference between arithmetic and geometric sequences (series)?

9a: Explain the difference between the Cartesian and goniometric (exponential) form of complex numbers.

9b: Explain the *n*-root evaluation of complex numbers.

9c: Give some example of a complex function of real variable.

10a: Write the definition of derivative of the function.

10b: What is the difference between the Leibniz's and Lagrange's notation of derivatives.

10c: List the basic differentiation rules and explain them.

11a: Give some examples of the differentiation of exponential functions.

11b: Give some examples of the differentiation of trigonometric functions.

11c: Give some examples of the differentiation of hyperbolic functions.

12a: Explain the Taylor series evaluation.

12b: Explain L'Hospital's rule.

12c: Explain the role of derivatives in graph course analysis.

13a: What is the difference between indefinite and definite integrals.

13b: Explain the geometrical meaning of definite integration.

13c: Explain the per partes method and substitution rule.

14a: List properties of definite integrals (e.g. splitting the interval, …).

14b: What kind of improper definite integrals do you know?

14c: Give the formula for the evaluation of the length of a graph of a function.

15a: Explain the classification of ordinary differential equations.

15b: Describe solution methods for homogeneous ordinary differential equations (1st order).

15c: Describe solution methods for non-homogeneous ordinary diff. equations (1st order).

16a: What is the difference between partial and total derivative evaluation (for functions of several variables).

16b: Define the grad and rot operator (differential operator for functions of several variables).

16c: Define the div and Laplacian operator (diff. operator for functions of several variables).

17a: Explain the reversing of integration order in double integrals (definite int.) evaluation.

17b: List some properties of double integrals (definite integrals).

17c: Give some example of area evaluation, using double integrals.

18a: List some types of frequency distributions, based on their shape.

18b: Explain briefly three basic measures of central tendency (of a distribution).

18c: Explain briefly three basic measures of dispersion (of a distribution).

19a: Write the formula for correlation coefficient.

19b: What is the basic difference between correlation and regression analysis.

19c: Explain the basic idea of LSQ-method for linear function fitting.

List of possible exercises (4 will be selected):

1. solve a system of linear equations (three equations with three unknowns),

2. find the product of matrices,

3. calculate a determinant (of a matrix of 6 x 6 elements),4. evaluate a limit of a selected function,

4. evaluate the Taylor series for a selected function,

5. apply the L'Hospital rule for a selected function limit evaluation,

6. analyze a selected function (extremes definition),

7. calculate selected indefinite integrals,

8. calculate selected definite integrals,

9. solve selected differential equation

10. construct (manually) a histogram for a simple data-set