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TRAINING IN MATHEMATICS OF FOREIGN STUDENTS IN THEIR FIRST YEAR OF STUDIES AT TECHNICAL UNIVERSITIES

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Abstract

The purpose of this document is to provide knowledge, skills and competencies that foreign students at the Technical University of Gabrovo have to acquire in Mathematics Education in the first preparatory year. The paper will describe the curriculum for Mathematics. This one-year training should unify the knowledge acquired by foreign students in their native countries with the knowledge of Bulgarian candidate students; it also aims at making them consistent with Bulgarian Mathematical terminology. To elaborate the curriculum for Mathematics, there were used Maths textbooks in Turkey, Algeria, Macedonia, Russia, Iran, Nigeria and Pakistan (native countries of the foreign students). The originality of this course is offered by the didactic materials (tests, which examine knowledge and progress of the students). The tasks included check Mathematical knowledge and language skills in Bulgarian language.

Key words*:* training in Mathematics, foreign students

Introduction

Successful education in technical institutes of higher learning is largely determined by training in Mathematics during secondary school studies. The matter is particularly topical concerning foreign students whose background in math was accomplished in educational systems that are typical to the countries these students come from. This is why the issue of sequence and continuity in mathematical competence acquired both in secondary school and university is of such importance. Actually, that is the main goal to be achieved in mathematical training of foreign students during their first year of university studies, also referred to as preparatory.

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Problem statement

The training in Mathematics during said period could likewise be regarded as a kind of adaptive course that serves the purpose of facilitating student candidates in their admission to university studies.

Such a course could be instrumental to the accomplishment of a number of aims such as (Stojkova and Dtagieva, 1994):

- proper systematization of the bulk of knowledge acquired during secondary school studies.

- development of mathematical awareness and acquisition of a set of skills, competences and learning habits needed in their academic training

- preparation for acquiring other academic subjects

- development of habits for individual use of mathematical teaching resources in Bulgarian

- development of understanding the fundamental significance and professional utility of mathematical methods and their application in studying engineering subjects

- development of mental attitude to Mathematics as cognitive instrument.

Taking into account the bulk of knowledge a secondary school graduate is supposed to have acquired, the course in Mathematics aims at shaping the fundamentals of mathematical culture in the mentality of future engineers, and is therefore both corrective and building-up in character. It should be carried out in accordance with a specific methodological system, which will take into account the fact that foreign students may still struggle with Bulgarian language. In many ways that particular problem presents a far greater challenge than real, purely mathematical problems may appear to be. The said methodological system has the following functions:

- development – aims at developing mathematical and engineering mind-set in Bulgarian by acquiring effective ways of mental activity (this function is of major importance as the target persons will attend various technical degree courses);

- training – formation of mathematical knowledge and skills in the use of mathematical apparatus for analysis of specific simulation (this function is needed to create habits of mathematical modelling of real-life situations);

- education – formation of cognitive interest and building skills for independent work, nurturing certain views and beliefs;

- control – its purpose is to determine the level of acquisition of a specific subject and the level of individual work during studies of specific learning material.

This will bring about the formation of long-lasting mathematical knowledge that is the product of a great amount of effort in their individual work.

As said above, this adaptive course in Mathematics taught to foreign students during their preparatory year, contains:

1. Algebra;

2. Calculus;

3. Geometry;

4. Mathematical instruments, language, numbers, operations with numbers, transformation of identities, sets, functions, equations and inequalities, vectors and processes with vectors.

The aims of this training are:

1. To systematize, correct, summarize and deepen the knowledge in Mathematics from secondary school and facilitate their further studies in Calculus.

2. To develop needed knowledge, skill and competences in foreign students and enable them to operate with fundamental mathematical concepts.

The first aim is achieved by familiarizing foreign students with fundamental mathematical concepts in Bulgarian language whereas the second one is accomplished by means of exercises and systematic individual work. The students' knowledge in Maths acquired in their counties of origin will serve as a base for further build-up. At this point their knowledge is to be corrected, systematized and aligned with the level of knowledge needed for studying Calculus.

Summarization and systematization of knowledge is the consummating stage of the training process and, as already stated, is accomplished in two basic cases: of individual self-accomplished generalization (empirical and at random) and in cases of making generalizations during studies (theory-based and consistent).

The bulk of teaching Mathematics is in line with the way it has been presented in the course books of Mathematics intended for training foreign students at the former Institute for Foreign Students in Sofia. Its structuring is in correspondence with the principle of continuity in knowledge and skills which, if adhered to, enhances quality and effectiveness of training thus contributing to:

1. Opportunities for differentiated training: the course of lectures is arranged by levels of difficulty and contains the bulk of material required for work with trainees of various knowledge and background.

2. Knowledge acquired as a product of this training becomes evident; each topic ends with individual assignment in which students apply what they have learnt so far.

3. Presentation of material is done by following the build-up principle i.e. referring to basic concepts and principles that had been previously acquired, for the purpose of learning new bulk of knowledge. During training it is absolutely necessary to adhere to the sequence perception-notion – concept i.e each new concept should be brought about following this sequence. This is why training of foreign students should begin with a revision and review of terms that contain a common word, common property and henceforth to continue with generalization of the concept being defined. This will facilitate the accomplishment of higher level of knowledge that is accompanied by introducing the specific terms in Bulgarian.

The bulk of material presented and the sequence of its teaching allow to get a complete idea about mathematical knowledge and the methods of its acquisition.

Results

Basic skills and habits, acquired by foreign students:

1. The ability to present a rational number written in the form of vulgar fraction, decimal fraction and vice versa, to reduce rational and irrational expressions.

2. The ability to do identity transformation with integer and fractional rational expressions (rationalizing of denominator, monomial evaluation, insertion and extrapolation of factor, etc), transformations of identities with powers and logarithms, trigonometric transformations.

3. The ability to recognize the properties of exponential, logarithmic and trigonometric functions and to draw, read and analyze graphs.

4. The ability to use ways and methods for operations such as “reduce the expression” or “prove the identity”.

5. The ability to use major methods of solving equations (by means of reducing factors, change of variable, use of formula etc.) and systems of equations (by addition, substitution and introduction

of new unknown value); The ability to solve equations containing modules, logarithmic, exponential and trigonometric equations.

6. The ability to solve inequalities (integer type or fractional by the method of intervals), system inequalities, inequalities containing modules, logarithmic, exponential and trigonometric inequalities.

7. The ability to search boundaries of functions and investigate the continuity of a certain function.

8. The ability to acknowledge the notion "function derivative" and to command the technique and rules for differentiating basic elementary functions.

9. The ability to solve triangles (arbitrary, right-angled and equilateral) by applying Pythagoras', sine and cosine rule plus basic metric dependences within triangles.

10. Becoming consistent with the basic properties of a quadrangle and types of quadrangles (square, rectangle, parallelogram, trapezium and rhombus).

11. The ability to do major processes in vector calculation (addition and subtraction of vectors, multiplying vector by a number; scalar, vector and mixed product) and be familiar with their geometry meaning.

12. Becoming consistent with the properties of angular and curved-surface objects (prism, pyramid, truncated pyramid, straight circular cylinder and cone, sphere).

The training course is 200 hours.

The forms of progress check are: current control-at the beginning of the first class by way of oral and written examination. Foreign students pronounce in Bulgarian newly learnt mathematical terms and notions, read and write formulae. At the end of each section there is a test which requires not only the correct problem solution but also its description in Bulgarian for the purpose of checking whether students are able to use appropriate terms and names of the operations done. In many instances, this proves to be more cumbersome a task for students than solving the problems. Sample Progress check after the "Basic geometric shapes" is given in Appendix 1. At the end of the course, a written exam. A fragment of a topic for a written examination is presented in Appendix 2.

The curriculum content includes:

Algebra: The focus here is on forming correct concept about "number" and its evolution. Special emphasis is laid on calculation technique and gaining rational ways and methods of work.

Identity transformations are done with algebraic expressions. Functions – properties and graphs. Equations, inequalities and systems of equations. Equivalence and consequence.

Calculus: Boundary and continuity of function. Function derivative- geometric and physical meaning of a derivative. Function monotony and extremum. Convolution and involution in function graph, points of inflexion. Investigation and function graph. This section is characterized by the high level of theory background and the role of theoretical generalization and deductions. It also features content-oriented formation of notions, reinforcement of specific methods for solution of problems pertaining to Calculus.

Geometry: Training is organized as intellectual-practical activity aiming at developing spatial conceptuality and enlarging the span of geometry vision thus enabling students to get familiar with the basic properties of 3D shapes (angular and curved-surfaced).

Training is done with continuous progress check of students as each trainee develops its personal profile in terms of pedagogy and psychology which serves as a fact file of their type of involvement in the process of studying. Each student's individual attitude to the process of study is carefully marked down and enables the tutors to pinpoint the moments of challenge as well as those of success. In the end the overall score is aggregated in terms of progress check grades and the written exam score.

Conclusions

In conclusion it is possible to claim that this adaptive course in math for foreign students would be quite effective if trainees involved were given such preparation in Bulgarian that could warrant their smooth transition from secondary school to technical university by removing the barrier between secondary and tertiary education (in our case this barrier is double being both linguistic and professional).

References

Andonian, A., Kanchev, N., Pesheva, U., Stojkova, C. (1995). *Guide in Mathematics for students – foreigners, Part 1, 2, 3*. Sofia: GEA-INF.

Stojkova, C., Dtagieva, V. (1994). *Mathematics for students - foreigners.* Sofia: GEA-INF.

Appendix 1. Progress check № 3

1. Give definitions of :

- Section -.....
- Beam - .....
- Angle - .....

2. Which of the following definitions of a right angled triangle is true:

a) a triangle whose angles are right

b) a triangle which has one right angle

c) a triangle whose sum total value of all angles equals 90 degrees

3. Formulate the first property of similitude of two triangles.

4. Is this assertion true? Two triangles are identical if their three sides are equal?

5. What types of quadrangles do you know? List them and make a drawing of each of them.

6. In an isosceles triangle the height to the base is 10 and the height to one of the sides is 12. Find out the length of the base.

   A) 24 B) 20 C) 12 D) 15

7. The sides of a parallelogram are 18 cm and 16 cm respectively. Find out the parts into which its longer side is segmented by the bisectors of its angles.

(A) 2 cm, 8cm and 8 см (B) 3 cm, 12cm and 3 cm (C) 2 cm, 14cm and 2 cm (D) 6 cm, 6cm and 6 cm

8. Calculate the area of a rhombus whose height is 6 cm and one of its angles is equal to 150^0.

(A) 28 cm^2 (B) 42 cm^2 (C) 72 cm^2 (D) 64 cm^2

9. A triangle, one of whose angles is equal to 30 degrees, is inscribed into a circle with radius of 5 cm. Find the length of the side which lies opposite that angle.

(A) 4 cm (B) 5 cm (C) 4,5 cm (D) 10 cm

10. A trapezium with thighs of 8 cm and 11 cm is circumscribed around a circle. Find out the length of the mean section of that trapezium.

(A) 8 cm (B) 11 cm (C) 19 cm (D) 9,5 cm

Appendix 2. MATHEMATICS

1. Calculate the value of the expression: $\frac{3x-y}{y+2x}$, if $\frac{2x}{y}=3$

a) 1 b) $\frac{5}{6}$ c) $\frac{7}{8}$ d) 2

2. The expression $\frac{\sqrt{(x+2)^2-8x}}{\sqrt{x}-\frac{2}{\sqrt{x}}}$ for 0<x<2 is identically equal to:

a) –x-1 b) $-\sqrt{x}$ c) $\sqrt{x}$ d) x+1

3. How many roots does the equation $4^{x+1} + 2^{x+2} - 8 = 0$ have?

a) 0 b) 1 c) 2 d) 4

4. The set of the solutions to the inequality $x^2(x^2+1)(x-2)\geq 0$ is:

a) $(-\infty,2)\cup(1,+\infty)$ b) (-2,0) c) $\{0\}\cup[2,+\infty)$ d) (0,2)

5. The sum of two numbers is 18, the sum of 25% of the first and 20% of the second number is 4. What is the product of the two numbers?

a) 60 b) 70 c) 80 d) 90

6. The functions $f(x)=\frac{x+5}{x+1}$ and $g(x)=2-5x^2$ are given. Calculate f(g(-1)).

a) -1 b) 2 c) 1 d) 0

7. What are the coordinates of the point where the graph of the function $y=2^{3-x}-1$ crosses the x axis?

a) (0,3) b) (3,0) c) (2,0) d) (0,0)

8. If $\text{tg}\frac{\alpha}{2}$ = -2, then the value of the expression $3\cos\alpha$ - $\sin\alpha$ +1 is:

a) 1 b) 2 c) -2 d) 0

9. Find the minimum value of the function $y=x^3-3x^2-24x$ for $x\in[-1;5]$:

a) 0 b) 20 c) -70 d) -80

10. The base of an isosceles triangle is 5 and its leg is 20. The length of the bisector to the leg is:

a) 8 b) 10 c) 6 d) 5