МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ
Федеральное государственное автономное образовательное учреждение
высшего образования
«Южно-уральский государственный университет
(Национальный исследовательский университет)»

Институт лингвистики и международных коммуникаций
Кафедра иностранных языков

ФОНД
ОЦЕНОЧНЫХ СРЕДСТВ

Направления 01.04.02. Прикладная математика и информатика
01.04.01. Математика
01.04.05 Статистика
09.04.04. Программная инженерия
03.04.01. Прикладная математика и физика
Дисциплина: «Иностранный язык в профессиональной деятельности»

2 семестр
Экзамен

Экзаменационный билет № 1

I. a) Прочитайте предложенный текст № 1 “Sets”.
b) Письменно переведите отрывок текста, где говорится о математическом определении понятия «множества».
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

III. Сообщение и беседа с экзаменаторами на иностранном языке по вопросам, связанным со специальностью и научной работой магистранта.

Преподаватель ___________________

Заведующий кафедрой ___________________ К.Н. Волченкова

Экзаменационный билет № 1

1. “Sets”

A set is a collection of objects. The objects belonging to the set are the elements or members of the set. Although in introducing set theory it is helpful to work with concrete sets, whose members are real objects, the sets of interest in mathematics always have members which are abstract mathematical objects: the set of all circles in the plane, the set of points on a sphere, the set of all numbers. As in ordinary algebra we shall use letters to represent sets and elements, small letters being used for elements and capital letters for sets. But it is impossible to keep rigidly to this convention because sets can themselves be elements of other sets. The phrase “is a member of” occurs so often that it is convenient to have a symbol, the one currently in use is $\in$. So $x \in S$ means “x is a member of S”.

A set is considered to be known if we know what its elements are – or at any rate if in theory we can find out. There are many ways of specifying a set, of which the simplest is to list all the members. The standard notation for this is to enclose the list in curly brackets. So {1, 2, 3, 4} is the set whose members are 1, 2, 3, 4 and only these, while {spring, summer, autumn, winter} is the set of seasons.

Two sets are equal if they have the same elements. We can easily write things like {1, 2, 3, 4, 4}. Despite being mentioned several times, there is only one 4 in the set, which being thus equal to {1, 2, 3, 4}. When using the curly bracket notation, elements listed more than once are thought of as occurring once in the set. The order inside the brackets makes no difference. The set {1,2, 3, 4, 4} has the same elements as {1, 2, 3, 4}, so is the same set.

More generally, a symbol such as {all epic poems} denotes the set of all epic poems. A variation of this idea allows us to write {x|x is an epic poem} for the same set. The vertical bar may be read as “such that”, and the set of all x such that x is an epic poem is the same as the set of all epic poems. The set $\{n|n \text{ is an integer and } 1 \leq n \leq 4\}$ is the same as the set $\{1, 2, 3, 4\}$.

Instead of a list, we give a property which specifies precisely the elements we wish to be included in the set. If we are careful with our definitions, making sure that we specify the exact property we want, this is as good as a list, and is usually more convenient. For sets with infinitely many members, such as {all whole numbers}, it is in any case impossible to give a complete list. The same is true for sets with a sufficiently large finite set of elements.

The mathematical notion of a set allows sets with only one member or even no members at all. If you specify a set by some property it may turn out later that there is only one object with that property or none at all. Sets with one element must not be confused with the element itself. It is not true that x and {x} are equal; {x} has just one member, namely x, while x may have any number of members depending on whether or not it is a set, and if it is, which set.

a. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

For exactly the same reasons that we allow sets with just one element, we have to allow sets with no elements at all. A set with no elements is called an empty set. A fact now emerges which many people find surprising: there is only one empty set. All empty sets are equal. Any two empty sets are equal because, in the absence of any members to distinguish them by, there is no way to tell them apart. Having established that there is just one empty set we can give it a symbol, the current one being Ø (which is a special symbol). The empty set is not “nothing”…, nor does it fail to exist. It is just as much in existence as any other set. It is its members that do not exist. It must not be confused with the number 0: for 0 is a number, whereas Ø is a set. Ø is one of the most useful sets in mathematics. One of its uses is to express concisely that something does not happen. Set theory as a foundation for mathematical analysis, topology, abstract algebra, and discrete mathematics is likewise uncontroversial; mathematicians accept that (in principle) theorems in these areas can be derived from the relevant definitions and the axioms of set theory. Few full derivations of complex mathematical theorems from set theory have been formally verified, however, because such formal derivations are often much longer than the natural language proofs mathematicians commonly present.

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2 семестр
Экзамен

Экзаменационный билет № 2

I. a) Прочитайте предложенный текст № 2 “Ordinary differential equations”.
b) Письменно переведите отрывок текста, где говорится о классификации дифференцированных уравнений.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

III. Сообщение и беседа с экзаменаторами на иностранном языке по вопросам, связанным со специальностью и научной работой магистранта.

Преподаватель ___________________

Заведующий кафедрой ___________________ К.Н. Волченкова

Экзаменационный билет № 2

1. “Ordinary differential equations”

The term “differential equation” was first used by Leibniz in 1676 to denote a relationship between the differentials dx and dy of two variables x and y. Such a relationship, in general, explicitly involves the variables x and y together with other symbols a, b, c … which represent constants. This restricted use of the term was soon abandoned; differential equations are now understood to include any algebraical or transcendental equalities which involve either differentials or differential coefficients. It is to be understood, however, that the differential equation is not an identity.

Differential equations are classified, in the first place according to the number of variables which they involve. An ordinary differential equation expresses a relation between an independent variable, a dependent variable and one or more differential coefficients of the dependent with respect to the independent variable. A partial differential equation involves one dependent and two or more independent variables, together with partial differential coefficients of the dependent with respect to the independent variables. A total differential equation contains two or more dependent variables together with their differentials or differential coefficients with respect to a single independent variable which may, or may not, enter explicitly into the equation.

The order of the equation is that of the highest derivative contained in it, so that the general differential equation of order n can be written in the form

$F\left\{y^{(n)}, y^{(n-r)}, \ldots, y^{(r)}, y, x\right\} = 0$, the symbol y^r denoting $d^r y/dx^r$.

The degree of the equation is defined mathematically to be that of its highest order derivative, when the equation has been made rational as far as the derivatives are concerned. When, in an ordinary or partial differential equation, the dependent variable and its derivatives occur to the first degree only, the equation is said to be linear. The coefficients of a linear equation are therefore either constants or functions of the independent variable or variables.

Differential equations arise in many areas of science and technology, specifically whenever a deterministic relation involving some continuously varying quantities (modeled by functions) and their rates of change in space and/or time (expressed as derivatives) is known or postulated. This is illustrated in classical mechanics, where the motion of a body is described by its position and velocity as the time value varies. Newton's laws allow one (given the position, velocity, acceleration and various forces acting on the body) to express these variables dynamically as a differential equation for the unknown position of the body as a function of time. In some cases, this differential equation (called an equation of motion) may be solved explicitly.

2. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

An example of modelling a real world problem using differential equations is the determination of the velocity of a ball falling through the air, considering only gravity and air resistance. The ball's acceleration towards the ground is the acceleration due to gravity minus the acceleration due to air resistance. Gravity is considered constant, and air resistance may be modeled as proportional to the ball's velocity. This means that the ball's acceleration, which is a derivative of its velocity, depends on the velocity (and the velocity depends on time). Finding the velocity as a function of time involves solving a differential equation. The study of differential equations is a wide field in pure and applied mathematics, physics, and engineering. All of these disciplines are concerned with the properties of differential equations of various types. Pure mathematics focuses on the existence and uniqueness of solutions, while applied mathematics emphasizes the rigorous justification of the methods for approximating solutions. Differential equations play an important role in modelling virtually every physical, technical, or biological process, from celestial motion, to bridge design, to interactions between neurons. Differential equations such as those used to solve real-life problems may not necessarily be directly solvable, i.e. do not have closed form solutions. Instead, solutions can be approximated using numerical methods.

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2 семестр
Экзамен

Экзаменационный билет № 3

I. a) Прочитайте предложенный текст № 3 “Equation and locus”.
b) Письменно переведите отрывок текста, где говорится о втором определении уравнения геометрического места точек.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

III. Сообщение и беседа с экзаменаторами на иностранном языке по вопросам, связанным со специальностью и научной работой магистранта.

Преподаватель ___________________

Заведующий кафедрой ___________________ К.Н. Волченкова

Экзаменационный билет № 3

1.“Equation and locus”

Two Fundamental Problems of analytic geometry. In this chapter we shall make a preliminary study of the following two fundamental problems of analytic geometry: I. Given an equation, to determine its geometric interpretation or representation. II. Given a geometric figure or condition, to determine its equation or analytic representation. The students will note that these problems are essentially converses of each other. Strictly speaking, however, both problems are so closely related that together they constitute the fundamental problem of all analytic geometry. For example, we shall see later that, after obtaining the equation for a given geometric condition, it is often possible by a study of this equation to determine further geometric characteristics and properties for the given condition. Our purpose in initially considering two separate problems is not one of necessity, but rather one of convenience; we are thus enabled to focus our attention on fewer ideas at a time. First Fundamental Problem. The Locus of an Equation.

Assume that we are given an equation in the two variables x and y, which we may write briefly in the form f (x, y) = 0. (1) In general there are infinitely many pairs of values of x and y which satisfy this equation. Each such pair of real values will be taken as the coordinates (x, y) of a point in the plane. This convention is the basis of Definition 1. The totality of points, and only those points, whose coordinates satisfy an equation (1), is called the locus or graph of the equation.

Another convenient expression is given by Definition 2. Any point whose coordinates satisfy an equation (1) is said to lie on the locus of the equation. It cannot be emphasized too strongly that only those points whose coordinates satisfy an equation lie on its locus. That is, if the coordinates of a point satisfy an equation, that point lies on the locus of the equation; and conversely, if a point lies on the locus of an equation, its coordinates satisfy the equation. Since the coordinates of the point of a locus are restricted by its equation, such points will in general be located in positions which, taken together, form a definite path called a curve as well as a graph or locus. Second fundamental problem. We will now consider the second fundamental problem of analytic geometry.

A geometric figure, such as a curve, is generally given by its definition. By the definition of an object is meant a description of that object of such a nature that it is possible to identify it definitely among all other objects of its class. The implication of this statement should be carefully noted: it expresses a necessary and sufficient condition for the existence of the object defined. Thus, let us consider that we are defining a plane curve of type C by means of a unique property P which C possesses. Then, in the entire class of all plane curves, a curve is of type C if and only if it possesses property P.

2. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

As a specific example, let us consider that familiar plane curve, the circle. We define a circle as a plane curve possessing the unique property P that all its points are equally distant from a fixed point in its plane. This means that every circle has property P; and conversely, every plane curve having property P is a circle. For a curve, a geometric condition is a law which the curve must obey. This means that every point on the curve must satisfy the particular law for the curve. Accordingly a curve is often defined as the locus or path traced by a point moving in accordance with a specified law. Thus, a circle may be defined as the locus moving in a plane so that it is always at a constant distance from a fixed point in that plane. A locus need not necessarily satisfy a single condition; it may satisfy two or more conditions. Thus, we may have a curve which is the locus of a point moving so that it passes through a given point, and it is always at a constant distance from a given line. We may then summarize the preceding remarks in the following definition: A curve is the locus of all those points, and only those points, which satisfy one or more given geometric conditions. The student should note that this definition implies that the given condition or conditions are both necessary and sufficient for the existence of the curve.

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2 семестр
Экзамен

Экзаменационный билет № 4

I. a) Прочитайте предложенный текст № 4 “Functions and graphs”.
b) Письменно переведите отрывок текста, где говорится о классификации функций.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

III. Сообщение и беседа с экзаменаторами на иностранном языке по вопросам, связанным со специальностью и научной работой магистранта.

Преподаватель ___________________

Заведующий кафедрой ___________________ К.Н. Волченкова

Экзаменационный билет № 4

1. “Functions and graphs”

The notion of function is essentially the same as that of correspondence. A numerical-valued function f assigns to each point p in its domain of definition a single real number f(p) called the value of f at p. The rule of correspondence may be described by a formula such as f (p) = x2 – 3xy, when p = (x, y) or by several formulas, such as f (p) = x when x > y x2 + y y ≤ x or by geometric description. F (p) is the distance from p to the point (4,7) or even by an assumed physical relationship: f (p) is the temperature at the point p. In all of these instances, it is important to bear in mind that the rule of correspondence is the function f, whereas f (p) is the numerical value which f assigns to p. A function may be thought of as a machine into which specific points may be fed, while the corresponding values emerge at the other end.

Real-valued functions are often classified according to the dimension of their domain of definition. If f (p) is defined for all p є S and S is a subset of the plane, then we may write p as (x, y) and f (p) as f (x, y) and refer to f as a function of two real variables. Similarly, when S is a set in 3-space, we may write f (x, y, z) for f (p) and say that f is a function of three real variables. When S is a set on the line, we usually write f (x) and call f a function of one real variable. In all these cases, however, f can still be thought of as a function defined for the single variable point p.

Other cases also arise. A function f may be defined only for points p which lie on a certain curve C in space. Side by side with the notion of a function as a correspondence or mapping between two sets (e.g. points and numbers), we have the concept of graph. If f is a function of one real variable, the graph of f is the set f points (x, y) in the plane for which y = f(x). If f is a function of two real variables, the graph of f is the set of points (x, y, z) in 3-space for which z = F (x, y). Conversely, it is possible to base the notion of function on that of graph. Let A and B be any two sets, and let E be any set composed of ordered pairs (a, b) with a є A and b є B. By analogy, (a, b) may be called the “point” in a A x B space having coordinates a and b, regardless of the nature of the sets A and B. Any such set E can be called a graph or relation, and those that have the special property of being single-valued are called functions.

Many special properties of a function are reflected in simple geometrical properties of its graph. A function f defined on the line is said to be monotonic increasing if f (x) ≤ f (x') whenever x < x'; this means that the graph of f “rises” as we move along it from left to right. Again, a function of two variables is said to be convex if it obeys the condition f (p1) + f (p2) ≤ 2 f ; this says that Σ, the graph of f, is a surface with the property that if A and B are any two points on Σ, their mid – point lies on or below Σ.

2. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

We now turn to the discussion of the fundamental notion of a function or mapping. It will be seen that a function is a special kind of a set, although there are other visualizations which are often suggestive. To the mathematician of a century ago the word “function” ordinarily means a definite formula, such as f(x) = x2 + 3x + 5, which associates to each real number x another real number f(x). The fact that certain formulas, such as g(x) = √ x – 5, do not give rise to real numbers for all real values of x was, of course, well-know but was not regarded as sufficient grounds to require an extension of the notion of function. Probably one could arouse controversy among those mathematicians as to whether the absolute value h (x) = │x│ of a real number is an “honest function” or not. For, after all, the definition of │x│ is given “in pieces” by │x│ = x, if x ≥ 0, │x│ = – x, if x < 0. As mathematics developed, it became increasingly clear that the requirement that a function be a formula was unduly restrictive and that a more general definition would be useful. It also became evident that it is important to make a clear distinction between the function itself and the values of the function. Our first revised definition of a function would be: A function f from a set A to a set B is a rule of correspondence that assigns to each x in a certain subset D of A, a uniquely determined element f (x) of B. Certainly, the explicit formulas of the type mentioned above are included in this definition. The proposed definition allows the possibility that the function might not be defined for certain elements of A and also allows the consideration of functions for which the set A and B are not necessarily real numbers.

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2 семестр
Экзамен

Экзаменационный билет № 5

I. a) Прочитайте предложенный текст № 5 “Curves”.
b) Письменно переведите отрывок текста, где говорится об определении кривой.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

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Преподаватель ________________

Заведующий кафедрой ________________ К.Н. Волченкова

Экзаменационный билет № 5

1.“Curves”

Definition and equations of a curve. In ordinary three-dimensional space let us establish a left-handed orthogonal cartesian coordinate system with the same unit of distance for all three axes. In this system any point P has coordinates x, y, z. A curve may be described qualitatively as the locus of a point moving with one degree of freedom. A curve is also sometimes said to be the locus of a one parameter family of points or the locus of a single infinity of points. Definition 1. Let the coordinates x, y, z of a point P be given as single-valued real-valued analytic functions of a real independent variable t on an interval T of t-axis by equations of the form x = x (t), y = y (t), z = z (t). (1) Further suppose that the functions x(t), y(t), z(t) are not all constant on T. Then the locus of the point P, as t varies on the interval T, is a real proper analytic curve C. Some comments on the foregoing definition will perhaps clarify its meaning.

Equations (1) are called the parametric equations of the curve C, the parameter being the variable t. We reserve the right to permit the parameter t to take on complex values. Moreover, one or more of the coordinates x, y, z may, under suitable conditions, be allowed to be complex. The curve C would in this case be called complex, or perhaps, on suitable conditions, imaginary. To say that a curve is proper means that it does not reduce to a single fixed point, as it would do if the coordinates x, y, z were all constant. It is clear that at an ordinary point of a real proper analytic curve, i.e. a point where nothing exceptional occurs, the inequality

(2)

$$x'^2 + y'^2 + z'^2 > 0\left(x' = \frac{dx}{dt}\right)$$

holds. Any point of such a curve where this inequality fails to hold is called singular, although the singularity may belong to the parametric representation being used for the curve defined as a point-locus, or may belong to the curve itself. A curve, or portion of a curve, which is free of singular points may be called nonsingular. Furthermore, we assume that the interval T is so small that values of the parameter t on the interval T and points (x, y, z) on the curve C are in one-to-one correspondence, so that the parameter t is a coordinate of the corresponding point (x, y, z) on the curve C.

To say that the functions are analytic means, roughly, that they can be expanded into power series. More precisely, this statement means that, at each point t0 within the interval T, each of these functions can be expanded into a Taylor's series of power of the difference t–t0 which converges when the absolute value t–t0 is sufficiently small. It would be possible to study differential geometry under the hypothesis that the functions considered possess only a definite, and rather small number of derivatives; but we assume analyticity in the interests of simplicity. So the word “function” will mean for us “analytic function”, and the word “curve” will mean a real proper nonsingular analytic curve unless the contrary is indicated.

2. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

A large number of other curves have been studied in multiple mathematical fields. The term curve has several meanings in non-mathematical language as well. For example, it can be almost synonymous with mathematical function, or graph of a function. An arc or segment of a curve is a part of a curve that is bounded by two distinct end points and contains every point on the curve between its end points. Depending on how the arc is defined, either of the two end points may or may not be part of it. When the arc is straight, it is typically called a line segment. Algebraic curves are the curves considered in algebraic geometry. A plane algebraic curve is the locus of the points of coordinates x, y such that f(x,y) = 0, where f is a polynomial in two variables defined over some field F. Algebraic geometry normally looks not only on points with coordinates in F but on all the points with coordinates in an algebraically closed field K. If C is a curve defined by a polynomial f with coefficients in F, the curve is said to be defined over F. The points of the curve C with the coordinates in a field G are said to be rational over G and can be denoted C(G); thus the full curve C = C(K). Algebraic curves can also be space curves, or curves in even higher dimension, obtained as the intersection (common solution set) of more than one polynomial equation in more than two variables. By eliminating variables (by any tool of elimination theory), an algebraic curve may be projected onto a plane algebraic curve, which however may introduce singularities such as cusps or double points.

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01.04.05 Статистика
09.04.04. Программная инженерия
03.04.01. Прикладная математика и физика
Дисциплина: «Иностранный язык в профессиональной деятельности»

2 семестр
Экзамен

Экзаменационный билет № 6

I. a) Прочитайте предложенный текст № 6 “Surfaces”.
b) Письменно переведите отрывок текста, где говорится о способе решения уравнения в неявном виде.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

III. Сообщение и беседа с экзаменаторами на иностранном языке по вопросам, связанным со специальностью и научной работой магистранта.

Преподаватель ________________

Заведующий кафедрой ________________ К.Н. Волченкова

Экзаменационный билет № 6

1. “Surfaces”

A surface can be described as a two-parameter family, or double infinity, of points. A surface can also be said to be the locus of a point moving with two degrees of freedom. One method of representing a surface analytically consists in first establishing the usual left-handed orthogonal cartesian coordinate system with the same unit of distance on all three axes and then imposing one condition on a variable point P (x, y, z) by an equation of the form F(x, y, z) = 0. (l)

Such an equation is called the implicit equation of the surface represented by it. Certain very simple types of surfaces are already familiar. For example, if the equation (1) is linear in the variables x, y, z the surface represented by it is a plane, which is the simplest surface of all. Perhaps the next simplest surface is the sphere. If the equation (1) is homogeneous in x, y, z it represents a cone which vertex is at the origin. Finally, if one of the variables is missing from the implicit equation of a surface, the surface is a cylinder whose generators are parallel to the axis of the missing variable.

If the implicit equation (1) be solved for one of the variables as a function of the other two, say for z as a function of x, y, the resulting equation z = f(x, y), (2) represents the same surface as before. Such an equation is called the explicit equation of the surface represented by it. The explicit equation (2) can be exhibited as a special case of the implicit equation (1) by transposing z to the right member and placing F(x, y, z) = f(x, y) – z. Although for some purposes the implicit and explicit equations of surfaces are very useful, the definition of a real proper analytic surface will be based on a parametric representation. Definition 1. Let the coordinates x, y, z of a point P be given as a single valued analytic function of two real independent variables u, v on a rectangle T in a uv-plane by equations of the form x = x(u, v), y = y(u, v), z = z(u, v). (3) Further, let the jacobians of x, y, z with respect to u, v be denoted by J1, J2, J3 so that

$$J_1 = y_u z_v - y_v z_u,\ J_2 = z_u x_v - z_v x_u,\ J_3 = x_u y_v - x_v y_u \left(x_u = \frac{dx}{dt}, \dots \right) \quad (4)$$

and suppose that not all of J1, J2, J3 vanish identically on the rectangle T. Then the locus of the point P, as u, v vary on T, is a real proper analytic surface. Equations (3) are called parametric equations of the surface S, the parameters being the variables u, v. We reserve the right to permit the parameters to take on complex values. Moreover, one or more of the coordinates x, y, z may, under suitable conditions, be allowed to be complex. To say that a surface is proper means that it does not reduce to a curve. Both of these degenerate cases are ruled out by the hypothesis that the jacobians J1= (1, 2, 3) do not all vanish identically. For, if the locus S were to reduce to a fixed point P, the coordinates x, y, z of P would all be constant, and the jacobians J1 would all vanish identically. Furthermore, if the locus S were to reduce to a curve, this curve could be represented parametrically by equations of the form (2). If in these equations the parameter t is set equal to any function of u, v, the result is three equations of the form (3), for which the jacobians J1 are easily proved, by actual calculation, to vanish identically.

2. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

In mathematics, specifically, in topology, a surface is a two-dimensional, topological manifold. The most familiar examples are those that arise as the boundaries of solid objects in ordinary three-dimensional Euclidean space R3 – for example, the surface of a ball. On the other hand, there are surfaces, such as the Klein bottle, that cannot be embedded in three dimensional Euclidean space without introducing singularities or self-intersections. To say that a surface is "two-dimensional" means that, about each point, there is a coordinate patch on which a two-dimensional coordinate system is defined. For example, the surface of the Earth is (ideally) a two-dimensional sphere, and latitude and longitude provide two-dimensional coordinates on it (except at the poles and along the 180th meridian). The concept of a surface finds application in physics, engineering, computer graphics, and many other disciplines, primarily in representing the surfaces of physical objects. For example, in analyzing the aerodynamic properties of an airplane, the central consideration is the flow of air along its surface. A (topological) surface is a nonempty second countable Hausdorff topological space in which every point has an open neighbourhood homeomorphic to some open subset of the Euclidean plane E2.

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2 семестр
Экзамен

Экзаменационный билет № 7

I. a) Прочитайте предложенный текст № 7 “Basic geometric concepts”.
b) Письменно переведите отрывок текста, где говорится об условиях, при которых два объекта считаются равными.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

III. Сообщение и беседа с экзаменаторами на иностранном языке по вопросам, связанным со специальностью и научной работой магистранта.

Преподаватель ____________________

Заведующий кафедрой ____________________ К.Н. Волченкова

Экзаменационный билет № 7

1. “Basic geometric concepts”

The practical value of Geometry lies in the fact that we can abstract and illustrate physical objects by drawings and models. For example, a drawing of a circle is not a circle, it suggests the idea of a circle. In our study of Geometry we separate all geometric figures into two groups: plane figures whose points lie in one plane and space figures or solids. A point is a primary and starting concept in Geometry. Line segments, rays, triangles and circles are definite sets of points. A simple closed curve with line segments as its boundaries is a polygon. The line segmerits are sides of the polygon and the end points of the segments are vertices of the polygon. A polygon with four sides is a quadrilateral. We can name some important quadrilaterals. Remember, that in each case we name a specific set of points. A trapezoid is a quadrilateral with one pair of parallel sides. A rectangle is a parallelogram with four right angles. A square is a rectangle with all sides of the same length. The regular polyhedra are a part of geometric study chiefly in antiquity. They have a symmetrical beauty that fascinate men of all ages.

The first question in connection with regular polyhedra is: How many different types are there? Thanks to the ancient Greeks we know that there are exactly five types of polyhedra. All objects in their view are composed of four basic elements: earth, air, fire and water. They believe that the fundamental particles of fire have the shape of tetrahedron, the air particles have the shape of octahedron, of water — the icosahedron, and the earth — the cube. The fifth shape, the dodecahedron, they reserve for the shape of the universe itself. Plane geometry is the science of the fundamental properties of the sizes and shapes of objects and treats geometric properties of figures.

The first question is: Under what conditions two objects are equal (or congruent) in size and shape? Next, if figures are not equal, what significant relationship may they possess to each other and what geometric properties can they have in common? The basic relationship is shape. Figures of unequal size but of the same shape, that is, similar figures have many geometric properties in common. If figures have neither shape nor size in common, they may have the same area, or, in geometric terms, they may be equivalent, or may have endless other possible relationships. Geometry is the science of the properties, measurement and construction of lines, planes, surfaces and different geometric figures. What do we call “constructions” in our study of Geometry? Ruler-compass constructions are simply the drawings which we can make when we use only a straightedge and a compass. For a ruler you ought to use an unmarked straightedge because measurement has no role in ruler-compass constructions. Of course, you can use a marked straightedge if you don’t permit yourself to use these marks for measurement. Later you ought to do some measurement to “check” your constructions. We measure segments in terms of other segments and angles in terms of other angles.

2. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

It seems only natural that we find areas indirectly as well. How does a person find the area of a floor? Does he take little squares one foot on a side, lay them out over the entire floor and thus decide that the area of a floor is 100 square feet, for this is indeed the meaning of area? Of course, he does not. He measures the length and width, quantities usually quite simple and then multiplies the two numbers to obtain the area. This is indirect measurement, for we find the area when we measure lengths. The dimensions we take in the case of volume are the area and the length or the height. Greek mathematicians are the founders of indirect measurement methods. Their contribution to this subject are formulae(= las) for areas and volumes of particular geometric shapes, that we use nowadays.-Thus thanks to the Greeks we can find the area of any one single triangle when we take the product of its base and half its height. We also know due to them, that the '"areas of two similar triangles are to each other as the squares of corresponding sides".. In other words, even the very common formulae of Geometry which we owe to the Greeks permit us to measure areas and volumes indirectly, when we express these quantities as lengths. We ought not to undervalue this contribution of the ancient Greek mathematicians. Their formulae for areas and volumes represent a great practical and important result. But) this type of indirect measurement is not the only one of interest to the Greeks. They measure indirectly the radius of the Earth, the diameter of the sun and moon, the distances to the moon, the sun, some planets and stars.

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2 семестр
Экзамен

Экзаменационный билет № 8

I. a) Прочитайте предложенный текст № 8 “ Mathematical propositions”.
b) Письменно переведите отрывок текста, где говорится об аксиомах.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

III. Сообщение и беседа с экзаменаторами на иностранном языке по вопросам, связанным со специальностью и научной работой магистранта.

Преподаватель __________________

Заведующий кафедрой __________________ К.Н. Волченкова

Экзаменационный билет № 8

1. **“Mathematical propositions”**

In geometry, the process of reasoning is a principal way to discover properties of geometric figures. It would be instructive therefore to acquaint yourself with the forms of reasoning usual in geometry. All facts established in geometry are expressed in the form of propositions. The propositions that we take for granted without proof are called assumptions. With regard to a different set of assumptions the same proposition may, or may not be true. The assumptions themselves are neither true nor false. They may be said to be “true” only in the sense that their truth has been assumed.

Definitions are propositions which explain what meaning one attributes to a name or expression. Axioms (some axioms are traditionally called postulates) are those facts which are accepted without proof. This includes, for example, some propositions: through any two points there is a unique line; if two points of a line lie in a given plane then all points of this line lie in the same plane. Propositions that can be logically deduced from the assumptions are often called theorems. For example, if one of the four angles formed by two intersecting lines turns out to be right, then the remaining three angles are right as well.

Corollaries are those propositions which follow directly from an axiom or a theorem. For instance, it follows from the axiom "there is only one line passing through two points" that "two lines can intersect at one point at most." In any theorem one can distinguish two parts: the hypothesis and the conclusion. The hypothesis expresses what is considered given, the conclusion what is required to prove. For example, in the theorem "if central angles are congruent, then the corresponding arcs are congruent" the hypothesis is the first part of the theorem: "if central angles are congruent," and the conclusion is the second part: "then the corresponding arcs are congruent;" in other words, it is given (known to us) that the central angles are congruent, and it is required to prove that under this hypothesis the corresponding arcs are congruent.

It is useful to notice that any theorem can be rephrased in such a way that the hypothesis will begin with the word "if," and the conclusion with the word "then." For example, the theorem "vertical angles are congruent" can be rephrased this way: "if two angles are vertical, then they are congruent." The theorem converse to a given theorem is obtained by replacing the hypothesis of the given theorem with the conclusion (or some part of the conclusion), and the conclusion with the hypothesis (or some part of the hypothesis) of the given theorem. For instance, the following two theorems are converse to each other: If central angles are congruent, then the corresponding arcs are congruent.

If arcs are congruent, then the corresponding central angles are congruent. If we call one of these theorems direct, then the other one should be called converse. In this example both theorems, the direct and the converse one, turn out to be true. This is not always the case. For example the theorem: "if two angles are vertical, then they are congruent" is true, but the converse statement: "if two angles are congruent, then they are vertical" is false. Indeed, suppose that in some angle the bisector is drawn. It divides the angle into two smaller ones. These smaller angles are congruent to each other, but they are not vertical.

2. **Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.**

The scientists have proved a chain of theorems and have come to recognize the entire structure of undefined terms, definitions, assumptions, and theorems as constituting an abstract logical system. In such a system we say that each proposition is derived from its predecessor by the process of logical deduction. This process of logical deduction is scientific reasoning. This scientific reasoning must not be confused with the mode of thinking employed by the scientist when he is feeling his way toward a new discovery. At such times the scientist, curious about the sum of the angles of a triangle, proceeds to measure the angles of a great many triangles very carefully. In every instance he notices that the sum of the three angles is very close to 180°; so he puts forward a guess that this will be true of every triangle he might draw. This method of deriving a general principle from a limited number of special instances is called induction. The method of induction always leaves the possibility that further measurement and experimentation may necessitate some modification of the general principle. The method of deduction is not subject to upsets of this sort. When the mathematician is groping for new mathematical ideas, he uses induction. On the other hand, when he wishes to link his ideas together into a logical system, he uses deduction. The laboratory scientist also uses deduction when he wishes to order and classify the results of his observations and his inspired guesses and to arrange them all in a logical system. While building this logical system he must have a pattern to guide him, an ideal of what a logical system ought to be. The simplest exposition of this ideal is to be found in the abstract logical system of demonstrative geometry.

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2 семестр
Экзамен

Экзаменационный билет № 9

I. a) Прочитайте предложенный текст № 9 “Points, lines, planes and angles”.
b) Письменно переведите отрывок текста, где говорится о некомпланарные прямые.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

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Преподаватель ___________________

Заведующий кафедрой ___________________ К.Н. Волченкова

Экзаменационный билет № 9

1. “Points, lines, planes and angles”

The most fundamental idea in the study of geometry is the idea of a point. Think of a point as an exact location in space, it has no dimensions. When writing about points, you represent the points by dots. Remember, the dot is only a picture of a point, and not the point itself. Points are commonly referred to by using capital letters. The dots mark points and are referred to as point A, point B and point C. A line is one of the undefined terms in geometry. A description of a line is that it has length but no thickness or depth. In theory, a line may be extended infinitely in each direction.

A plane is a flat surface that extends infinitely in all directions. Imagine extending the length and width of a table top forever. Lines that lie in the same plane are called coplanar lines. Any two coplanar lines must have one and only one of the characteristics listed: 1. The lines may intersect. If they intersect and form right angles, they are perpendicular lines. 2. The lines may be parallel. Parallel lines will never meet. 3. The lines may coincide. Lines that coincide are actually the same lines.

Lines that lie in different planes and do not intersect are called noncoplanar lines or skew lines. If two planes do not intersect, the planes are parallel. If two planes intersect, their intersection is a line. An angle is formed by two rays that have the same endpoint, which is called the vertex of the angle. The rays are called the sides of the angle. (A ray is a part of a line drawn from a given point called the endpoint. The ray continues forever in the other direction.) A point between the sides of the angle is in the interior of the angle. To name an angle use three letters. The center letter corresponds to the vertex. The other two letters are points on each ray. The angle can be named ABC or CBA. It can be read as “angle ABC or angle CBA. An angle is measured in degrees with an instrument called a protractor.

There are five types of angles that are essential to the study of geometry. Acute angle – an angle whose measure is less than 90°. Right angle – an angle whose measure equals 90°. A box in the vertex denotes a right angle. Obtuse angle – an angle whose measure is greater than 90° and less than 180°. Straight angle – an angle whose measure equals 180°. Reflex angle – an angle whose measure is greater than 180° and less than 360°.

Equal angles are angles that have the same number of degrees. A ray that bisects an angle divides it into 2 equal parts. The line is called the angle bisector. Congruent angles have the same measure. Perpendiculars are lines that form right angles. All right angles are congruent. The sides of a straight angle lie on a straight line. All straight angles are congruent. A perpendicular bisector of a line bisects the line and is perpendicular to the line.

2. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

Points are most often considered within the framework of Euclidean geometry, where they are one of the fundamental objects. Euclid originally defined the point vaguely, as "that which has no part". In two dimensional Euclidean space, a point is represented by an ordered pair, (x, y), of numbers, where the first number conventionally represents the horizontal and is often denoted by x, and the second number conventionally represents the vertical and is often denoted by y. This idea is easily generalized to three dimensional Euclidean space, where a point is represented by an ordered triplet, (X, Y, Z) with the additional third number representing depth and often denoted by z. In addition to defining points and constructs (построения) related to points, Euclid also postulated idea about points; he claimed that any two points can be connected by a straight line. This is easily confirmed under modern developments of Euclidean geometry, and had lasting consequences at its introduction, allowing the construction of almost all the geometric concepts of the time. However, Euclid's postulation of points was neither complete nor definitive, as he occasionally assumed facts about points that didn't follow directly from his axioms, such as the ordering of points on the line or the existence of specific points. In spite of this, modern developments of the system serve to remove these assumptions.

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2 семестр
Экзамен

Экзаменационный билет № 10

I. a) Прочитайте предложенный текст № 10 “Matrices”.
b) Письменно переведите отрывок текста, где говорится о типах матриц.
c) Обсудите с преподавателем тему статьи, её общее содержание и затронутые проблемы.

II. Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.

III. Сообщение и беседа с экзаменаторами на иностранном языке по вопросам, связанным со специальностью и научной работой магистранта.

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Экзаменационный билет № 10

1. **“Matrices”**

A matrix is a set of quantities arranged in rows and columns to form a rectangular array. Matrices don’t have a numerical value. They are used to represent relations between quantities as well as to represent and solve simultaneous equations. A matrix of m rows and n columns is called an (mn) matrix.

There are a few types of matrices: a square matrix, a row matrix, a column matrix, a unit matrix, a transpose of a matrix and others. Here we’ll regard more closely a square matrix. In algebra a square matrix is an orthogonal matrix with real entries whose columns and rows are orthogonal unit vectors. Equivalently, a matrix Q is orthogonal if its transpose – the matrix that results from interchanging the rows and columns – is equal to its inverse: $Q^T = Q^{-1}$, which derives $Q^TQ = \ = QQ^T = I$, where I is the identity matrix. This type of matrix is a square matrix in which all the elements in the leading diagonal are ones and the other elements are equal to zero. An orthogonal matrix is the real specialization of a unitary matrix. The set of n × n orthogonal matrices forms a group O(n), known as the orthogonal group. The subgroup SO(n) consisting of orthogonal matrices with determinant +1 is called the special orthogonal group, and each of its elements is a special orthogonal matrix. Orthogonal matrices arise naturally from inner products, and from matrices of complex numbers. Orthogonal matrices preserve inner product, so for vectors u, v in an n-dimensional real inner product space ‹u,v› = ‹Qu, Qv›.

To see the inner product connection, let’s consider a vector v in an ndimensional real inner product space. Written with respect to an orthonormal basis, the squared length of v is $v^Tv = (Qv)^T(Qv) = v^TQ^T v$. The finite-dimensional linear isometries – rotations, reflections, and their combinations – produce orthogonal matrices. The converse is also true: orthogonal matrices imply orthogonal transformations. However, linear algebra includes orthogonal transformations between spaces which may be neither finite-dimensional nor of the same dimension.

The inverse of every orthogonal matrix is again orthogonal. In fact, the set of all n × n orthogonal matrices satisfies all the axioms of a group. It is a compact Lie group of dimension n (n − 1)/2, called the orthogonal group and denoted by O(n).

The orthogonal matrices whose determinant is + 1 form the special orthogonal group SO(n) of rotations. Now let’s consider (n+1) × (n+1) orthogonal matrices with bottom right entry equal to 1. The remainder of the last column (and last row) must be zeros, and the product of any two such matrices has the same form. The rest of the matrix is an n×n orthogonal matrix; thus O(n) is a subgroup of O(n + 1) (and of all higher groups).

Since an elementary reflection can reduce any orthogonal matrix to this constrained form, a series of such reflections can bring any orthogonal matrix to the identity; thus an orthogonal group is a reflection group. Orthogonal matrices are important for a number of reasons, both theoretical and practical.

2. **Беглое чтение текста и передача извлеченной информации на русском языке в форме аннотации.**

A matrix is a rectangular table of elements (or entries) which may be numbers or more generally any abstract quantities that can be added and multiplied. Matrices find many applications. They are a key tool in linear algebra. One use of matrices in linear algebra is to represent linear transformations. Matrices can also keep track of the coefficients in a system of linear equations. Physics makes use of matrices in various domains, for example, in geometrical optics, mechanics. Graph theory uses matrices to measure distances. Computer graphics uses them to project a 3-dimensional space onto a 2-dimensional screen. To apply a matrix correctly one should bear in mind its properties. Matrices of the same size can be added and subtracted. Matrices of compatible sizes can be multiplied. These operations have many properties of ordinary arithmetic, except that a matrix multiplication is not commutative, that is, AB and BA are not equal in general. Matrices have the following properties: to add matrices, add corresponding elements together to obtain anothermatrix of the same order; only matrices of the same order may be added; to subtract matrices, subtract corresponding elements to obtain another matrix of the same order; only matrices of the same order may be subtracted; to multiply a matrix by a number (also called a scalar), multiply each element of it; to multiply matrices, multiply rows by columns and add.