III. GRAMMAR EXERCISES

I. a) Analyse the following sentences and define the functions of the Infinitive and the Participle. b) Translate these sentences.

1. Using voltage levels and positive logic this means that with a low voltage at the input, the output is at a high voltage level, or vice versa. 2. The first form of digital ICs to receive general usage was a simple connection of bipolar transistor inverted circuits to yield a NOR gate. 3. Since the circuit consisted of only resistors and transistors, it was named RTL. 4. An IC development consisted of a diode AND circuit followed by a bipolar transistor inverter. 5. The first "new" digital design made possible by the IC fabrication process was TTL. 6. Widely used schemetic representation for the n-p-n and p-n-p transistors are shown in Fig. 3.1*a*. 7. The emitter lead of each transistor type is seen to have an arrowhead which points in the direction of conventional current flow in the emitter lead. 8. Input connections may be made to any two terminals, with the output appearing across the third terminal and one of the input terminals. 9. The grounded-emitter and grounded-base switching circuits can be made to operate from saturation to cutoff.

II. Define the tense-forms of the verbs in the following sentences and translate them.

1. This was called DTL. 2. The first form of digital ICs was introduced in 1962. 3. The circuit with only resistors and transistors was named RTL. 4. Both RTL and DTL had long been popular with digital circuit designers. 5. In this circuit the diode AND function of DTL was performed by a multi-emitter transistor, a bipolar transistor with as many as eight emitters. 6. Various types of computers and control operations can be performed with switches which have two distinct levels of output current or voltage. 7. Transistors have three terminals and may be connected into a circuit in one of several different configurations. 8. Input connections may be made to any two terminals. 9. The grounded-collector switch is usually designed to operate out of saturation.

III. a) Analyse the structure of the following sentences. b) Translate these sentences.

1. When the input voltage in Fig. 3.2*a* falls to ground potential, the transistor base is connected to ground through a resistor: the transistor is at cutoff, collector leakage current is equal to I_{CE0}, and the quiescent operating point of the circuit is at point *D* of Fig.3.2*b*. 2. This equation shows that if there were no voltage drop across the transistor, the collector current would become $I_C = \frac{U_{CC}}{R_L}$. 3. Conversely if collector current were equal to zero, there would be no voltage drop across R_L and, from Eq. (3.1) $U_{CE} = U_{CC}$, when the transistor is at cutoff.

Lesson 2. BINARY NUMBER SYSTEM AND BOOLEAN ALGEBRA

I. INDEPENDENT WORK

In the Laboratory

1. Skimming Reading

PRE-TEXT EXERCISES

I. a) Listen and repeat after the speaker. b) Practise the pronunciation of the following.

I. [ʌ] multiplied, number, product, hundred, discussion; [ju] numeral, constitute, utilize, tube, cube; [ɪ] system, analogy, binary, this, is, in, bit, him; [i:] each, read, field, yield.

II. Various ['vɛərɪəs], sequence ['si:kwəns], yield [ji:ld], immediately [i'mi:djətlɪ], interpret [ɪn'tə:prɪt], extreme [ɪks'tri:m].

II. a) Make sure that you know these words. Say what Russian words help you to guess their meanings. b) Repeat these words after the speaker.

Symbolic, logic, analogy, arabic, summed, positive, binary, system, decimal, analysis, position, bit, relay, elements, contact, algebra, analyze, synthesize.

III. Check if you know the meaning of these words and word-combinations.

Numbering system система счисления; binary (decimal) number system двоичная (десятичная) система счисления; constitute v. составлять; utilize v. использовать; digit (десятичная) цифра, разряд (десятичного числа); sequence последовательность; familiar знакомый; integer целый; shorthand notation сокращенная запись; in proper manner должным образом; extreme left (right) крайний левый (правый); by a power of 10 на степень десяти; the various products are then summed together затем различные произведения складываются; multiply v. умножать; numeral цифра; yield v. производить, создавать omit v. опускать; extreme крайний; convention *зд.* условие.

IV. a) Give initial forms of the following words and define the function of suffixes. b) Translate these words.

Notation, symbolic, numbering, actually, summation, generally, combining, convention, additional, summarising.

V. Make up sentences using the following word-combinations and translate them.

The binary number system; utilize the arabic numerals; be summed together; a given sequence of numerals; the only digit used; in the proper manner; in order to represent a decimal number; each addition position; from left to right.

VI. Listen and repeat after the speaker the following numbers and arithmetic steps with them.

10^3 ten in the third power;
10^1 ten in the first power;
10^2 ten in the second power (ten squared);
$1 \times 10^3 + 3 \times 10^2 + 5 \times 10^1 + 2 \times 10^0 - 4$. One multiplied by ten in the third power plus three multiplied by ten squared plus five multiplied by 10 in the first power plus two multiplied by ten in zero power minus four.

Text A

CONCEPTION ABOUT NUMBER SYSTEM

I. a) Listen to the text, mind the English intonation. b) Read the text to yourself and grasp the main idea of it.

Symbolic logic uses only the numerals 0 and 1. These two digits constitute a numbering system known as the "binary number system".

The binary number system can best be described by analogy to the decimal number system. The decimal number system utilizes the arabic numerals 0 to 9 in a shorthand notation for certain arithmetic operations. Each digit in a decimal number is actually multiplied by a power of 10; the various products are then summed together to yield the decimal quantity. The power of 10 by which a digit is multiplied is determined by the position of the digit within a given sequence. For instance, the sequence of numerals 1,352 is interpreted as $1 \times 10^3 + 3 \times 10^2 + 5 \times 10^1 + 2 \times 10^0$; the various products can be formed to yield $1{,}000 + 300 + 50 + 2$. Summation of the last group of digit yields the quantity one thousand three hundred fifty-two. Because the decimal number system is so familiar, the above arithmetic steps are generally omitted and a given sequence of numerals is immediately interpreted as a particular quantity.

2. Average Reading

Text B

BINARY NUMBER SYSTEM

I. a) Listen to the text. b) Read it (time limit is 3 min.). c) Find the part of it dealing with the various bits in a binary sequence. Speak on them.

In the binary number system, the arabic numerals 0 and 1 are the only digits used. By combining these binary digits, or bits, in the proper manner, decimal numbers can be represented. For the present analysis, only integer decimal values will be considered. In order to represent a decimal number, the bits 0 and 1 are written in a sequence. The various bits in a binary sequence are multiplied by power of 2, and the position of a bit determines the power of 2 by which the bit is to be multiplied. The sequence is often written from right to left, with the most significant bit to the extreme left. This convention will be followed in the present discussion. Let the bit position at the extreme right in the sequence represent $2^0 = 1$; then the second bit position from the right represents $2^1 = 2$. Each additional position to the left represents an additional power of 2. The binary number 1011 is interpreted, from left to right, as $1 \times 2^3 + 0 \times 2^2 + 1 \times 2^1 + 1 \times 2^0$, which is equal to the decimal number 11.

ASSIGNMENTS

I. a) Choose the key sentences from the Text A and compare them with the title of the text. b) Say what the text is about.

II. a) Skim through the Text B and explain how decimal numbers can be represented by binary digits.

III. Answer the following questions embracing the contents of the texts.

1. What numerals does symbolic logic use? 2. What do these two digits constitute? 3. How can the binary number system best be described? 4. What numerals does the decimal number system utilize? 5. By what is each digit in decimal number multiplied? 6. Are the various products then summed together to yield the decimal quantity? 7. By what is the power of 10 by which a digit is multiplied determined? 8. What are the only digits used in the binary number system? 9. How can decimal numbers be represented? 10. How are the bits 0 and 1 written in order to represent a decimal number? 11. By what are the various bits in a binary sequence multiplied? 12. What does the position of a bit determined?

IV. Prepare a dialogue using information of the Text A and Text B.

V. Speak on:

1. Symbolic logic.
2. Binary number system.

II. CLASSWORK

3. Close Reading

PRE-TEXT EXERCISES

I. Be sure that you know these words.

Application применение; design проект, конструкция; describe описывать; respectively соответственно; provide обеспечивать; network сеть; stable стабильный, устойчивый; profound глубокий, сильный; expression выражение; subject v. подвергать, подчиняться; assign определять; extensively широко; refer v. относиться.

II. Memorize these terms.

Relay switching network релейная переключающая цепь; network design построение цепи (схемы); circuit arrangement схемная конфигурация; straight forward method простой и очевидный метод; switching elements переключающие элементы; refer tо as "logic circuits" относиться к «логическим цепям».

III. Find these word-combinations in the Text C and translate sentences containing them.

Relay contacts релейные контакты; to provide a straightforward method обеспечить простой метод; a mathematical expression to describe математические выражения для описания; a profound effect сильный эффект.

IV. Analyse the structure of the following words and give their initial forms.

Application, switching, network, straightforward, writing, expression, arrangement, simplification, extensively, bistable, magnetic. operation.

V. Find in the Text C the English equivalents of the following Russian word-combinations.

Написать статью о применении: открытое и закрытое положение; описаны в выражениях; два устойчивых положения; подвергаться определенным правилам упрощения; для того, чтобы уменьшить.

Text C

BOOLEAN ALGEBRA AND SWITCHING CIRCUITS

I. a) Read the text. b) Find the part of it describing a simply stated network design. Translate it.

In 1938, Shannon wrote a paper on the application of Boolean algebra to the design of relay switching networks. Open and closed states of relay contacts were described in terms of 1 and 0, respectively. The mathematics of logic was shown to provide a straitforward method of designing networks composed of switching elements having two stable states. Simply stated network design consisted of writing a mathematical expression to describe a circuit arrangement of relay contacts; the expression could then be subjected to certain rules of simplification in order to reduce the total number of relay contacts.

The above application of Boolean algebra had a profound effect upon future designs of switching networks. This algebra has since been used extensively to analyze and synthesize circuits which contain elements having two stable states; these elements may be relays, vacuum tubes, transistors, bistable magnetic devices, or other bistable electrical devices. The above circuits perform operations which are described by the algebra of logic and are often referred to as "logic circuits".

ASSIGNMENTS

I. Answer the following questions embracing the contents of the Text C.

1. When was a paper on the application of Boolean algebra to the design of relay switching networks written? 2. Had the application of Boolean algebra a profound effect upon future designs of switching networks? 3. How has this algebra been used? 4. What elements have two stable states? 5. What are referred to as "logic circuits"?

II. Combine your answers into a short summary of the text.

III. a) Divide the text into logical parts. b) Choose the key sentences and translate them.

IV. Comment on the author's attitude to Boolean algebra and switching circuits.

V. Speak on Boolean algebra applied to switching circuits.

VI. Translate the Text C to be sure you understand it well.

4. Searching Reading

PRE-TEXT EXERCISES

I. Match the following English words and word-combinations with the Russian ones.

associative, commutative and distributive laws	с черточкой над буквой
evaluate v.	прямой, простой
proposition	соседний
straightforward	знак
in honour	круглые скобки
parentheses pl.	не A
truth table	таблица истинности
substitute v.	применять
employ v.	оценить
likewise	высказывание
with the bar over the letter	в честь
sign	тем не менее, подобно
adjacent	по отношению к
with respect to	по крайней мере
	точка (над чем-либо)

at least	заменять
dot	ассоциативный, коммуникативный и распределительный законы
$\overline{A}$ (not A)	

II. Make sure that you know these word-combinations.

In order to evaluate для того чтобы оценить; generally known общеизвестно; in general вообще; an expression such as выражение, такое как; with respect to по отношению к; it is seen видно; both terms оба терма, обе величины; a listing of various values перечень разных величин; in accordance with в соответствии с; for instance например; although a further simplification хотя дальнейшее упрощение.

III. Give the main forms of the following verbs and translate them.

Develop, denote, know, write, employ, read, give, use, include, see, yield, take, determine, combine, obtain, apply, exist, have, represent, evaluate, show, obtain, reduce, allow.

IV. a) Give the initial forms of the following words and translate them. b) State the function of suffixes.

Generally, description, logical, notation, expression, operation, equation, variable, resulting, listing, distributive, associative, commutative, multiplication, containing, interpretation, relationship.

Text D

BOOLEAN ALGEBRA

I. Read the text and state briefly Boolean algebra.

In order to evaluate logical propositions in a straightforward manner a mathematics of logic was developed. This mathematics is generally known as "Boolean algebra", in honour of George Boole, who in 1854 wrote a description of this logical language.

Two mathematical operations OR and AND are employed in Boolean expressions. In general, the OR function is denoted by $+$ and the AND function is denoted by $\times$, a dot, parentheses, or simply no notation between two adjacent symbols. The expression $A+B$ is read «A or B» and the expression AB is read «A and B». An expression such as $(A+B)\cdot(C+D)$ is read «A or B and C or D».

Six postulates, or rules, of Boolean algebra are given below. These postulates can be used to evaluate various logical expressions.

$0+0=0$ (1) $\qquad 0\times 0=0$ (4)
$0+1=1$ (2) $\qquad 0\times 1=0$ (5)
$1+1=1$ (3) $\qquad 1\times 1=1$ (6)

With respect to postulates that include the OR operation, it is seen that the result is 1 if at least one of the terms on the left side of the expression is 1. The AND operation yields 1 only when both terms on the left are 1.

Letters are often used in the equations of Boolean algebra to represent variable quantities. Each of these letters may take on a value of 1 or of 0. The expression $A+B=C$ (7) indicates that the value of C is determined by an OR operation upon values of A and B. A listing of various values of A and B, together with each resulting value of C, is referred to as a «truth table».

Truth Table for $A+B=C$

A	B	C
0	0	0
1	0	1
0	1	1
1	1	1

Truth Table for $AB=C$

A	B	C
0	0	0
1	0	0
0	1	0
1	1	1

If there letters A and B are combined in the AND function, the expression is written $AB=C$. (8)

As in ordinary algebra, equivalent expression may be obtained by factoring, combining or expanding terms. The associative, commutative, and distributive laws of ordinary algebra apply to the OR and AND operations. From the associative laws for addition and multiplication:

$$A+(B+C)=(A+B)+C \qquad (9)$$
$$A(BC)=(AB)C \qquad (10)$$

The commutative laws for addition and multiplication give

$$A+B=B+A, \qquad (11)$$
$$AB=BA. \qquad (12)$$

The distributive law yields

$$A(B+C)=AB+AC. \qquad (13)$$

Several differences exist between ordinary algebra and Boolean algebra. A Boolean expression containing a variable and the number 1 or 0 represents a logical operation and must be evaluated in accordance with postulates (1) to (6). For instance, postulates (2) and (3) show that $A+1=1$ (14)
and postulates (5) and (6) show that

$$A\times 1=A. \qquad (15)$$

The six postulates can also be used to obtain

$$A+A=A \qquad (16)$$

and

$$A\times A=A. \qquad (17)$$

In ordinary algebra, the expression $AB+B$ can be reduced to $B(A+1)$. The above reduction is also valid in Boolean algebra, although a further simplification can be made. Equation (14) shows $A + 1$ is equal to 1; this reduces the expression to $B \times 1$ which from Eq. (15), yields B alone. The above steps give the Boolean identity

$$AB + B = B. \tag{18}$$

Since a binary number must be either 0 or 1, the two numbers are said to be complements of each other. A letter used to represent a binary number has a complement. If the letter represents 1, the complement to this letter is 0. Likewise, the complement of the letter takes on the value 1 when the letter itself represents 0. The complement of a letter is the "inverse" of the letter and is usually denoted by the same letter primed or with a bar over the letter; the bar notation will be used throughout the book. The letter A has as its complement the letter $\bar{A}$; this letter symbol is read "not A". One interpretation of the symbol A and $\bar{A}$ is that the former represents the true state of the variable and the latter represents the false, or complementary, state of the variable.

Two useful relationships between the true and complementary states of a variable are given below:

$$A + \bar{A} = 1, \tag{19}$$

$$A \times \bar{A} = 0. \tag{20}$$

Postulates (2) and (3) can be used to varify Eqs. (19) and (20), respectively. An OR function can be written in the form of an AND function by use of complements. Likewise, complementary notation allows an AND function to be modified to the form of an OR function. The identities can be varified by use of truth tables:

$$\overline{ABC \ldots} = \bar{A} + \bar{B} + \bar{C} \ldots, \tag{21}$$

$$A + B + C \ldots = \overline{\bar{A}\,\bar{B}\,\bar{C}} \ldots. \tag{22}$$

ASSIGNMENTS

I. Answer the following questions embracing the contents of the text.

1. Upon what is Boolean algebra based? 2. What operations are employed in Boolean expressions? 3. How are OR and AND functions denoted? 4. Are letters used in the equations of Boolean algebra? 5. What value may each of the letters take? 6. What does the expression $A + B = C$ indicate? 7. What is referred to as a "truth table"? 8. To what do the associative, commutative, and distributive laws of ordinary algebra apply? 9. What represents a logical operation? 10. How must a Boolean expression be evaluated? 11. What is one interpretation of the symbol A and $\bar{A}$?

II. Prepare a dialogue on the topic.

III. Make up a plan of the Text D.

IV. Speak on the text according to your plan.

V. Look through the latest magazines and find additional information on Boolean algebra. Discuss it.

III. GRAMMAR EXERCISES

I. a) Analyse the following sentences, find out the subject and the predicate. b) Translate the sentences.

1. For the present analysis, only integer decimal values will be considered. 2. Since a binary number must be either 0 or 1, the two numbers are said to be complements of each other. 3. The various bits in a binary sequence are multiplied by power of 2, and the position of a bit determines the power of 2 by which the bit is to be multiplied. 4. Let the bit position at the extreme right in the sequence represent $2^0 = 1.5$. The power of 10 by which digit is multiplied is determined by the position of the digit within a given sequence. 6. It is necessary that there be a detectable difference in voltage or current levels between the two stable states of a transistor switch in order for the correct binary interpretation to be made.

II. a) Define the function of the Participle. b) Translate the sentences.

1. A given sequence of materials is immediately interpreted as a particular quantity. 2. In the binary number system, the arabic numerals 0 and 1 are the only digits used. 3. A Boolean expression containing a variable and the number 1 or 0 represents a logical operation.

III. Pick out all sentences in the Text D containing modal verbs with the Passive Infinitive and translate them.

IV. Change the following sentences according to the model and translate them.

Model. The expression **was subjected** to certain rules of simplification.
The expression **could be subjected** to certain rules of simplification.

1. This algebra was used extensively to analyze and synthesized circuits. 2. A mathematics of logic was developed. 3. Two mathematical operations OR and AND are employed in Boolean expressions. 4. The OR function is denoted by + and the AND function is denote by x.

V. Define the function of the Gerund and translate sentences.

1. By combining these binary digits, or bits, in the proper manner, decimal numbers can be represented. 2. The mathematics of logic was shown to provide a straightforward method of designing networks of switching elements having two stable states. 3. Simply stated network design consisted of writing a mathematical expression to describe a circuit arrangement of relay contacts; the expression could then be subjected to certain rules of simplification in order to reduce the total number of relay contacts. 4. As in ordinary algebra, equivalent expressions may be obtained by factoring, combining or expanding terms.

VI. Define the tense-forms of the verb in these sentences and translate them.

1. Various products are then summed together to yield the decimal quantity. 2. Only integer decimals will be considered. 3. The bits 0 and 1 were written in sequence. 4. The sequence is often written from

right to left. 5. This convention will be followed in present discussion. 6. Each digit in a decimal number is actually multiplied by a power of 10.

Lesson 3. LOGIC CIRCUITS

I. INDEPENDENT WORK

In the Laboratory.

1. Skimming Reading

PRE-TEXT EXERCISES

I. a) Listen and repeat after the speaker. b) Practise the pronunciation of the following.

[ei] name, make, operation, gate, range; [æ] as, fact, that, and, can, maximum; [ai] describe, type, whilst, diode, wide, primarily, spike; [i] initial, is, different, give, still, system, which, input, single, chip; [i:] be, field, descrete, speed, achieve, increase; [ou] whole, so low, most, approach, slow; [ɔ] logic, only, on, cost, popular, all, not; [ju:] use, calculate, popular; [ʌ] supplement, multiple, function, such, consumption, currently; [oi] noise, avoid.

supplement ['sʌpləmənt], availability [əˌveilə'bılıtı], deliberately [di'lıbərıtlı], environment [ın'vaıərənmənt], precaution [prı'kɔ:ʃən], immunity [i'mju:niti], elaborate [ı'læbərıt], virtue ['və:tju:].

II. Make sure that you know these words. Say what Russian words help you to guess their meanings. b) Repeat these words after the speaker.

Logic, descrete, resistor, transistor, diode, popular, computer, maximum, equivalent, propagation, serious, compact, calculator, base, function, voltage, perform.

III. a) Listen, repeat and memorize the following words and word-combinations. b) Check if you know the meaning of these words.

Abbreviation сокращение; describe описывать; supplement добавлять, дополнять; availability (при)годность, наличие; low cost низкая стоимость; capability способность; deliberately обдуманно; precaution предостережение, предосторожность; in noise immunity помехоустойчивость; incorporate помещать, включать; permissible допустимый; margin грань, предел, граница поля; elaborate тщательно разработанный, выработанный; complementary дополнительный, добавочный; chief virtue главное достоинство (свойство); extremely чрезвычайно; consumption потребление; gate input вход элемента (вентиля); fast noise spikes быстрые шумовые всплески; pocket calculator chips кристаллы для карманных калькуляторов; IC computer ЭВМ на интегральных схемах; CMOS system система логики на основе К-МДП транзисторов.

IV. a) Listen and repeat after the speaker the following terms. b) Memorize them and their abbreviations.

multiple-emitter transistor (MET) многоэмиттерный транзистор (МЭТ); emitter-coupled logic (ECL) логика с эмиттерной связью (ЭСЛ); high-level logic (HLL) высокоуровневая логика; high-noise immunity logic HNIL) высокопороговая логика, не восприимчивая к высоким шумам логика (НВШЛ); resistor-transistor logic (RTL) резисторно-транзисторная логика (РТЛ); diode-transistor logic (DTL) диодно-транзисторная логика (ДТЛ); transistor-transistor logic (TTL) транзисторно-транзисторная логика (ТТЛ); IC computer ЭВМ на интегральных схемах; random-access memories (RAMs) ЗУ со случайной выборкой (ОЗУ); CMOS system система логики на основе К-МДП транзисторов.

V. Make up sentences using the following word-combinations from the Text A and the Text B and translate them.

Extensive use широкое применение; whilst it uses в то время, как он использует; makes it popular делает его известным; the fact remains, however, that однако сущность заключается в том, что; such as такие, как; it also makes possible это также делает возможным; in addition в дополнение; however однако.

VI. a) Give initial forms of the following words. b) Translate them.

Abbreviations, supplement, giving, availability, counting, operating, operation, achieving, achievement, typically, saturation, approaching, capability, deliberately, particularly, permissible.

Text A

TYPES OF LOGIC CIRCUITS

I. a) Listen to the text, mind the English intonation. b) Read the text to yourself and grasp the main idea of it.

Extensive use is made of abbreviations in the logic field. A whole series of initials is used to describe different types of logic circuits. If the discrete circuits use only resistors and a transistor, so they are described as resistor-transistor logic (RTL) whilst it uses diodes on the input to supplement the transistor and are termed diode transistor logic (DTL). The diode at the input may be fabricated in the form of a special multiple-emitter transistor, giving the circuit its name of transistor-transistor logic (TTL). The wide availability and low cost of TTL makes it popular for all logic and counting function. The fact remains, however, that it is primarily designed for fast operating in large computer. Still faster types of logic, such as Schottky TTL and emitter-coupled logic (ECL) are currently used, these achieving extra speed (typically 2ns delay per gate) by avoiding transistor saturation. Most logical control and counting operations do not require operating speeds even approaching the capability of TTL.

2. Average Reading

Text B

LOGIC CIRCUITS FOR SLOW OPERATION

I. a) Listen to the text. b) Read it (time limit is 3 min.). c) Find the part of it dealing with the using of MOS logic. Translate it.

Several logic systems are available which are deliberately designed for slow operation, making them particularly useful in noisy environments without special precautions. High-level logic (HLL) and high-noise immunity logic (HNIL) both use a modified form of diode-transistor logic (DTL). A Zener diode is incorporated in the gate input to raise the maximum permissible logic 0 input level to 5 V, giving increased margin over the equivalent 0.8 V range of TTL. A higher supply voltage of 12 V to 15 V gives increased margin of 4 V to 7 V at the logic I threshold. Gate propagation times are some 20 times greater than with TTL, so that fast noise spikes are no longer a serious problem.

Elaborate logic functions can be fabricated on a single chip using MOSFET transistor, which are very compact, some 5000 devices being possible on a chip 4 mm square.

MOS logic is used for pocket calculator chips; it also makes possible the IC computer or micro-processor and random-access memories (RAMs). This very popular range of IC logic uses complementary MOSFET transistors. The chief virtue of the CMOS system is its extremely low power consumption (typically 10 nW per gate). In addition it offers very good noise immunity. However MOS logic has low speed of operation.

ASSIGNMENTS

I. a) Choose the key sentences from the Text A and compare them with the title of the text. b) Say what the text is about.

II. Skim through the Text B and find the part of it dealing with HLL and HNIL. b) Discuss information about several logic systems with your fellow-students.

III. a) Find the part of the text containing information about gate propagation times. b) Discuss it using your knowledge on the topic.

IV. Answer the following questions embracing the contents of the Text A and the Text B.

1. What is used to describe different types of logic circuits? 2. What is described as resistor-transistor logic? 3. In what form may the diodes at the input be fabricated? 4. What makes TTL popular for all logic and counting functions? 5. For what is TTL primarily designed? 6. What computers are currently used? 7. What operations do not require operating speed? 8. What logic systems are designed for slow operation? 9. What form of diode transistor logic do both high-level logic and high-noise immunity logic use? 10. What can elaborate logic functions be fabricated on? 11. For what is MOS logic used? 12. What is the chief virtue of the CMOS system?

V. Prepare a dialogue on the topic.

VI. Speak on:

1. TTL integrated circuit logic.
2. High-level logic.

VII. Express your opinion of logic circuits and their using for different types of operations.

II. CLASSWORK

3. Close Reading

PRE-TEXT EXERCISES

I. Be sure that you know these words and word-combinations.

Advent приход; relatively относительно; approximately приблизительно; recently недавно; brief краткий; alter v. изменять(ся), переделывать; convey v. передавать, выражать; especially особенно; realize осуществлять; application применение; verify v. подтверждать, проверять.

II. Memorize the following abbreviations.

SSI	small-scale integration	малый уровень интеграции;
LSI	large-scale integration	большой уровень интеграции;
PLA	programmable logic array	программируемая логическая матрица.

III. Find these word-combinations in the Text C and translate; sentences containing them.

Multiple sums of products многократные суммы произведений; by making or ommiting устанавливая или пропуская; at intersection point в точках пересечения; not convey the same meaning не иметь того же значения; digital controller цифровой контроллер; product terms члены в виде произведений (в булевой алгебре); random logic произвольные логические схемы.

IV. a) State the function of each suffix in the following words. b) Translate these words.

Transistorized, relatively, desirable, cheaper, programmable, combinational, especially, implementation, realization, usually, application, realizing, regularity, equivalent.

Text C

DIODE LOGIC AND THE PROGRAMMABLE LOGIC ARRAYS (PLA)

I. a) Read the text. b) Find the part of it describing the forms of SSI logic. Translate it.

The first transistorized digital circuits used individually packaged ("discrete") diodes and transistors in a circuit form known as diode logic. Diode logic uses relatively few transistors and many more diodes, a desirable situation in those days when diodes were much cheaper than transistors. With the advent of small-scale integrated (SSI) digital circuits, the cost of diodes and transistors were approximately equalised, so circuit forms using more transistors were economical. The forms of SSI logic in wide use today are transistor-transistor logic (TTL), emitter-coupled logic (ECL), and complementary metal-oxide semiconductor (CMOS) logic.

Recently, an evolutionary form of diode logic has come into use in large-scale integrated (LSI) microprocessors and other circuits. It is known by a new name, programmable logic array (PLA).

The programmable logic array (PLA) is a combinational circuit for finding multiple sums of products. The word programmable in the name refers to the fact that the logic function is altered by making or omitting logic connections at intersection points within a rectangular array of orthogonal conductors. In this context, the word programmable does not convey the same meaning as it does when referring to a programmable computer.

PLAs are widely used today, both as individual LSI circuits and as subcircuits within LSI microprocessors and digital controllers. They are especially efficient for realizing control logic functions. Usually in control applications, less than all the possible product terms are needed. PLAs are less efficient for realization of arithmetic logic, in which all product terms are likely to be used. Efficiency here is defined as the silicon chip area of a PLA as compared to gate logic for realization of a specific logic function. The regularity of the PLA as contrasted with the irregular "random logic" nature of gate logic implementations always makes it easier to design and verify than the equivalent function designed with gates.

ASSIGNMENTS

I. a) Divide the text into logical parts. b) Choose the key sentences and translate them.

II. Look through the Text C and find the part of it dealing with programmable logic array (PLA). Comment on the point.

III. Answer the questions embracing the contents of the Text C.

1. What are transistorized digital circuits? 2. What does diode logic use? 3. What is the cost of diodes and transistors? 4. What are the forms of SSI logic in wide use today? 5. What is known as a programmable logic array (PLA)? 6. What does the word programmable in the name refer to? 7. Are PLAs widely used today? 8. What are PLAs especially efficient for? 9. Where are PLAs less efficient? 10. How is efficiency of PLA defined here? 11. What makes PLA easier to design and verify than the equivalent function designed with gates?

IV. Summarize your answers into a short summary of the text.

V. Make up a plan of the Text C and speak on the topic according to your own plan.

VI. Find the verbs in all sentences in the Text C and state their tense-forms.

VII. Translate the Text C to be sure you understand it well.

4. Searching Reading

PRE-TEXT EXERCISES

I. Match the following words and word-combinations with the Russian ones.

a sink	управлять, направлять
shift v.	из-за
distribution	достаточно
because of	насыщать, пропитывать
sufficiently	распределение
saturate	сдвигать
current-hogging effect	сток, поглотитель
steer v.	эффект неравномерности токов («искривления» токов)

II. Give the initial forms of the following words from the Text D and translate them.

Relatively, independent, principally, leakage, generally, driving, succeeding, cutoff, development, coupling, connection, increasingly, identical.

III. State the tense-forms of the following verbs from the Text D.

Insert, serve, determine, add, refer, combine, apply, amplify, transform, connect, show, utilize, make, flow, become, rise, steer, perform.

Text D

TRANSISTOR-RESISTOR LOGIC AND OTHERS

I. Read the text and give short information about transistor-resistor logic.

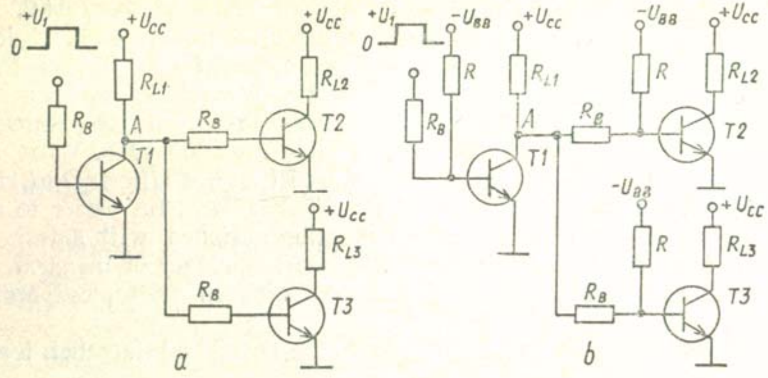

Fig. 3.4. Logic circuits of RTL-type.
a a circuit without base bias; *b* a circuit with base bias.

Resistors can be inserted between the collector of a transistor and the bases of fan-out transistor, as shown in Fig. 3.4*a*. These resistors serve to make base current to a transistor relatively independent of the base-emitter diode characteristic of the device. Hence, base currents to T_2 and T_3 in the above figure are determined principally by the magnitude of R_B and R_{L1}. In order to reverse bias T_1, T_2, T_3 in the OFF state and also to provide a sink for collector-base leakage current of these devices, resistor R and supply voltage — U_{BB} can be added to the inputs, as shown in Fig. 3.4*b*. This latter circuit is generally referred to as either a "transistor-resistor logic (TRL)" or as a "resistor-transistor logic (RTL)" stage.

The diode logic circuits can be combined with transistors to form "diode-transistor logic (DTL)" circuits. In effect, the output of diode gate is applied to the base of a grounded-emitter transistor; the transistor amplifies the signal and shifts it to the proper voltage level for driving a succeeding stage.

Both the OR/AND and AND/OR diode gates can be combined with the transistor; the base-input-voltage level to the transistor is inverted, and the complete circuit function is the inverse of that for the diode gate alone. Hence, the OR/AND gate is transformed to a NOR/NAND circuit, and the AND/OR gate becomes a NAND/NOR gate.

Fig. 3.5*a* shows a NOR/NAND DTL stage. A diode OR/AND gate is connected to the input of a single-transistor inverter. When the transistor is at cutoff, resistance R_L and supply voltage U_{CC} serve as a current source to N_0 fan-out transistors. Resistor R_B is connected in series with the transistor base to give an equal distribution of forward connected to a single inverter; this prevents the current-hogging effect.

One of the more recent developments in transistor logic circuits is shown in Fig. 3.5*b*. This logic circuit, which utilizes a multiple-emitter transistor as the coupling element between stages, is variously referred to as a "transistor-coupled logic (TCL) circuit", a "transistor-

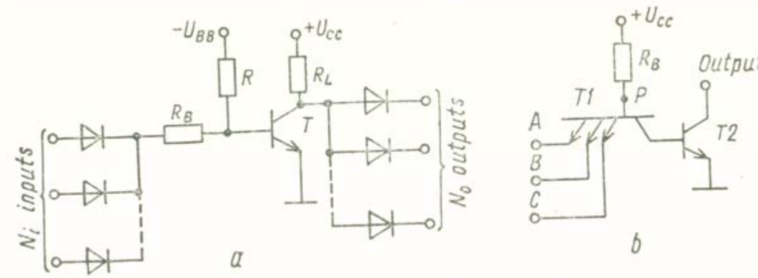

Fig. 3.5. Logic circuits of DTL- and TTL-types:
a the DTL circuit with simple inverter; *b* the TTL circuit identical to *a*.

transistor-logic (TTL) circuit", or "a transistor-squared logic (T^2L) circuit". Because of the requirement for a multiple-emitter transistor, this form of logic circuit is generally available only in integrated form.

Consider, for a moment, that an input signal is applied only to emitter A in the circuit of Fig. 3.5*b*, no connections are made to emitter B and C. When the input signal is at ground potential, current from the U_{CC} supply flows through R_B, into the base terminal of T_1, and out of emitter A. There is no forward base current to transistor T_2, as the voltage level at point P is not sufficiently positive to forward-bias both the base-collector diode of T_1 and the base-emitter diode of T_2.

Let the input signal level at emitter A now become increasingly positive. The voltage level at point P eventually becomes sufficiently positive for a portion of the base-input current of T_1 to flow through the base-collector junction of T_1 and into the base of T_2. When the voltage level at terminal A rises above the two diode drops seen to the right of point P, the entire current through R_B is steered through the collector of T_1 and into the base of T_2; forward base current to T_2 is now sufficiently large to saturate this device. The multiple-emitter transistor performs a logic function which is identical to that of the diode AND gate.

ASSIGNMENTS

I. Answer the following questions embracing the contents of the Text D.

1. What do the resistors shown in Fig. 3.4*a* serve? 2. How are base currents to T_2 and T_3 in the above figure determined? 3. What does a base speed up capacitor improve? 4. What can be combined with transistors to form "diode-transistor logic" (DTL) circuits? 5. What gates can be combined with the transistor? 6. What does Fig. 3.5*a* show? 7. When does resistance R_L and supply voltage U_{CC} serve as a current source to N_0 fan-out transistors? 8. How is resistor R_B connected with the transistor base to give an equal distribution of forward connected to a single inverter? 9. Does it prevent the current-hogging effect? 10. Where does current from the U_{CC} supply flow when the

input signal is at ground potential? 11. What is a diode OR gate connected to?

II. Prepare a dialogue on your own situation, describing the popularity of TTL and showing how to avoid transistor saturation.

III. Make up a plan of the Text C and retell the text according to your plan.

IV. Examine Figs. 3.4 and 3.5. Comment on:

1. A circuit without base bias.
2. A circuit with base bias.
3. The DTL circuit with simple inverter.
4. The TTL circuit identical to *a*.

V. Speak on:

1. TRL stages.
2. Diode transistor logic.

VI. Make a short written summary of the Text D.

VII. Look through the latest magazines on the topic of this lesson and discuss an additional material with your fellow-student as a problem of nowadays.

III. GRAMMAR EXERCISES

I. a) Find the following word-combinations in the Text D and translate them. b) State the attributes in all of them.

Base-emitter diode, reverse-bias, OFF state, collector-base leakage currents, transistor-resistor logic, resistor-transistor logic, diode-logic circuits, grounded-emitter transistor, OR/AND and AND/OR diode gates, base-input-voltage level, NOR/NAND circuit, AND/OR gate, NAND/NOR gate, NOR/NAND DTL stage, single-transistor inverter, fan-out transistor, transistor-coupled logic circuits, multiple-emitter transistor, base-input current.

II. Translate these sentences with the verbs in the Passive Voice.

1. Extensive use is made of abbreviation in the logic field. 2. The discrete circuits are described as resistor-transistor logic (RTL) when they use only resistors and transistors. 3. TTL is primarily designed for fast operating in large computer. 4. Schottky TTL and ECL are currently used. 5. Several logic systems are designed for slow operation. 6. MOS logic is used for pocket calculator chips.

III. Pay attention to modal verbs with the Passive Infinitive while translating these sentences.

1. The diode at the input may be fabricated in the form of a special multiple-emitter transistor. 2. Elaborate logic functions can be fabricated on a single chip using MOSFET transistor.

IV. a) Find the Participle and the Gerund in these sentences. b) Define their functions and translate them.

1. The wide availability and low cost of TTL makes it popular for all logic and counting functions. 2. Still faster types of logic, such as Schottky TTL and emitter-coupled logic (ECL) are currently used, these achieving extra speed by avoiding transistor saturation. 3. Most logical control and counting operations do not require operating speeds even approaching the capability of TTL. 4. A Zener diode is incorporated in the gate input to raise the maximum permissible logic 0 input level to 5 V, giving increased margin over the equivalent 0.8 V range of TTL. 5. Elaborate logic functions can be fabricated on a single chip using MOSFET transistor, which are very compact, some 5000 devices being possible on a chip 4 mm square.

V. a) Analyse the following sentences. b) Find subjects and predicates in the principle and subordinate clauses. c) Translate these sentences.

1. Diode logic uses relatively few transistors and many more diodes, a desirable situation in those days when diodes were much cheaper than transistors. 2. In order to reverse bias T_1, T_2, T_3 in the OFF state and also to provide a sink for collector-base leakage currents of these devices, resistor R and supply voltage $-U_{BB}$ can be added to the inputs, as shown in Fig. 3.4*b*. 3. When the input signal A in Fig. 3.5*b* is at ground potential, current from the U_{CC} supply flows through R_B, into the base terminal of T_1 and out of emitter A.

Lesson 4. FLIP-FLOP CIRCUITS

I. INDEPENDENT WORK

In the Laboratory

1. Skimming Reading

PRE-TEXT EXERCISES

I. a) Listen and repeat after the speaker. b) Practise the pronunciation of the following.

[s] piece, except, place; [k] capacity, circuit, describe, directly, combination, class, common; [dʒ] voltage, logic, register, stage; [g]

grid, propagation, negative, going, signal, regulate; [tʃ] such, which, each, change, achieve; [k] characteristic, orchestra; [ʃ] show, short, should, shall; [ð] there, another, that, then, than; [θ] theory, theme, three.

Simultaneous [ˌsiməl'teinjəs]; indeterminate [ˌindi'tə:minit].

II. a) Make sure that you know these words. Say what Russian words help you to guess their meanings. b) Repeat these words after the speaker.

Combinational, class, nonregenerative, analyse, transistor, positive, negative, voltage, practical, method, signal, symbol, construct, configuration, terminal, energize, line, diagram, identical, normally, music, adapt, basic, pulse, data.

III. a) Listen, repeat and memorize the following words and word-combinations from the Text A and the Text B. b) Check if you know their meanings.

Combinational комбинационный; sequential последовательный; common example обычный (простой) пример; previous предшествующий; immediately previous input data непосредственно предшествующие входные данные; as well as также, как; intentionally намеренно, умышленно; sufficiently positive to saturate transistor T_2 достаточно положительное для насыщения транзистора T_2; logic-circuit representation of this flip-flop представление этого триггера как логической схемы; sufficiently достаточно; considerably значительно.

IV. Memorize these terms and their Russian equivalents.

Delay задержка; lack v. испытывать недостаток; clock counter счетчик с параллельным переносом (синхронный счетчик); data register цифровой регистр; clock oscillator тактовый генератор; time delay circuit схема временной задержки; characteristic of sequential circuits характерное свойство последовательных схем; output node выходной узел; inverter stage инверторный каскад; bistable circuit схема с двумя устойчивыми состояниями; flip-flop circuits триггерные схемы; cross-coupled перекрестносвязанный; transient response переходная функция; speedup capacitor ускоряющий конденсатор.

V. Pay attention to the translation of the terms.

NOR stage (NOR = NO : OR) каскад ИЛИ/НЕ; cross-coupled single-input NOR stage одновходовые каскады ИЛИ/НЕ с перекрестной связью; OR-gate input вход элемента ИЛИ; NOR-type flip-flop триггер на элементах ИЛИ/НЕ; AND-NOT logic логика И-НЕ; NAND-type flip-flop триггер на элементах И-НЕ; DTL NAND gates ДТЛ элементы И/НЕ.

VI. a) Find attributes in these word-combinations and say by what parts of speech they are expressed. b) Translate them.

Combinational logic circuits; internal connections; clock counter; positive feedback; inverter stage; bistable circuit; each stage; above operating conditions; circuit application; techniques described; small capacitors; positive or negative-going signal; the above speedup capacitors; cross-coupled single-input NOR stages; the output terminal of this circuit.

VII. Translate the following pairs of words paying attention to the meanings of prefixes.

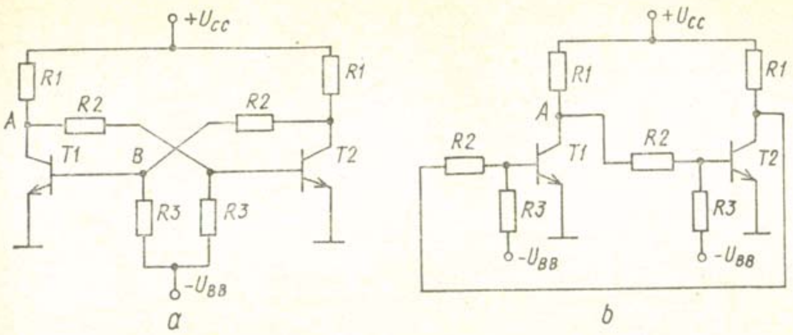

Fig. 3.6. Flip-flop:
a a basic circuit; b the basic circuit redrawing as two RTL stages.

Draw — redraw; drawing — redrawing; connect — reconnect; connect — disconnect; increase — decrease.

Text A

COMBINATIONAL AND SEQUENTIAL LOGIC CIRCUITS

I. a) Listen to the text, mind the English intonation. b) Read the text to yourself and grasp the main idea of it.

In all the logic circuits that have so far been described, at any point in time the output has been directly related to the input by some logic combination, except for some short propagation delay. Hence, as a class these circuits are known as combinational logic circuits. Common examples of this type of circuit are the simple digital gates NOR, NAND, etc. Combinational circuits, which lack intentional connections between output and inputs, are also known as non-regenerative circuits.

There is another class of circuits, known as sequential logic circuits, in which not only immediately previous input data affect the outputs. Outputs also are dependent on preceding values of input data. These circuits also find ready application in digital systems. Examples are clock counters and data register as well as clock oscillators and time delay circuits. A characteristic of sequential circuits is that one or more output nodes are intentionally connected back to inputs to give positive feedback, or regeneration.

Basic to sequential circuits is the bistable circuit. Two inverter stages, cross-coupled as shown in Fig. 3.6*a*, provide a basic form of bistable circuit, or "flip-flop" circuit. The above circuit may be analyzed by redrawing it as in Fig. 3.6*b*, which shows that the flip-flop is simply a connection of two TRL NOR stages, with the output of each stage serving as the input to the other stage. When transistor T_1 is cut off, voltage at point A is sufficiently positive to saturate transistor T_2. Voltage at point B is now slightly negative, and T_1 is reverse-biased to cutoff. The above operating conditions for T_1

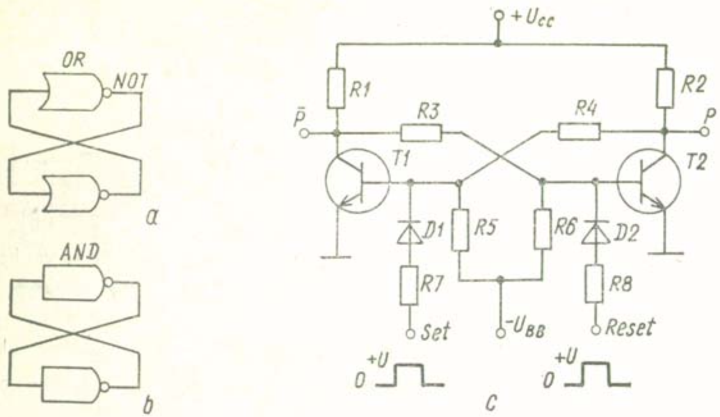

Fig. 3.7. A logic-circuit diagram:
a for NOR-type flip-flop; *b* for NAND-type flip-flop; *c* flip-flop as in Fig. 3.6 *a*, but with two input signal lines.

and T_2 represent one stable state of the flip-flop. A second state exists when T_1 is in saturation and T_2 is at cutoff.

2. Average Reading

Text B

FLIP-FLOP OPERATION

I. a) Listen to the text. b) Read it (time limit is 5 min.). c) Find the part of it dealing with cross-coupled single-input NOR stages used in the flip-flop circuits. Translate it.

Consider, for instance, that the flip-flop circuit of Fig. 3.6*a* is at the stable state where T_1 is on and T_2 is off. The circuit will change to the other stable state (T_1 off and T_2 on) for any one of the following:

1. Disconnect T_1 from the circuit and then reconnect it (this causes T_2 to turn on. When T_1 is again connected the $U_{CE(sat)}$ collector voltage of T_2 prevents T_1 from turning on).
2. Apply a positive-voltage level to the base of Q_2 (Q_2 turns on, and Q_1 turns off.)
3. Apply a negative-voltage level to the base of T_1 (T_1 turns off and T_2 turns on).
4. Temporarily ground the collector of T_2 (This removes the base drive to T_1, and the base of T_2 becomes forward-biased).
5. Connect a low resistance from the collector of T_1 to the + Ucc supply. (The increase in collector current forces T_1 out of saturation).

Methods 1 and 5 are not practical for most circuit applications of the flip-flop. The techniques described in 2 to 4 are widely used to change the operating of a flip-flop.

Small capacitors are often connected across the R_2 resistors in Fig. 3.6*a* and 3.6*b*. These capacitors serve to couple a positive- or negative-going signal from the collector of one transistor to the base of the other transistor. Transient response of the circuit is improved considerably by use of the above speedup capacitors.

Cross-coupled single-input NOR stages are used in the above flip-flop circuit. A logic circuit representation of this flip-flop connection is shown in Fig. 3.7*a*; symbols for the OR and NOT (invert) operations are indicated in the figure. This form of basic flip-flop is referred to here as a NOR-type flip-flop.

Flip-flop stages can also be constructed with AND-NOT logic as shown in the diagram of Fig. 3.7*b*; the stage is considered to be a NAND-type flip-flop. This circuit configuration can be implemented by cross-coupling single-input DTL NAND gates.

ASSIGNMENTS

I. a) Choose the key sentences from the Text A and compare them with the title of the text. b) Say what the text is about.

II. a) Skim through the Text B and choose the key sentences. b) Translate the sentences.

III. a) Divide the Text B into logical parts. b) Give the main idea of each part.

IV. Answer the questions embracing the content of the Text A and the Text B.

1. What has the output been directly related in all the logic circuits to? 2. What circuits are known as combinational logic circuits? 3. What are common examples of combinational logic circuits? 4. Why combinational circuits are known as non-regenerative circuits? 5. Is there another class of circuits, known as sequential logic circuits? 6. Are outputs dependent on preceding values of input data? 7. Where do these circuits find ready application? 8. What are examples of sequential logic circuits? 9. What is a characteristic of sequential circuits? 10. What is the bistable circuit? 11. What do the inverter stages, cross-coupled as shown in Fig. 3.6*a*, provide? 12. What does Fig. 3.6*b* show? 13. What do the above operating conditions for T_1 and T_2 represent? 14. Are method 1 and 5 practical for most circuit applications of the flip-flop? 15. Where are cross-coupled single-input NOR stages used?

V. Examine Fig. 3.7 and comment on a logic-circuit diagram:

1. For NOR-type flip-flop.
2. For NAND-type flip-flop.
3. Flip-flop as in Fig. 3.6*a*, but with two input signal lines.

VI. Prepare a dialogue on your own situation.

VII. Speak on:

1. Combinational and sequential logic circuits.
2. Two inverter stages, cross-coupled as shown in Fig. 3.6*a*.
3. Flip-flop operation.

II. CLASSWORK

3. Close Reading

PRE-TEXT EXERCISES

I. Be sure that you know these words.

Flip-flop триггер; binary storage двоичная память; true истинный, настоящий; complement дополнение; at a time в данное время; represent представлять; consider рассматривать; store накапливать; saturation насыщение; reduce уменьшать; continue продолжать; change изменять (ся); maintain поддерживать; simultaneously одновременно; refer относиться; "latch" circuit "фиксаторная" схема, схема-защелка; set-reset (SR) flip-flop RS-триггер (с раздельными входами R и S); clocked RS flip-flop синхронный RS-триггер; depend upon зависеть от; allow разрешать; associate связывать; value величина.

II. Find the following word-combinations in the Text C and translate them with the sentences they are involved.

Input signal lines; output terminals; ground potential; set line; forward-biased; input signal; reset line; last stable states; SR stage; logic circuit diagram; logic configuration; external signal; NOR-type SR flip-flop; input binary level; NAND-type SR flip-flop.

III. Give the main forms of the verbs from the Text C and translate them.

Show, be, represent, consider, store, held, provide, reduce, energize, remain, clear, maintain, ground, indetermine, refer, depend, allow, describe, reverse, reset.

Text C

SR FLIP-FLOP

I. a) Read the text. b) Describe a logic-circuit diagram of the SR flip-flop.

Fig. 3.7*c* shows a flip-flop having two input-signal lines. The output terminals of this circuit are shown as P (true) and $\bar{P}$ (complement). When T_2 is off, voltage at P is positive and represents a binary 1; the circuit is now considered to be storing a 1. For T_2 turned on, voltage at P is close to ground potential, and the circuit stores a 0. Consider that the set line is at the $+U$ level and that the reset line is held at ground potential. Diode D_1 is forward-biased and provides base current to T_1; this transistor is in saturation while T_2 is cutoff, and P is at a positive voltage level. The circuit is presently set to 1 state. If the input signal on the set line is reduced to ground potential, the flip-flop continues to store a 1. If the reset line is then energized with the $+U$ level and the set line remains at ground potential, diode D_2 provides forward base current to Q_2; this transistor turns on, and the flip-flop changes states. The flip-flop is now reset, or cleared,

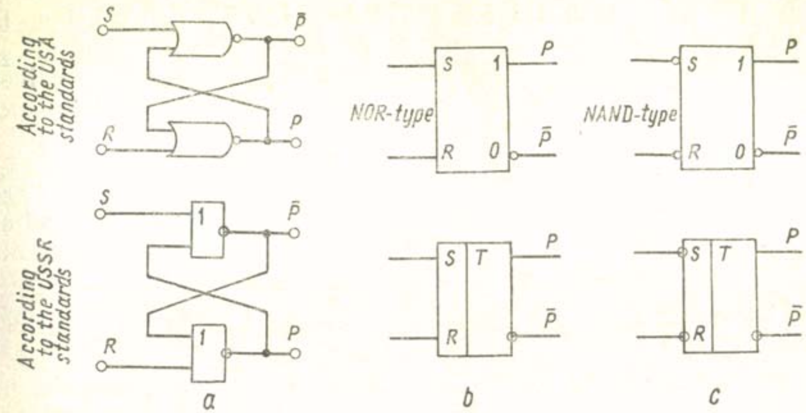

Fig. 3.8. Logic-circuit diagrams and their symbols:
a a diagram for SR flip-flop NOR-type; *b* the symbol for SR flip-flop NOR-type; *c* the symbol for SR flip-flop NAND-type.

to the 0 state. This last state is maintained when the reset line is rounded. If both the set and reset lines are simultaneously at the $+U$ level, the final state of the flip-flop indetermined. Hence, only one input signal at a time can be positive. Because the present flip-flop configuration can be set to 1 and reset to 0, the circuit is generally referred to as a "set-reset" (SR) flip-flop. The SR stage is sometimes referred to as a "latch" circuit. This name results from the circuit's ability to latch in one state or the other depending upon which of two input lines is energized.

A logic-circuit diagram of the above SR flip-flop is shown in Fig. 3.8*a*. The logic configuration is identical to that of Fig. 3.7*a*, except that each OR gate now has two input terminals. The added input terminal at each gate allows external signals to change the state of the circuit.

Fig. 3.8*b* shows a symbol for the NOR-type SR flip-flop described above. The output lines are shown to have the binary values associated with the storage of a 1. These output binary levels are reversed when a 0 is stored in the flip-flop. Symbol for the NAND-type SR flip-flop is shown in Fig. 3.8*c*.

ASSIGNMENTS

I. a) Divide the text into logical parts. b) Choose the key sentences and translate them.

II. Look through the text and find the part of it dealing with diode D_1 which is forward-biased and provides base current to Q_1.

III. Answer the following questions embracing the contents of the Text C.

1. What does Fig. 3.7*c* show? 2. How are the output terminals of this circuit show? 3. When is the circuit considered to be storing a 1? 4. For what is voltage at P close to ground potential? 5. When is the

transistor T_1 in saturation? 6. When does the flip-flop continue to store a 1? 7. When does diode D_2 provide forward base current to T_2? 8. What is the final state of the flip-flop if both the set and reset lines are simultaneously at the $+U$ level? 9. Why is the SR stage sometimes referred to as "latch" circuit?

IV. Put questions to the words in bold type.

1. Consider that the **set line** is at the $+U$ level and that the reset line is held **at ground potential**. 2. Hence, only **one input signal** at a time **can be positive**. 3. **A logic-circuit diagram** of the above SR flip-flop is shown in Fig. 3.8*a*.

V. Examine Fig. 3.8 and comment on:

1. A diagram for SR flip-flop NOR-type.
2. The symbol for SR flip-flop NOR-type.
3. The symbol for SR flip-flop NAND-type.

VI. Make up a plan of the Text C and retell the text according to your plan.

VII. Review the text in written form.

VIII. Translate the Text C to be sure you understand it well.

4. Searching Reading

PRE-TEXT EXERCISES

I. Match the following English words and word-combinations with the Russian ones.

clocked RS flip-flop	отвечать на
regular train of clock pulses	обычно обозначается
orchestra conductor maintains the best with his baton ensuring that all the players keep in time with the music	счетчик
logic 1 pulse	неопределенный выход
clock pulse input (CP)	вход синхроимпульса (СИ)
indetermined output	цифровой отсчет (считывание)
respond to	наоборот
digital read-out	это соединяется
it is wired	это осуществляется через инвертор
counter	регулярная последовательность тактовых (синхронизирующих) импульсов
shift register	двухступенчатая структура (структура основной-вспомогательный или хозяин-раб)
this is accomplished via an inverter	триггер с раздельной установкой (RS-триггер)
vice versa	сдвигающий регистр
by convention labbeled	синхронный RS-триггер
master-slave arrangement	логический единичный импульс
simultaneously	одновременно
set-reset (SR) flip-flop	дирижер оркестра поддерживает порядок своей палочкой, добиваясь, чтобы все музыканты играли слаженно

II. Give initial forms of the following words and translate them.

Digital, usually, exactly, operation, normally, ensuring, basic, according, simultaneously, undeterminate, useful, application, counter, register, arrangement, convention, directly, inverter, storing.

III. Translate the following word-combinations from the Text D.

Orchestra conductor; set-reset flip-flop; clock pulse input; basic flip-flop; a clocked SR flip-flop; an indeterminate output; clock input; this useful little memory; digital read-out; many flip-flop applications; a master-slave arrangement; the master flip-flop.

Text D

CLOCKED SR FLIP-FLOP AND OTHER TYPES

I. Read the following text and say about different types of flip-flop.

In digital systems, we usually require to determine exactly when an operation is to take place. For instance, if data is to be stored in a flip-flop, it is often essential that the time when the data was entered should be known. This is normally achieved in a computer by a regular train of clock pulses, which control the sequence of events rather as an orchestra conductor maintains the best with his baton, ensuring that all the players keep in time with the music.

The circuit of Fig. 3.9*a* is a set-reset flip-flop adapted so that it can change state only when the clock pulse input(CP) receives a logic 1 pulse. Whilst the CP input is at 0, the NOT gate ensures that each OR gate has an input at 1; both S and R on the basic flip-flop are held at 1 and the Q and $\bar{Q}$ outputs cannot change. As soon as CP goes to 1, however, the OR gates each have an input at zero, so that S and R on the flip-flop depend only on the logic levels at the external S and R inputs; the flip-flop will therefore set its state according to the truth table. In this way the clocked SR flip-flop can only respond to the R and S inputs during a logic 1 clock pulse.

The D, or data, flip-flop is a clocked RS flip-flop operated from just one input. This has the advantage that S and R cannot simultaneously be set to 0 and give an undeterminate output. It is wired as in Fig. 3.9*b*, where the rectangular represents a clocked RS flip-flop. The output is held until the clock input goes from 0 to 1, when whatever logic level is on the D input is transferred to the Q output, which stores the logic level present when the clock returns to zero. This useful little memory finds particular application in instruments with a digital read-out, where the output must be held steady long enough to be read.

For many flip-flop applications, such as counters and shift registers, it is essential that there can be no change in the output whilst the clock pulse is high, no matter what happens to the data inputs