А. С. Кутькова

СИСТЕМЫ АВТОМАТИЗИРОВАННОГО ПРОЕКТИРОВАНИЯ

Пособие по английскому языку для вузов

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А. С. Кутькова

СИСТЕМЫ АВТОМАТИЗИРОВАННОГО ПРОЕКТИРОВАНИЯ

Пособие по обучению чтению на английском языке

Допущено Министерством высшего и среднего специального образования СССР в качестве учебного пособия для студентов технических высших учебных заведений

93

Москва «Высшая школа» 1988

ББК 81.2 Англ-923
К 95

Рецензенты: кафедра иностранных языков Обнинского института атомной энергетики (зав. кафедрой доц. И. А. Воробьева); канд. филол. наук, доц. К. А. Иванова (Ленинградский электротехнический институт им. В. И. Ульянова (Ленина))

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К 95 Системы автоматизированного проектирования: Пособие по обучению чтению на английском языке: Учеб. пособие.— М.: Высш. шк.— 128 с.: ил.
ISBN 5—06—001310—3

Цель пособия – совершенствование навыков чтения и аннотирования литературы по специальности. Тексты пособия посвящены основным проблемам разработки и применения систем автоматизированного проектирования: принципам построения, техническим средствам, информационному и прикладному программному обеспечению, моделированию систем, автоматизации функционального проектирования и др. Поурочные словари и система упражнений способствуют накоплению общенаучного и терминологического словаря, отработке навыков чтения, составления аннотаций и пр.

$К\frac{4602010000 (4309000000)—333}{001 (01)—88}$ 228—88 **ББК 81.2 Англ-923**
4И (Англ)

Учебное издание

Кутькова Алиса Семеновна

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Заведующая редакцией *И. Э. Волкова*. Редактор *Л. Н. Белая*. Младший редактор *Е. П. Политова*. Художник *Ю. Д. Федичкин*. Художественный редактор *В. И. Пономаренко*. Технический редактор *В. М. Романова*. Старший корректор *З. Ф. Юрескул*

ИБ № 7216

Изд. № А-77. Сдано в набор 19.01.88. Подп. в печать 06.05.88. Формат 84×108/32. Бум. тип. № 2. Гарнитура литературная. Печать высокая. Объем 6,72 усл. печ. л. 6,93 усл. кр.-отт. 7,87 уч.-изд. л. Тираж 27 500 экз. Заказ № 146 . Цена 25 коп.

Издательство «Высшая школа», 101430, Москва, ГСП-4, Неглинная ул., д. 29/14

Отпечатано с матриц ордена Октябрьской Революции и ордена Трудового Красного Знамени МПО «Первая Образцовая типография» имени А. А. Жданова «Союзполиграфпрома» при Государственном комитете СССР по делам издательств, полиграфии и книжной торговли. 113054, Москва, Валовая, 28 во Владимирской типографии Союзполиграфпрома при Государственном комитете СССР по делам издательств, полиграфии и книжной торговли, 600000, г. Владимир, Октябрьский проспект, д. 7.

ISBN 5—06—001310—3

CONTENTS

Part II

Part III

ПРЕДИСЛОВИЕ

В настоящее время высшая школа приступила к подготовке специалистов нового профиля — инженеров-разработчиков систем автоматизированного проектирования (САПР), в задачу которых входит разработка новых средств автоматизированного проектирования (АП), адаптация существующих средств АП и объединение систем АП в единые комплексы. Кроме того, в учебные планы большинства инженерных специальностей включены дисциплины, посвященные АП, которые изучаются будущими инженерами — пользователями САПР.

Молодых специалистов, выпускников технических вузов, необходимо не только ознакомить еще в стенах вуза с литературой на английском языке по САПР и гибким производственным системам (ГПС), но и привить им навыки беспереводного понимания зарубежных оригинальных источников по данным вопросам, т. е. всемерно способствовать их профориентации, поскольку в настоящее время научно-техническая англо-американская и японская (на английском языке) литература изобилует сведениями, связанными с САПР и ГПС.

Так как в наши дни компьютеризация коснулась практически всех отраслей народного хозяйства, предлагаемое учебное пособие предназначено для студентов ряда специальностей. Но в первую очередь оно предназначено для студентов специальностей «Робототехника», «Робототехнические комплексы», «Гибкие производственные системы», «Гибкие автоматизированные производства», «Автоматизированные системы управления», «Электронно-вычислительные машины», «Прикладная математика». Оно создано с учетом требований Программы целевой интенсивной подготовки специалистов по иностранному языку (Ленинград, 1986) и предназначено для самостоятельной работы студентов в аудитории под руководством преподавателя и вне аудитории.

Целью пособия является дальнейшее совершенствование навыков чтения литературы по специальности для извлечения необходимой информации, а также навыков перевода научно-технических статей и их аннотирования.

Автор выражает глубокую признательность и благодарность профессорам Е. М. Синельникову, А. Г. Никитенко, Ф. И. Кукозу, доценту А. Н. Иванченко, старшему преподавателю И. Д. Удовенко, ассистентам Н. П. Сорокину и Г. О. Кочаряну за ценные консультации и советы при подготовке рукописи данной книги.

Поскольку данное пособие является первой попыткой в создании подобных, автор будет признателен всем, кто найдет возможным прислать свой отзыв и замечания по адресу: 101430, ГСП, Москва, К—51, Неглинная ул., 29/14, издательство «Высшая школа», редакция литературы по английскому языку.

МЕТОДИЧЕСКАЯ ЗАПИСКА

Автор рекомендует работать с предлагаемым пособием на IV, V и VI или на V, VI и VII семестрах.

Пособие состоит из трех частей. Первая часть — 8 циклов-уроков, вторая — статьи из оригинальных журналов и книг для аннотирования, третья — приложение, включающее терминологический словарь, а также краткие сведения о видах чтения и по составлению конспектов и аннотаций.

Каждый цикл-урок состоит из трех самостоятельных текстов A, B, C (или более), предтекстовых и послетекстовых упражнений. После каждых двух циклов-уроков дается их краткое обзорное содержание (Summary and Review), а затем тест (Self-Test) на проверку овладения студентами изученного материала.

Материал, вошедший в пособие, рассчитан на 80—100 часов самостоятельной работы студентов в аудитории под руководством преподавателя и вне аудитории. На каждый цикл-урок предлагается затрачивать от 10 до 12 часов.

Приступая к работе с пособием, преподавателю необходимо не только ознакомить студентов с его структурой, но и объяснить, что эффективность обучения может быть обеспечена прежде всего при условии самостоятельного изучения всего учебного материала пособия.

Пособие предусматривает ведущую роль самостоятельной творческой работы студента, а успех обучения в большей степени зависит от его активности и от того, как преподаватель помогает ему в овладении материалом. Студент при работе с текстами должен уметь составлять план, анализировать содержание, расчленять текст на логические части, сокращать текст, находить в нем ключевые слова и предложения в абзацах (параграфах), находить предложения, соответствующие основной мысли каждого параграфа, составлять краткий конспект текста и, наконец, писать аннотацию на английском или русском языках.

Работа с пособием подразумевает одновременное расширение языкового обучения на английском языке в виде студенческих конференций, работы в иностранном отделе научной библиотеки по обработке текущей информации, участие в работе студенческих бюро переводов, посещение лекций и практических занятий отделения переводчиков-референтов ФОП, переводы для нужд профилирующих кафедр, участие в работе научно-исследовательских студенческих обществ и т. п., и, наконец, защиты курсовых и дипломных проектов на английском языке.

Автор преднамеренно оставляет за преподавателями право свободного выбора в организации учебного процесса по овладению материалом предлагаемого учебного пособия в зависимости от местных условий и контингента студентов.

Автор

PART I

UNIT I

Text A. Some Facts from the History of Computer-Aided Design (CAD). Text B. Text C.

EXERCISES

1. Recognize the following international words:

fact, history, occupation, to practise, to manufacture, artist, detail, plan, graphical, method, mathematical, problem, analytical, to limit, nonlinear, mechanism, analysis, programming, system, professional, technological, conversion, industry, configuration, discipline, modelling, robotics, machine, instruction, fabrication, technical, literature, category, function, standard, text

2. Practise the reading of the following words:

drafting ['drɑːftɪŋ] черчение (часто с помощью ЭВМ)
design [dɪ'zaɪn] *v* проектировать, конструировать
drawing ['drɔːɪŋ] чертеж, рисунок, набросок
tool [tuːl] инструмент, станок; *мн. ч.* средства, инструментарий
quality ['kwɔlɪtɪ] качество
hardware ['hɑːdwɛə] аппаратура, аппаратное обеспечение
applied [ə'plaɪd] прикладной
nonlinear ['nɔn'lɪnɪə] нелинейный
equation [ɪ'kweɪʃən] уравнение
appearance [ə'pɪərəns] появление
debugging [dɪ'bʌgɪŋ] отладка (программы)
capability [,keɪpə'bɪlɪtɪ] способность, возможность
advantage [əd'vɑːntɪdʒ] преимущество
computer-aided [kəm'pjuːtə,eɪdɪd] автоматизированный
variety [və'raɪətɪ] разнообразие, ряд, множество
increase [ɪn'kriːs] *v* увеличивать, усиливать
scheduling ['ʃedjuːlɪŋ] составление расписания
manufacture [,mænju'fæktʃə] *v* производить, изготовлять
robotics ['roubɔtɪks] робототехника
requirement [rɪ'kwaɪəmənt] требование

3. Memorize the word combinations below:

high-quality высококачественный
drafting hardware чертежная аппаратура
drafting methods чертежные методы
graphical methods графические методы
applied science прикладная наука
nonlinear equations нелинейные уравнения
graphics capability графические возможности
significant saving значительная экономия
technological advances технические достижения
computer-aided design автоматизированное проектирование
computer-aided manufacturing автоматизированное производство
computer-aided engineering автоматизированный труд инженера
integrated circuits интегральные схемы
materials requirements planning планирование требований к материалам
numerical control числовое программное управление

4. Look through Text A (skimming reading) and answer the questions below in writing:

1. Since what time has drafting been practised? 2. Who was an accomplished drafter? 3. How did the appearance of computers influence the graphical methods? 4. What are advantages of automated graphical methods compared with manual ones? 5. What radical changes in the CAD industry have there been since the beginning of 1983?

TEXT A. SOME FACTS FROM THE HISTORY OF COMPUTER-AIDED DESIGN (CAD)

1. Drafting is one of the oldest occupations. It has been practised since mankind first felt need to design, invent, build, or manufacture to perfect living on Earth. In fact, the famous artist and inventor Leonardo da Vinci was himself an accomplished drafter. Some of his most famous works are detailed plans and drawings for his numerous inventions.

2. Over the years the need for drawings has not changed. However, the tools and techniques used to produce drawings have. As the time went by and the need to produce higher-quality drawings faster continued to increase, drafting hardware improved.

3. It was noticed centuries ago that drafting or graphical methods can solve very easily various mathematical problems

for which an explicit (точный) analytical solution either did not exist or was very cumbersome (громоздкий). The accuracy of these methods depends on the scale of drawings, and is therefore limited, but their simplicity and effectiveness made their use widespread (широкораспространенный) in the pre-computer era in various branches of applied science, including such fields as the solution of nonlinear equations and mechanism analysis.

4. The appearance of the first generations of computers significantly diminished (уменьшать) the use of graphical methods. Computers' methods were cumbersome at those times, programming and debugging were tedious (утомительный) since the first generations of computers did not have any graphical options, but they were the only way of solving many problems in applied science. The situation has changed greatly with the latest generations of mini- and microcomputers which have powerful and versatile graphics capabilities.

5. All the advantages of graphical methods which made them widespread many years ago, after automatization, can be successfully used now, giving significant savings at all stages: programming, debugging, software documentation development and the use of software itself.

6. From their very beginning, all computers were graphic systems, that is, they communicated with human beings by some means of graphic display. In the early 1970s professionals in the field of drafting became interested in automated drafting, i.e. in computer-aided drafting. Computer-aided drafting systems were the latest in a long line of technological advances designed to improve on the drafter's capabilities. Computer-aided drafting represented and still represents a conversion from manual to automated drafting. It has given rise to Computer-Aided Design (CAD).

7. There have been some radical changes in the CAD industry since the beginning of 1983. The variety of CAD systems configurations has increased. Applications software has become more sophisticated (сложный). In engineering not merely CAD but Computer-Aided Design and Manufacturing (CAD/CAM) and Computer-Integrated Manufacture (CIM)—the linking together of many different disciplines such as drafting, analysis, modelling, numerical control, and scheduling—are often used. The electronics industry too has coined (создавать новые слова) a Computer-Aided Engineering (CAE) for design, simulation and layout of integrated circuits. CAM is a large category of automated

manufacturing systems and technique, including numerical control, process control, robotics and materials requirements planning.

8. CAD/CAM systems imply that the products designed in the CAD system are directly input to the CAM system. An example of CAD/CAM is a machine part designed in a CAD system, which, after design, becomes direct input to a numerical control programming language which then generate the machine instructions to control the fabrication of this part.

9. Sometimes in technical literature, one may come across the acronym CADD which means Computer-Aided Design and Drafting. CADD systems are CAD systems with additional features for drafting functions such as dimensioning (size annotations on standard engineering drawings) as well as text (description and notes) entry.

5. Read Text A attentively (study reading). Make up a list of key words.

6. Choose the title for the seventh and eighth paragraphs of Text A from those given below:

1. Computers and their applications. 2. Radical changes in the CAD industry. 3. Numerical control machines. 4. Radical changes in engineering.

7. Say what the following acronyms mean:

CAD, CAM, CIM, CAE, CADD

8. Say which statements are wrong:

1. Drafting is not one of the oldest occupations. 2. Over the years the need for drawings has changed. 3. Graphical methods can solve very easily various mathematical problems. 4. The appearance of computers did not diminish the use of graphical methods. 5. Nothing has changed in the field of design with the appearance of mini- and microcomputers. 6. All computers were graphic systems from their very beginning. 7. Computer-aided drafting still represents a conversion from manual to automated drafting. 8. CIM is the linking together of many different disciplines such as drafting, analysis, numerical control, etc. 9. After design in a CAD system a machine part becomes direct input to a numerical control programming language.

9. Check up yourself how much you have memorized from Text A:

a) Say what difference between manual and automated drafting is. b) Say what a CAM system includes. c) Name various disciplines which are linked together in CIM. d) Recall what savings the automated graphical methods give compared with the manual ones. e) Recall in what field of industry CAE is used.

10. Retell in short Text A using the plan below:

1. One of the oldest occupations. 2. Leonardo da Vinci — an accomplished drafter. 3. The simplicity and effectiveness of graphical methods in the pre-computer era. 4. The appearance of the latest generations of computers—mini- and microcomputers. 5. Improving the designer's capabilities with the help of CAD systems. 6. Applications of different computer-aided systems in engineering.

11. Look through Text B (skimming reading). List its main points.

TEXT B

Engineers and drafters have used computers for years in performing the mathematical operations that go with their job. However, an even more innovative computer application has begun to be applied: Computer-Aided Design and Drafting (CADD). CADD involves using the computer as a tool in making, checking, correcting, and revising original drawings. The computer can be used for converting a rough sketch into a finished working drawing, performing an infinite number of design computations, producing parts lists or materials lists, and many other design tasks.

In many cases a person's first experience with a computer is negative. Most people blame (обвинять) it in a mistake that they have done themselves. An incorrect billing statement is issued, [1] an airplane reservation is badly made, or an important shipment arrives late, and in each case the computer is blamed. Blaming the computer for what are really human errors has become common practice. However, it should be understood that computers are machines. They rarely (редко) make mistakes, but the people who operate them frequently do. An understanding of this concept is fundamental to developing an understanding of the computer.

The computer has four distinguishing (отличительный) characteristics: (1) computers perform all operations electronically; (2) computers have an internal storage capacity; (3) computers receive operational instructions from stored programs; and (4) computers can modify program executions by making logical decisions.

The computer has two capabilities that make it a particularly valuable tool for human use: (1) a computer is extraordinarily (чрезвычайно) fast compared to human beings, and (2) a computer is much more accurate and reliable than a human being. On the other hand, the computer has two critical shortcomings (недостаток). (1) A computer cannot reason and think as a human being can. Computers are capable of making decisions based on mathematical logic, but they cannot reason, apply common sense, [2] make judgements, [3] or use intuition. (2) A computer cannot adapt or innovate during the problem-solving process. A computer that has been incorrectly programmed will simply keep repeating the same mistakes regardless of circumstances (обстоятельство), until it is stopped and reprogrammed. A computer is only capable of doing precisely (точно) what it is told and nothing more.

People are well suited for thinking, reasoning, adapting, innovating, applying intuition, and learning from experience. Computers are particularly suited for calculating, performing repetitive tasks, and making comparisons, all with a high degree of accuracy and reliability. The computer can help people expand their capabilities considerably in certain areas if properly used. [4] One of the newest, most innovative of these areas is Computer-Aided Design and Drafting.

NOTES

1. **an incorrect billing statement is issued** — допущено искажение в денежном счете
2. **common sense** — здравый смысл
3. **judgement** — суждение
4. **if properly used** — если его (компьютер) правильно использовать

12. Read Text B again, divide it into logical parts and entitle each part.

13. Compare main human and computer characteristics. Write these characteristics down into your exercise-book.

14. Choose the suitable title for Text B from those below:

1. Microcomputers. 2. Accuracy and reliability of modern computers. 3. Human beings versus (в сравнении с) computers. 4. Innovative computer applications.

15. Write an abstract of Text B (see p. 126) in English.

16. Look through Text C (skimming reading). Guess the subject-matter of it. Write the subject-matter down into your exercise-book.

TEXT C

This century is but an episode in the life of human culture. But it is absolutely clear that a great deal[1] of things of this epoch may be cast off than they will survive (продолжать существовать) in the next one. Yet surely the computer will not.[2] A solid-state image[3] will replace (заменять) the chemical ribbon, and cinema will be handed over to the archival museum. But computer and computer graphics will bring to mind the kind of tools that may characterize an age succeeding this century's age of the machine.[4]

The encoding and transmission of digital pictures dates back to 1921 when a transatlantic cable utilized a digital system with intensity levels and a teletype. During the last thirty years the technology has evolved (развиваться) from the first computer driven CRT[5] to countless (бесчисленный) home (personal) computers with graphic capabilities.

Great accomplishments (достижение) from industry, research, and development laboratories as well as individual efforts (попытка) have provided developments (разработка) that today make the state-of-the-art[6] the most promising tool of the century.

A technology, that has brought us the dreams of da Vinci, appeals (взывать) to our senses because for the first time we can create the elegance of motion (движение), exactly as what happens in music.[7]

We have always been able to see motion, but not able to recreate (воссоздавать) it. For the first time we can make patterns (модель) of motion; from geometrical equations we can create designs so rich that the moving visual imagery[8] of real world culture may be recalled (запоминать) forever (навсегда). (Real world culture is art, science, etc.)

The time has come to revise (пересмотреть) and develop the guidelines (основные направления) that will reap the greatest benefits[9] from all computer-aided applications. The future lies in the principle that we must adapt machinery to people and their specific needs. In turn, we can project (воплотить) an intelligence in the process of man-machine communication that will accelerate the course of history.

Computer-aided design (CAD) is still relatively new and there is a great deal to be done for us in this field.

NOTES

1. **a great deal** — много
2. **Yet surely the computer will not.** — Однако безусловно с компьютером такое не случится.
3. **a solid-state image** — изображение на полупроводниках
4. **that may characterize an age succeeding this century's age of the machine** — который может служить отличительным признаком эпохи, последующей за этим машинным веком
5. **from the first computer driven CRT (cathode-ray tube)** — от первой управляемой компьютером катодно-лучевой трубки
6. **state-of-the-art** — реальный
7. **exactly as what happens in music** — точно так же как то, что происходит в музыке
8. **the moving visual imagery** — движущееся визуальное отображение
9. **that will reap the greatest benefits** — которые извлекут огромную пользу

17. Read Text C again. Find all the international words in it. Write them down into your exercise-book.

18. Render Text C in Russian in your own words.

UNIT 2

Text A. Computers Used in CAD/CAM. Texts B, C, D.

EXERCISES

1. Recognize the following international words:

application, program, computer, central, processor, process, to group, class, minicomputer, microcomputer, chip, bit, byte, traditionally, original, massive, supercomputer, special, to optimize, architecture, to combine, operations, personal, microprocessors, adequate, productive, simulation, minimum, to recommend, disk, cabinet, base, to locate, typically, department, resources, terminal, million, emitter, transistor

2. Practise the reading of the following words:

speed [spi:d] скорость
accessible [æk'sesəbl] доступный, удобный
microcomputer ['maıkroukəm'pju:tə] микрокомпьютер
minicomputer ['mınıkəm'pju:tə] миникомпьютер
mainframe ['meın'freım] универсальный компьютер, большая ЭВМ
require [rı'kwaıə] *v* требовать(ся)
simulation [,sımju'leıʃən] моделирование, имитация
widespread ['waıd'spred] широкораспространенный
advance [əd'vɑ:ns] достижение, улучшение
circuit ['sə:kıt] схема; цикл; сеть; система
resources [rı'sɔ:sız] ресурсы

supercomputer [ˌsjuːpəkəm'pjuːtə] суперкомпьютер
byte [baɪt] байт
turnkey ['təːnkiː] полностью готовый, со сдачей «под ключ»
dedicated ['dedɪkeɪtɪd] специализированный
flexibility [ˌfleksə'bɪlɪtɪ] гибкость
architecture ['ɑːkɪtektʃə] архитектура; структура; строение
simultaneously [ˌsɪməl'teɪnjəslɪ] одновременно
optimize ['ɔptɪmaɪz] *v* оптимизировать

3. Memorize the following word combinations:

application programs прикладные программы
a single-chip CPU ЦПУ на одном кристалле (чипе)
personal computers персональные компьютеры
standard configurations стандартные (типовые) конфигурации
sophisticated design сложный проект (конструкция)
interactive terminals интерактивные терминалы
integrated circuit technology технология изготовления интегральных схем
emitter-coupled logic (ECL) эмиттерно-связанная логика
printed circuit boards (PCB) печатные платы
computer architecture архитектура компьютера
graphics-intensive tasks задачи, усиленные графическим исполнением
random access memory (RAM) оперативное запоминающее устройство
a floppy disk гибкий диск
a hard disk твердый диск
an access speed скорость доступа (обращения) к памяти
processing power производительность (компьютера)
computing resources вычислительные ресурсы

4. Look through Text A (skimming reading) and answer the questions below in writing:

1. What parts does any computer consist of? 2. What computers are used in CAD/CAM systems? 3. What are the main characteristics of microcomputers? 4. What are the main characteristics of minicomputers? 5. Why are personal computers used for CAD/CAM systems? 6. What features are similar in mini-, micro-, mainframes and supercomputers?

TEXT A. COMPUTERS USED IN CAD/CAM

Application programs for CAD/CAM can be run on almost any computer consisting of a central processing unit (CPU), memory, and some type of input and output units. The CPU carries out program instructions to perform operations on data. Programs and data are stored in memory, and so-called data buses carry signals between the CPU, memory, and input and output devices. Input typically consists of devices for manual data entry such as keyboards, while output is usually graphics on CRTs[1] or printers and plotters.[2]

Computers commonly are divided into several classes. Speed, accessible memory, and processor are used to classify computers. Both speed and memory depend mostly on word length, the number of bits a computer can handle at a time. Internal word length is the number of bits that the CPU can handle, while external word length is the number of bits that can pass at a time on the data bus. Internal word length generally determines processing speed, while external word length determines the amount of main memory that can be directly accessed. Internal and external word lengths are often the same, but may differ depending on the system.

Computers are generally grouped into one of four main classes: microcomputers, minicomputers, mainframes, and supercomputers. Microcomputers are defined by a single-chip CPU, which has either an 8- or 16-bit word length. Main memory sizes range from 64 to 512 Kbytes. Newer micros work with 32-bit lengths, and can access 1 Mbyte or more of main memory. Most microcomputers used for CAD/CAM are personal computers—general-purpose machines[3] based on microprocessors. Software converts the personal computer into a CAD/CAM workstation.[4] More recently personal computers have become so powerful that they are being applied as turnkey CAD/CAM systems.[5] In addition to personal computers, microprocessors provide processing power in many engineering workstations. These systems are dedicated microcomputers optimized for CAD/CAM applications.

Often, standard configurations personal computers are not adequate for productive CAD/CAM operations. A substantial amount of internal read/write memory, called random-access memory (RAM), is required to run graphics-intensive tasks such as simulation and analysis. A minimum of 256 Kbytes is required, while more is usually recommended.

External storage devices such as a floppy disk drive are also needed. Most CAD/CAM applications require at least two of these devices since the program and required data are stored on two and as many as six floppy disks. Hard disk drives which store 10 to 80 Mbytes of data on rigid disks and operate in an enclosed cabinet, are often used in CAD/CAM because of their capacity and increased access speed over floppy disk drives.

Most minicomputers have 32-bit processing power, so they can handle all but specialized CAD/CAM functions. Most turnkey CAD/CAM systems are still based on standard minicomputers, and a substantial amount of software is available to perform sophisticated design, analysis, and related tasks. While mainframes are often located in a corporate data processing facility, minicomputers are typically placed near the engineering department so CAD/CAM does not rely on outside computing resources. In addition, most minicomputers can support many interactive terminals, permitting widespread access to engineering and manufacturing databases.

Superminis with operating speeds of 3 to 5 million instructions per second are becoming increasingly important in CAD/CAM applications. The higher speed of superminis is made possible by new applications of integrated circuit technology, most notably emitter-coupled logic (ECL). This is a technique of arranging transistors which allows them to operate faster.

Mainframes take their beginning from the original computer and are used today in applications requiring substantial data processing and large memory capacity. These processors typically require room-size facilities. Mainframes support many peripheral devices and can drive several at a time, including printers, terminals, card readers, card punchers, tape drives, and disk drives. Memory is especially important since mainframes are used in data-intensive tasks such as financial operations. Originally, the only way to communicate with a computer was through punched cards, and thus mainframes still support reading and punching cards. As a result, mainframes are often used to provide processing power after a problem has been set up with the aid of a micro- or minicomputer. Moreover, mainframes are used to link together distributed smaller processors throughout an enterprise. And minicomputers can be tied directly into mainframes so users can access their large database.

Supercomputers take advantage of the most recent advances in electronic circuits, processing techniques, and memory organization to reach computing speeds many times that of mainframes. Complex problems in CAD/CAM that were not even considered several years ago can now be solved economically. Applications of supercomputers include modelling and simulation tasks such as solid modelling,[6] kinematics, analysis, and fluid-flow simulations.[7] Another major application is a finite-element analysis.[8] Here, a supercomputer will perform the task three to ten times faster than a mainframe. Supercomputers work so much faster because of data pipelining,[9] high-speed circuits, and large internal memories. In pipelining, data elements are streamed through the processor in blocks instead of being handled one-at-a-time as in conventional computers.

NOTES

1. **CRTs (cathode-ray tubes)** — катодно-лучевые трубки (как экраны у телевизоров)
2. **plotter** — графопостроитель
3. **general-purpose machine** — универсальный компьютер
4. **a workstation** — автоматизированное рабочее место (АРМ)
5. **turnkey CAD/CAM systems** — системы САПР/АСУ ТП, полностью готовые к работе
6. **solid modelling** — моделирование пространственных тел
7. **fluid-flow simulation** — моделирование потока жидкости
8. **a finite-element analysis** — анализ конечных элементов
9. **pipelining** — конвейерная обработка данных

5. Read Text A attentively (study reading). Make up a list of key words. Divide Text A into logical parts.

6. Choose the title for each logical part from given below:

1. Parts of any computer. 2. Random-access memories. 3. A floppy disk drive. 4. Hard disk drives. 5. External storage devices. 6. The main notions for classification of computers. 7. Application of microcomputers (personal computers) in CAD/CAM. 8. Personal computers. 9. Characteristics of minicomputers. 10. Interactive terminals. 11. Manufacturing databases. 12. Integrated circuit technology. 13. Mainframes. 14. Advantages in electronic circuits. 15. Applications of supercomputers in CAD/CAM.

7. Check up yourself how much you have memorized from Text A:

a) Say what advantage the supercomputers take. b) Recall which devices use floppy and hard disks. c) Name what applications supercomputers include. d) Recall what processing power most microcomputers and minicomputers have. e) Say what difference between four classes of computers is.

8. Translate the extract of Text A from the words "Mainframes take their beginning..." up to the words "...their large database" in written form.

9. Speak on the problem of application of four main classes of computers used in CAD/CAM.

10. Using the key words from Text A write an abstract in English and in Russian (see p. 126).

11. Look through Text B (skimming reading). List its main points.

TEXT B

Because of extraordinary technological development during the past decades, the term "computer" is becoming a household word. Computer applications have expanded to such breadth[1] that the computer is now an integral part of virtually every type of business and industrial enterprises.

Engineers and drafters have used computers for years in performing the mathematical operations that go with their jobs. However, an even more innovative computer application has begun to get widespread using computer-aided design and manufacturing. Computer-aided design and manufacturing, or CAD/CAM as it is now called, involves applying the computer as a tool in making, checking, correcting, and revising original drawings. The computer can be used for converting a rough sketch[2] into a finished working drawing, performing an infinite number of design computations, producing parts lists, including numerical control, process control, robotics and material requirements planning.

Computers can be classified as being general purpose, special purpose, or hybrid. General-purpose computers, as the name implies, are designed to perform any number of different tasks. Computers designed to serve one limited, specific purpose are called special-purpose computers.[3] Some computers used in CAD/CAM are special-purpose computers. Hybrid computers combine the most desirable characteristics, speed and flexibility, of general- and special-purpose computers.

General-purpose computers have the advantage of flexibility. This allows for a broader utilization of the computer. The primary disadvantage of a general-purpose computer is lack of speed. General-purpose computers are not able to perform tasks as quickly as special-purpose computers.

Special-purpose computers are much faster than general-purpose computers. However, they sacrifice[4] flexibility in getting this advantage. CAD/CAM systems make use of the digital computers as to the data they can handle, and they make use of general-purpose, or special-purpose, or hybrid ones as to the purpose they needed to satisfy. Although there are extremely large and complex "supercomputers", such as those used in space program, most digital computers applied in CAD/CAM are either minicomputers or microcomputers.

Computers are used by engineers, designers, architects, and drafters in all phases of the design process and then in all phases of the manufacturing process. Design process is combining scientific principles, new ideas, old ideas, and sometimes existing products to the solution of a problem or the meeting of a need. Manufacturing is the process of fabricating complete or finished products or parts.

NOTES

1. **to such breadth** — до такой ширины
2. **a rough** [rʌf] **sketch** — грубый набросок (эскиз)
3. **special-purpose computer** — специализированный компьютер
4. **to sacrifice** — жертвовать

12. Read Text B attentively (study reading). Make up a list of key words. Divide Text B into logical parts.

13. Choose the title for Text B from given below:

1. Technological developments in industry. 2. CAD/CAM systems. 3. Computers for CAD/CAM. 4. General-purpose computers. 5. Special-purpose computers. 6. Computers' flexibility and speed.

14. Compare special-purpose computers and general-purpose computers.

15. Speak on the primary advantage and disadvantage of general-purpose computers.

16. Using the key words from Text B write a summary in English (see p. 126).

17. Read the following two texts and say which of them is an abstract.

TEXT C

A microcomputer is a computer that is manufactured on a single printed circuit board that contains one or more chips. Microcomputers are the result of technological advances that allow over 100,000 electronic components to be contained in a single chip. The most common makeup of the microcomputer is: (1) a microprocessor chip which serves the same purpose as a conventional CPU, (2) a number of chips that serve as the memory, and (3) circuitry for connection to input/output devices. A number of these devices can be used as typewriters, line printers, magnetic cassette tapes, and floppy disks.

TEXT D

This paper presents work currently in progress in the area of computer-aided design (CAD) of robots and their environments. Several results of previous work concerning mathematical modelling of complex mechanisms have been implemented in computer-aided design with a three-dimensional interactive systems (CADTDIS). So far, it is possible to build robot models and to visualize their motions on a graphic display, as well as to program trajectories and to control a process with the simulation results. The paper is of interest for engineers working in robot industry.

18. Analyse the extract below and the translation given. Practise the oral back translation:

The first computers to run computer-aided design and manufacturing programs were mainframes of the early 1960s.

The powerful machines occupied entire rooms.

In the 1970s, CAD/CAM was made accessible to a broader range of users with the advent of less-expensive and more compact minicomputers based on integrated circuit technology.

Today, machines running CAD/CAM software span an even broader range, from low-cost personal computers that make the technology affordable to even the smallest of the firms, to the most powerful supercomputers that routinely perform tasks formerly considered too cumbersome, expensive and much time spending.

В ранние 60-е годы первые компьютеры, работавшие с программами САПР/АСУ ТП, были большими.

Эти мощные машины занимали целые помещения.

В 70-х годах на основе интегральных схем были разработаны миникомпьютеры, которые стали проще в обращении и доступны более широкому кругу пользователей САПР/АСУ ТП.

Сегодня машины, работающие с ПО САПР/АСУ ТП, охватывают более широкую область: от недорогих персональных компьютеров, технология изготовления которых стала доступной даже самым малым фирмам, до самых мощных суперкомпьютеров, которые выполняют рутинные задачи, ранее считавшиеся слишком громоздкими, дорогостоящими и требующими больших затрат времени.

But computers still can be broadly classified according to physical size, processing speed and accessible memory.

Компьютеры все еще принято классифицировать по их физическому размеру, скорости обработки и времени обращения к памяти.

The four main types of computers generally used for CAD/CAM include microcomputers, minicomputers, mainframes, and supercomputers.

Четыре основных типа компьютеров, обычно используемых в САПР/АСУ ТП, включают микро-, мини-, большие и суперЭВМ.

Selecting one type over the other is almost always a trade-off between the cost of the machine and computational speed it can handle.

Предпочтение одного типа компьютера другому почти всегда является компромиссом между стоимостью и скоростью, с которой он сможет управлять вычислительным процессом.

SUMMARY AND REVIEW TO UNITS 1 AND 2

1. Engineers and drafters have used computers for years in performing mathematical computations. Now an even more innovative computer application is being used: CAD/CAM.

2. Interest in computer-aided design began to develop on a large scale in the early 1970s. By 1990, computer-aided design and manufacturing (CAD/CAM) will probably be the norm in all research institutions and industry.

3. The computer can be used not only in producing drawings, but also in compiling parts, lists and bills of materials, developing schedules, and in performing mathematical computations.

4. Drafting began to flourish as an occupation when industry converted to mass production methods.

5. The single most important benefit of CAD/CAM is increased productivity.

6. CAD does not eliminate the need for drafters. Rather, it allows drafters to do their jobs faster and better.

7. The most important concept to understand about computer-aided design and drafting is that the computer, by itself, does not make design or drawings. Designers and drafters make drawings and different documentations using the computer as a tool.

8. A computer can be defined as an electronic machine which has storage, logic, and mathematical capabilities and can perform tasks at extremely fast speeds.

9. The most promising developments of CAD/CAM are in the areas of machine parts, architecture, electronics, piping, etc.

10. When computers are classified according to the type of data they are capable of handling, they are classified as being either digital or analog.

11. In CAD/CAM systems the digital computers are only used.

12. When computers are classified according to the purpose they serve, they are classified as general-purpose or special-purpose computers.

13. General-purpose computers have the advantage of flexibility, which allows for broader utilization, but they sacrifice speed.

14. Special-purpose computers are very fast, but they sacrifice flexibility.

15. The most common types of digital computers are the minicomputers and microcomputers.

16. A microcomputer is a computer that is manufactured on a single printed circuit board which contains one or more integrated circuit chips.

SELF-TEST

Этот тест поможет вам проверить, как вы усвоили и запомнили содержание учебных текстов, представленных в двух уроках-циклах. Постарайтесь сначала ответить на все вопросы, не обращаясь к текстам. Только после этого обратитесь к ним и проверьте правильность ваших ответов. Это даст вам возможность понять тот материал, который вы почему-либо пропустили или недостаточно поняли.

1. Indicate whether each of the following statements is true or false:

a) Computers have become so technically advanced that they will soon be able to operate without any human help. b) Together human beings and computers can make up a very capable team because their strengths are complementary (дополняющий) while their disadvantages are offsetting (компенсировать). c) The most commonly used type of computer in CAD/CAM systems is the analog computer. d) Engineers, designers, and drafters have used computers for years in performing many different operations, beginning with drawings and finishing with complete parts or products. e) The list of computer applications in CAD/CAM has grown rapidly over the past decades, but it has now reached its peak.

2. A computer has two critical disadvantages. Which of the following are they?

a) Cannot think or reason. b) Unreliable and unaccurate. c) Unable to perform long, arduous (изнурительный) tasks. d) Cannot avoid human programming.

3. What are the two most common types of computers used in CAD/CAM systems? 4. Define the term "microcomputer". 5. The computer has two capabilities that make it a valuable tool for human use. What are they?

6. When computers are classified according to the purpose they will serve, they are classified as:

a) Digital computers. b) Analog computers. c) Hybrid computers. d) Microcomputers. e) Special-purpose computers. f) General-purpose computers. g) Minicomputers.

7. When computers are classified according to the various characteristics, they are classified as:

a) Analog computers. b) General-purpose computers. c) Digital computers. d) Minicomputers. e) Special-purpose computers. f) Microcomputers. g) Hybrid computers. h) Mainframes. i) Supercomputers.

8. Why is the first person's experience with the computer negative in many cases? 9. What are computers particularly suited for?

UNIT 3

Text A. Interactive Graphics Hardware. Text B. Data Entry Devices. Text C. CAD Software.

EXERCISES

1. Recognize the following international words:

interactive, graphics, component, terminal, natural, session, model, line, technically, diagram, term, synonymous, operator, manner, isometric, mechanical, automatic, to construct, command, menu, productivity, to manipulate, special, routine, to analyse, result, figure, vector, cathode, principle, resolution, raster, contrast, horizontal, vertical

2. Practise the reading of the following words:

provide [prə'vaɪd] *v* снабжать, обеспечивать, давать

retrieve [rɪ'tri:v] *v* обнаруживать, находить; восстанавливать

reach [riːtʃ] *v* достигать
observe [əb'zəːv] *v* наблюдать, следить; соблюдать
evaluate [ɪ'væljueɪt] *v* оценивать, вычислять
session ['seʃn] период работы
specify ['spesɪfaɪ] *v* точно определять, устанавливать; обусловливать
screen [skriːn] экран
represent [,reprɪ'zent] *v* представлять собою; исполнять роль
bottom ['bɔtəm] низ
feature ['fiːtʃə] черта, особенность
routine [ru'tiːn] *n*, *a* программа, рутина; рутинный
workstation ['wəːk,steɪʃən] автоматизированное рабочее место (АРМ)
image ['ɪmɪdʒ] изображение, образ
hardcopy ['hɑːdkɔpɪ] копия на твердой основе (например, на бумаге)
device [dɪ'vaɪs] прибор, устройство
drive [draɪv] *n*, *v* привод, передача, накопитель; управлять
plotter ['plɔtə] графопостроитель, самописец
deflect [dɪ'flekt] *v* отклонять
resolution [,rezə'ljuːʃən] разрешающая способность (прибора)
animation [,ænɪ'meɪʃən] (машинное) «оживление»; динамика
brightness ['braɪtnɪs] яркость
suit [sjuːt] *v* годиться, подходить, удовлетворять требованиям
viewable ['vjuːəbl] видимый, зримый
sharpness ['ʃɑːpnɪs] резкость
allocate ['æləkeɪt] *v* размещать, распределять
description [dɪs'krɪpʃən] описание
pixel ['pɪksɪl] элемент изображения
produce [prə'djuːs] *v* производить, создавать
amount [ə'maunt] количество, величина
exist [ɪg'zɪst] *v* существовать

3. Memorize the following words and word combinations and compose *your own* sentences using them:

interactive graphics интерактивная (диалоговая) графика
a wire-frame image (model) каркасное (скелетное) изображение (модель)
a mathematical representation математическое представление
a computer database база данных компьютера
the CRT (cathode-ray tube) screen экранное устройство отображения
a drawing board чертежная доска
a function menu меню функций
a turnkey system высоконадежная система; система, сдаваемая «под ключ»
a hardcopy device устройство выдачи печатных копий (документов)
a visible trace видимый (визуальный) след (трассировка)
viewable resolution видимая разрешающая способность
image description описание изображения (образа)

4. Look through Text A. Say whether the main idea of Text A is mathematical representation models or the general components of graphics hardware configuration.

TEXT A. INTERACTIVE GRAPHICS HARDWARE

1. Interactive graphics is an important component of CAD/CAM, providing a "window" through which the computer can be reached and observed. Interactive terminals enables a means of communications so natural to human beings that graphics-based systems are now often evaluated on the basis of how "friendly" they are to the people operating them.[1]

2. In interactive graphics session, the user constructs a wire-frame image or model by specifying points and lines on the screen. Technically, the model is a mathematical representation of the diagram in the computer database. But use of computer graphics to represent these data is so common that the term "model" is virtually synonymous with the graphic display itself on the CRT screen.

3. The operator uses the screen in much the same manner as a drawing board to create top, bottom, side, isometric, and other views of the model. But unlike mechanical drafting, interactive graphics provides automatic features to speed design. Essentially, the designer need not manually draw each line in a wire-frame model. Rather, the computer system constructs the lines based on user-specified points and commands chosen from a function menu.

4. Interactive computer graphics significantly increases design and drafting productivity. Users of these systems can generally perform routine tasks more quickly and accurately than possible with traditional pencil-and-paper methods.[2] Changes can be made faster and inexpensively at a keyboard or electronic tablet.[3]

5. Special hardware is required for interactive graphics systems, however. Several types of terminals are used for graphics and dedicated computers called workstations contain many features to produce and manipulate graphic images. Turnkey systems also contain special components and routines for interactive graphics. In addition, graphics require a different type of hardcopy device than text. And many devices exist to help operators enter and manipulate graphics faster than with the keyboard.

6. Users of interactive graphics systems typically communicate with the computer through graphics terminals. The computer translates images drawn on the screen into a mathematical model and stores it in memory. At any time, the user may instruct the computer to retrieve data and drive a plotter for hardcopy output of the drawing.

Or simple pushbutton commands[4] may direct the computer to analyse the model. Results of such analysis are also displayed on the screen through easily interpreted animated figures,[5] colour-coded diagrams,[6] or other graphic images.

7. Most interactive CAD/CAM systems use one of three main types of graphic terminals: raster-scan, vector-refresh, or storage-tube.[7] All of these types produce images through the same basic cathode-ray tube (CRT) principle. In a glass-enclosed tube,[8] a finely-focused electron beam[9] is deflected onto a phosphor-coated screen.[10] The screen then glows to produce a visible trace when excited by impinging electrons.[11] There are differences in characteristics, such as resolution, colour, animation, and brightness that make each of the three types of terminals best suited for certain CAD/CAM applications.

8. Resolution is an important consideration in raster terminals which can be specified in viewable or addressable terms. Viewable resolution indicates the level of sharpness displayed on the CRT and is limited by physical construction of the tube. In contrast, addressable resolution refers to the amount of memory allocated for image description.

9. Screen resolution is defined by the number of horizontal pixels $\times$ the number of vertical pixels. Higher resolution screens of $1{,}000 \times 1{,}000$ or more are often used in CAD/CAM applications in those cases when lines on the screen are at horizontal, vertical or 45° angles.[12]

10. Interactive graphics hardware configuration would contain terminals, entry devices, hardcopy outputs, and workstations which, in turn, consist of a primary processor and associated memory,[13] a graphic display system, and software.

(To be continued)

NOTES

1. **on the basis of how "friendly" they are to the people operating them** — исходя из того, насколько «дружественны» они по отношению к людям, работающим с ними

2. **with traditional pencil-and-paper methods** — традиционными методами с помощью карандаша и бумаги

3. **an electronic tablet** — электронный планшет («сколка»)

4. **pushbutton commands** — команды, осуществляемые нажатием кнопок

5. **animated figures** — динамические («оживленные») рисунки

6. **colour-coded diagrams** — цветные закодированные диаграммы

7. **raster-scan, vector-refresh, or storage-tube (terminals)** — (терминалы) с растровым сканированием, векторной регенерацией или запоминающей трубкой

8. **a glass-enclosed tube** — трубка, помещенная в стеклянный корпус

9. **a finely-focused electron beam** — точно сфокусированный электронный луч

10. **a phosphor-coated screen** — экран, покрытый фосфором

11. **when excited by impinging electrons** — при возбуждении сталкивающимися электронами

12. **when lines on the screen are at horizontal, vertical, or 45° angles** — когда строки находятся под горизонтально и вертикально расположенными углами или под углом в 45°

13. **a primary processor and associated memory** — исходный процессор и относящееся к нему запоминающее устройство

5. Read Text A attentively. Make up a list of key words and word combinations. Translate the 7th, 8th and 9th paragraphs in written form.

6. Compose your own sentences using the key words from Text A.

7. Complete the following sentences choosing one of the given words and word combinations.

1. Interactive graphics is an important component of (a computer, CAD/CAM systems). 2. The user constructs a wire-frame image or model specifying points and lines on (an electronic tablet, resolution, the CRT screen). 3. The operator uses the screen in much the same manner as (a keyboard, a drawing board, a mathematical model). 4. The computer system constructs the lines based on specified points and commands from (a plotter, a menu, a table). 5. Dedicated computers called workstations contain many features to produce (calculations, flexibility, graphic images). 6. The computer translates images on the screen into a mathematical model and stores it in (display, memory, wire-frames).

8. State to what passages the following titles may suit:

1. Constructing wire-frame models. 2. Increasing design and drafting productivity. 3. Types of graphic terminals.

9. Speak on the basic principle of the CRT screen.

10. Check up yourself how much you have memorized from Text A:

a) Say what the operator creates on the CRT screen. b) Recall how workstations are sometimes called. c) Say when the user instructs the computer to drive a plotter for hardware output of the drawing. d) Name the three types of graphic terminals. e) Say what viewable resolution indicates. f) Recall by what the screen resolution is defined.

11. Write an abstract in Russian (see p. 126) using the key words from Text A.

12. Look through Text B. List its main points.

TEXT B. DATA ENTRY DEVICES

The keyboard is a primary data entry devices with buttons that resemble those on a typewriter used to enter commands and data by typing out words and numbers. Many keyboards have features that aid in entering data for interactive graphics tasks, but more often so-called graphic-input devices are used instead.

Graphic-input devices allow operators to enter data in an easy-to-interpret graphic form, primarily to specify lines and points. This task is usually accomplished by controlling the position of a set of cursor cross-hairs on the screen. Some devices are touched onto the screen for more direct interaction. Graphic-input devices are also used to select items from a menu.

There are several types of graphic-input devices. Some CAD/CAM systems use only one device, while other systems use two or three different types. The major types of graphic-input devices are: lightpens, joysticks, trackballs, mice, digitizers, and voice data entry devices. In addition, automated drawing entry devices permit input of an entire document without manual intervention. Let us consider some of them.

Lightpens. Lightpens are shaped like a pen with a wire connected to it to interact directly with the CRT display. These devices can be used for positioning a cursor as well as for pointing to and selecting from menus displayed on the screen.

Lightpens consist of a stylus containing a photocell. The stylus produces an electronic signal when it is placed on the screen and detects light. This signal is sent to the computer, which determines the screen location being illuminated at the time the signal is generated.

Touchscreens. Touchscreens are even more direct devices than lightpens. They are used by simply touching the CRT display with one's finger or other pointing device.

Joysticks. Joysticks are potentiometric devices that contain sets of variable resistors which feed signals that indicate device position to the computer. These devices rely on the operator's sense of touch and hand-eye coordination[1] to control the position of cross-hairs on the screen.

Joysticks are normally set so that side-to-side movement produces change in the *x* coordinate and front-to-back movement produces change in the *y* coordinate. Many users prefer joysticks because they allow rapid cursor movement for relatively small device displacements, enabling graphic operations to be performed quickly.

Mice. Mice are small handheld puck-like devices[2] with attached wire that can be moved around by an operator on any flat surface to provide graphic input. An important advantage to using mice is their ability to position rapidly the cursor on the screen.

Two possible disadvantages are often mentioned when evaluating mice for CAD/CAM systems. One is that slippage of the contacting surfaces, or momentarily lifting the device, may result in tracking errors. Another potential problem is that mice usually require about one square foot of clear desk space,[3] which is sometimes at a premium[4] in CAD/CAM systems.

Voice Data Entry. Voice data entry devices are used primarily to increase operator productivity in selecting menu items. Their most important feature is that voice data entry gives the system operator more mobility due to unrestricted hand and eye use.[5] Key to effectiveness of voice data entry devices in CAD/CAM systems is their ability to allow users to enter accurately data and commands in a natural stream of spoken words, numbers, and phrases without the artificial pauses between words and phrases required in using some devices.

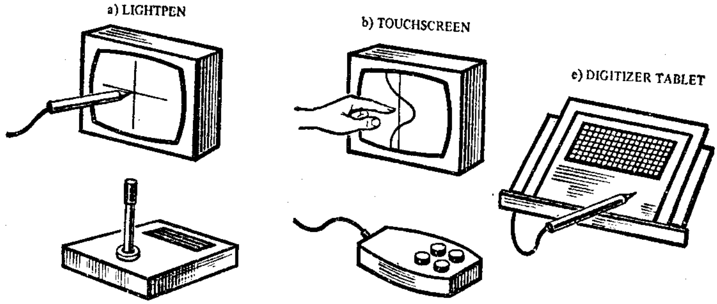

Fig. 1

Digitizers. Digitizers consist of three basic elements: a pen or cursor, a tablet, and a software package. Digitizers can be used in CAD/CAM systems to copy existing drawings and send the data directly to the computer for storage. But more frequently, digitizers are used actually to help create a drawing, using an interactive software package to enter a new sketch or drawing, which can then be redrawn and edited as the display appears on the CRT screen.

Digitizer tablets range in size from just a few square inches[6] to tablets of the size of a drawing board, about 50×60 inches. The drawing-board-size tablets allow tracing of existing engineering drawings or entering free-hand sketches.[7] However, smaller tablets permit the user to interact quickly with the screen. Nearly all mentioned devices are illustrated in Figure 1 (a, b, c, d, e).

NOTES

1. **These devices rely on the operator's sense of touch and hand-eye coordination**—Эти устройства реагируют на осязательную и зрительную координацию оператора
2. **puck-like devices**—устройства, напоминающие хоккейную шайбу
3. **about one square foot of clear desk space**—около одного квадратного фута свободного пространства стола
4. **at a premium**—*зд.* дефицитный
5. **due to unrestricted hand and eye use**—за счет неограниченного осязательного и зрительного использования
6. **from just a few square inches**—всего от нескольких квадратных дюймов
7. **free-hand sketches**—наброски (эскизы), сделанные от руки

13. Read Text B attentively, looking at the words given below. Try to memorize them:

to resemble [rɪ'zembl]—напоминать; button ['bʌtn] кнопка; instead (of) [ɪn'sted]—вместо; a set of—ряд; несколько; cross-hairs ['krɔshɛəz]—*опт.* крест нитей; to touch [tʌtʃ]—прикасаться; item ['aɪtəm]—пункт; lightpen ['laɪtpen]—световое перо; joystick ['dʒɔɪstɪk]—координатный указатель; trackball ['trækbɔ:l]—шаровой указатель; mouse [maus] (*pl.* mice)—«мышь» (устройство для отработки положения указателя на экране дисплея); digitizer ['dɪdʒɪtaɪzə]—цифрователь; voice [vɔɪs]—голос; entry ['entrɪ]—вход; to permit [pə'mɪt]—позволять; разрешать; entire [ɪn'taɪə]—весь, полный; to shape [ʃeɪp]—оформлять, придавать форму; stylus ['staɪləs]—перо прибора; photocell ['foutəsel]—фотоэлемент; touchscreen ['tʌtʃskri:n]—сенсорный экран; to feed [fi:d]—подавать, питать; change [tʃeɪndʒ]—изменение; movement ['mu:vmənt]—движение; to allow [ə'lau]—позволять; displacement [dɪs'pleɪsmənt]—смещение; to enable [ɪ'neɪbl]—давать возможность; to attach [ə'tætʃ]—присоединять; wire [waɪə]—провод, проволока; surface ['sə:fɪs]—поверхность; slippage ['slɪpɪdʒ]—проскальзывание; error ['erə]—ошибка; ability [ə'bɪlɪtɪ]—способность; tablet ['tæblɪt]—планшет, «сколка»; to create [krɪ'eɪt] — создавать; size [saɪz] — размер; tracing ['treɪsɪŋ] — копирование; nearly ['nɪəlɪ] — почти

14. Check up yourself what words given above you have memorized. Find the English equivalents to the following Russian words:

a) 1. ошибка; 2. «сколка»; 3. поверхность; 4. присоединять; 5. провод; 6. способность; 7. создавать; 8. походить на; 9. пункт; 10. координатный указатель; 11. придавать форму; 12. позволять; 13. весь; 14. подавать; 15. движение; 16. вход; 17. изменение; 18. смещение; 19. перо графического прибора; 20. фотоэлемент

b) 1. to create; 2. item; 3. movement; 4. joystick; 5. entire; 6. ability; 7. tablet; 8. error; 9. wire; 10. to feed; 11. to shape; 12. entry; 13. stylus; 14. photocell; 15. to resemble; 16. displacement; 17. to allow (to permit); 18. to attach; 19. change; 20. surface

15. Make up a list of the key words from Text B.

16. Using the key words give the principal ideas of Text B.

17. Compare a lightpen and a joystick. Begin with the following words:

"Both a lightpen and a joystick are data entry devices used in interactive graphics. But the lightpen is shaped like .... As for the joystick, it is a potentiometer device ...."

18. Speak on the digitizer and the tablet.

19. Divide Text B into paragraphs and logical parts.

20. Read Text C attentively. Translate the fifth paragraph in writing.

TEXT C. CAD SOFTWARE

1. The key to flexibility of a computer-aided design system is the software available for the system. Software for a CAD system falls into one of four categories: operational software, graphics software, application software, and user software (Fig. 2). A user is any person who uses a CAD system to perform its tasks. Users may be engineers, designers, drafters, system operators, and students.

2. Operational software makes possible the general operation of a CAD system. This includes such tasks as memory allocation, scheduling of the processing unit, driving of input/output devices, arranging of priorities of operations, and interrupting (прерывание) of operations.

3. Graphics software is designed especially to allow the computer to deal with graphic data. This includes the ability to enter, manipulate, edit, revise (пересматривать), correct, and store two- and three-dimensional data [1] such as points, lines, planes (плоскость), arcs, and circles (окружность).

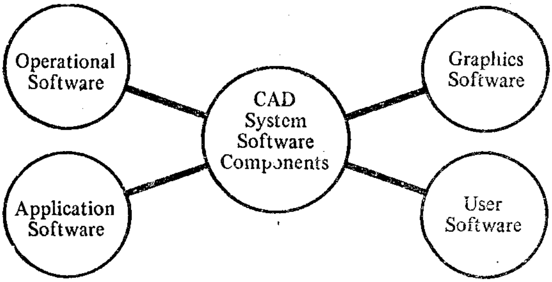

Fig. 2

4. Application software provides for the performance of design tasks within specific (конкретный) design fields, such as architectural, civil, electronics, mechanical, piping, etc. It also allows for specific tasks within each of these design fields, such as drawing engineering, layout (компоновка), erection (монтаж), or shop drawings. [2]

5. User software is that which is developed (разрабатывать) by the CAD system user at the workplace for applications that are specific to the user. User software is task-oriented and frequently consists of such things as special-purpose CAD templates (шаблон) known as menus, or special styles lettering fonts. [3] A menu is the electronic equivalent of a template. It resembles a large rectangular (прямоугольный) card which contains symbols or geometric shapes that are frequently used in a given drafting setting. [4] By using the menu in conjunction with [5] a digitizing implement (прибор) such as an electronic pen or a cursor, the user is able to enter frequently used symbols or geometric shapes by simply pressing a button.

NOTES

1. **two- and three-dimensional data = 2D and 3D data** — двух- и трехмерные данные

2. **shop drawing** — рабочий чертеж

3. **special styles lettering fonts** — буквенные шрифты особых сортов (стилей)

4. **in a given drafting setting** — в данной чертежной установке

5. **in conjunction with** — вместе с

21. Read the following statements and say which of the four CAD system software each statement suits (operational, graphics, applications, user):

a) provides for very specific tasks which are intrinsic (присущий) to a given drafting setting; b) provides for memory allocation in the processing unit; c) allows the CAD system to handle graphic data; d) provides for the driving of input/output devices within the system; e) allows the CAD system to perform tasks in the area of mechanical drafting.

22. State which sentence expresses the main idea of Text C.

23. Compare the operational software and the user software.

24. Render Text C in your own words.

UNIT 4

Text A. Interactive Graphics Hardware *(continued)*. Engineering Workstations. Text B. Hardcopy Output. Text C.

EXERCISES

1. Recognize the following international words:

contrast, act, form, special, front, documentation, popular, effective, to activate, complex, copy, thermal, presentation, particular, type, to select, criteria, intensity, pigment, electrode, electrostatic, tone, dielectric, problem, production, stationary, professional, intervention, personal, archive, electromechanical, film, electrophotographic, compact, cable, video, buffer

2. Practise the reading of the following words:

power ['pauə] мощность, энергия; степень
appropriate [ə'prouprɪɪt] соответствующий, подходящий
network ['netwə:k] сеть
primary ['praɪmərɪ] первичный, исходный
approach [ə'proutʃ] подход, приближение
rival ['raɪvəl] *n*, *v* конкурент; конкурировать
setup ['setʌp] *v* устанавливаться, помещаться
run [rʌn] *v* прогонять (программу); работать, выполнять
supply [sə'plaɪ] *v* снабжать, обеспечивать
apply [ə'plaɪ] *v* применять; прилагать, прикладывать
relate (to) [rɪ'leɪt] *v* связываться с; относиться к
driver ['draɪvə] драйвер, привод, возбудитель
draw [drɔ:] *v* **(drew, drawn)** чертить, рисовать
offer ['ɔfə] *v* предлагать
support [sə'pɔ:t] *v* поддерживать, обеспечивать

3. **Memorize the following word combinations:**

computing power вычислительная мощность
low-end workstation автоматизированное рабочее место (АРМ) низшего класса
high-end workstation АРМ высшего класса
high-resolution graphic display графический дисплей с высокой разрешающей способностью
a main memory оперативное запоминающее устройство (ОЗУ)
a computer network сеть вычислительных машин
basic components основные детали (компоненты)
a primary processor первичный (исходный) процессор
basic approaches основные подходы
stand-alone processors автономные процессоры
a particular user особый (частный, индивидуальный) пользователь
a host computer главная вычислительная машина
a substantial amount значительное количество
custom processors процессоры, изготовленные по техническим условиям заказчика

4. **Look through Text A. List the main ideas of it.**

TEXT A. INTERACTIVE GRAPHICS HARDWARE (CONTINUED)

Engineering Workstations

Engineering workstations are display terminals combined with computing power, most often in the form of 32-bit microprocessors. Workstations are typically divided into two broad categories: low and high end. Low-end workstations generally consist of personal computers, often incorporating a hard disk. Appropriate software is then added, along with [1] special hardware. High-end engineering workstations contain more powerful processors than personal computers. Hardware in these systems generally consists of a high-resolution graphic display (512×512 pixels of more), a processor capable of 0.5 to 2.0 million instructions per second, 1 Mbyte or more of main memory, mass storage [2] of 50 Mbytes; and the ability to operate in a computer network with other workstations or host computers.

Workstations consist of three basic components: a primary processor and associated memory, a graphics display system, and software. These elements are assembled in various manners, however. With low-end workstations standard personal computers as a base are used, often adding standard options and proprietary software to the system as a turnkey workstation. In high-end systems, there are two basic approaches. First, standard workstations that rival minicomputers in processing power and memory are used as a base, with software being added to make the system an engineering workstation. Second, some computing plants build proprietary workstations on which to run their software. (See a typical workstation in Fig. 3.)

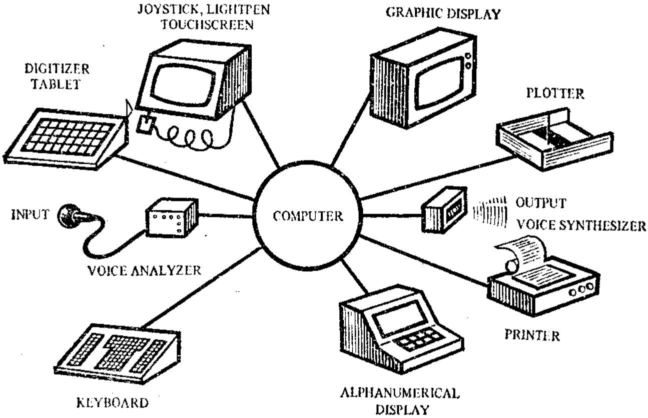

Fig. 3

Workstations can be used in a variety of ways. First, they can act as dedicated, stand-alone processors for certain design or analysis tasks. They can be dedicated to a different task or for a particular user. Another large use of workstations is as front-ends[3] to larger host computers. Problems can be setup with the workstations, and up-loaded to the host for processing.

Processors for workstations are typically either 16-bit, as used in personal computers, or 32-bit, as used in high-end workstations. Personal computers, with their standard 16-bit processors, have an advantage of being able to run a substantial amount of software such as programs for word processing. In contrast, 32-bit workstations can provide processing power close to that of minicomputers. And some workstations manufacturers offer packages for other tasks such as word processing and documentation.

High-end workstations are generally based on 32-bit microprocessors, and take one of three forms: those found in newer personal computers, custom processors, and popular microprocessors built-in architecture. High-end workstations are generally supplied with large, high-resolution displays of around 1,000×1,000 pixels. Main memory consists of at least[4] 1 Mbyte, and sometimes more. Network interfacing is built into the system. And all features can be found in a family of processors so that the appropriate processing power can be applied to a given task.

Workstations typically place an emphasis on graphics display and manipulation[5] since this is an effective method of off-loading the host. The features of a display system are directly related to the processing power of a so-called display driver and not to the characteristics of the terminal screen itself. Functions such as colour fills,[6] line and arc generation, and rotating are controlled by the display processor and associated hardware. For example, to draw a line between two points on a raster system the display processor must calculate which pixels fall along that line and activate them.

Graphics calculations for a raster display may require large processing power. For example, 1 Mbyte of memory is required to support a screen with a resolution of 1,000× ×1,000 picture elements (pixels). A manipulation can be as simple as changing the colour of one line or as complex as rotating the entire image. Colour adds to the amount of information stored in memory.

NOTES

1. **along with** — вместе с
2. **mass storage** — массовое запоминающее устройство (ЗУ)
3. **front-ends** — связующие (компьютеры)
4. **at least** — по крайней мере
5. **place an emphasis on graphics display and manipulation** — придают особое значение графическому дисплею и управлению операциями
6. **colour fills** — цветовые наполнения

5. Find the Russian equivalents to the following English word combinations:

a) 1. in the form of 32-bit microprocessors; 2. in various manners; 3. as a base; 4. proprietary software; 5. a low-end workstation; 6. a turnkey workstation; 7. processing power; 8. computing power; 9. an engineering workstation; 10. front-end and large computers; 11. so-called; 12. host computers; 13. the basic approach; 14. a stand-alone processor; 15. an uploaded host computer; 16. dedicated processors; 17. custom processors; 18. an effective method of off-loading; 19. an entire image; 20. line and arc generation; 21. the proprietary workstations

b) 1. центральные компьютеры; 2. производительность; 3. различными способами; 4. автономный процессор; 5. эффективный метод разгрузки; 6. полное изображение; 7. в качестве базы; 8. готовое к использованию АРМ; 9. вычислительная мощность; 10. связующие и большие компьютеры; 11. так называемый; 12. основной подход; 13. специализированные процессоры; 14. загруженный центральный компьютер; 15. формирование линий и дуг; 16. в виде 32-разрядных микропроцессоров; 17. запатентованное программное обеспечение; 18. АРМ низшего класса; 19. инженерное (техническое) АРМ; 20. запатентованные АРМ; 21. сделанные на заказ процессоры

6. Memorize the following words and word combinations:

such as—такой как; as simple/complex as—такой простой/сложный как; since—так как, с, с тех пор; directly—непосредственно; so-called—так называемый; generally—главным образом; at least—по крайней мере; sometimes—иногда; more—больше; most of—большинство из; along—вдоль, по; along with—вместе с; then—затем; than—чем; thus—таким образом; however—однако; hence—следовательно; only—только; the only—единственный; very—очень; the very—самый; moreover—более того; in addition—кроме; typically—типично; according to—согласно; due to—благодаря; in conjunction with—в соответствии с; in contrast—наоборот; on the contrary—наоборот; usually—обычно; nevertheless—тем не менее; also—также; always—всегда; although—хотя; against—против; again—снова, опять; almost—почти

7. Translate the following definitions and memorize the terms which they describe:

Graphics is picture creation and processing. People can design and create picture images in a computer system with graphics software and input devices, like digitizer tablets and lightpens. Real pictures can be "photographed" into the computer system by being scanned by a digital camera.

Cursor is the screen pointer. The cursor is the square or special symbol on a video screen that indicates which character on the screen is being referenced.

Screen is the display portion of a video terminal. The screen is the CRT, or display portion of a video terminal.

CRT (Cathode-Ray Tube) is the technical term for the vacuum tube used in a TV or video terminal screen.

Digitizer tablet is the graphics input device. It is a flat tablet which serves as a drawing surface for graphics input.

Digitizer tablets can be used for sketching new images, tracing old images, selecting from menus or simply for moving the cursor around on the screen.

Interactive means conversing with the computer. An interactive system is an on-line conversational system.

Joystick is a video terminal input device, which serves as a lever (рычаг) that directs the movement of the cursor on the video screen. It allows the user to position the cursor anywhere on the screen more rapidly than with the standard way on the keyboard by pressing the keys.

Lightpen is a video terminal input device. A lightpen is a light-sensitive stylus connected by a wire to the video terminal. The user brings the lightpen to the desired (нужный) point on the screen surface and presses a button causing (заставлять) the lightpen to identify the location of the light on the screen. Lightpens are used to select options from a menu displayed on the screen.

Resolution is image quality. High-resolution refers to a large number of dots (точка) in a picture image. Low-resolution refers to a small number of dots in a picture image.

Menu is a list of available (имеющийся) options in an interactive program. Menus display all options used by a user at the terminal. Sometimes, a menu will display the commands that should be entered.

Pixel is a picture element. A pixel is the smallest part of a video screen. A computer video screen is broken up into thousands of tiny (крошечный) dots. A pixel is one or more dots which are treated (рассматривать) as a unit.

Printer is a device that converts computer output into printed images. The major categories of printers are: serial printers, line printers, page printers which are also called laser printers, and electronic printers, graphics printers and colour graphics printers.

Hardcopy is something printed on paper. It is a contrast with **softcopy** which is in audio (звуковой) or video form.

Plotter is a graphics output device. Plotters are devices that draw lines with ink pens. Plotters require that the picture image is coded in vector graphics format (point-to-point). They are flatbed (планшетный) and drum (барабанный) plotters. The former ones draw by moving the pen in both horizontal and vertical axes (ось). The latter ones draw by moving the pen along one axis and the paper along the other.

8. Compose your own sentences with the terms given above and write down them into your exercise-book.

9. Read Text A attentively. Divide it into logical parts. Write out the key words and the topic sentences from each paragraph.

10. Using the topic sentences from Text A, compose a plan (5-6 items) and recall the text according to your plan.

11. Check up yourself how much you have memorized from Text A.

a) Complete the following sentences:

1. Workstations are display terminals combined with computing (machine, power, numbers). 2. Low-end workstations generally consist of personal computers, often incorporating a hard (disk, ware, copy). 3. Workstations are dedicated to a different task or for a particular (computer, user, equipment). 4. Graphics calculations for a raster display may require large processing (device, capability, power). 5. High-end workstations are supplied with large high-resolution displays of around 1,000×1,000 (numbers, pixels, points). 6. In engineering workstations personal computers are used with their standard 16-bit (memory, input, processors).

b) Say which two classes the workstations consist of. c) Name in which ways workstations can be used. d) Recall which processors are used for workstations. e) Say what difference is between 16-bit and 32-bit microprocessors. f) Recall words and word combinations used for describing low-end and high-end workstations.

12. Write an abstract of Text A in Russian (see p. 126).

13. Look through Text B. List its main points.

TEXT B. HARDCOPY OUTPUT

A CAD/CAM system is not complete unless it can make hardcopies[1] of designs or analyses created on the terminal. Equipment for producing such copies includes pen plotters, photocopiers,[2] and graphics printers. Determining the best output device for a particular CAD/CAM application is a three-step process: (1) specifying how hardcopies will be used, (2) identifying quality and cost criteria, and (3) selecting equipment most suited for the application.

(1) Hardcopies are used for a variety of purposes. Design iterations can be reduced by making hardcopies at crucial (решающий) stages and distributing (распределять) them to the personnel for review. Hardcopy production equipment also permits drawings and documents to be made for archiving purposes.

(2) Another criteria is copy quality in terms of clarity and precision.[3] Although resolution is often given in dots

per inch or addressable points per inch, [4] the number of lines is important consideration in determining copy quality. Resolution of the hardcopy device must be important as it is in the display terminal.

(3) The first step in selecting an output system is to develop application requirements in terms of specific (конкретный) copy characteristics and production capabilities. The first of these is visual effect, primarily with regards to whether a hardcopy is black-and-white or colour. [5] Black-and-white is usually satisfactory for reproducing data, text, and line drawings. Colours can help emphasize areas of figures in data tables, highlight changes [6] on production drawings, and differentiate between components in system layouts. Moreover, colour is almost a requirement in complex or 3D designs. [7]

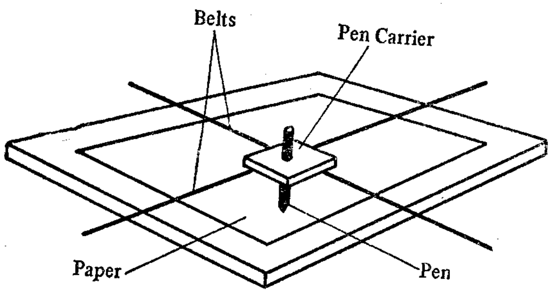

Fig. 4

Plotters. Two basic types of electromechanical pen plotters are used in CAD/CAM systems. In flatbed plotters, servo-controlled pens or styli are moved in two axis over flat, stationary sheets of paper. In drum or roll plotters, pens, styli, or ink jets remain stationary or move along one axis while the paper moves in another axis on a revolving drum.

Pen plotters are used to produce colour, professional drawings. They will produce large size hardcopies and have high line quality. Pen plotters can also work with almost any media, including paper, mylar (милар — искусственная пленка), and film. They are best suited for applications requiring high-line resolution. (See Fig. 4.)

Photocopiers. Copiers typically use the so-called electrophotographic method, in which a beam of light projects an image from a CRT onto light-sensitive (светочувствительный) paper. These units are most appropriate for applications that require high-speed, high-resolution copier. Copiers are compact, inexpensive, and easy to operate. CRT copiers are most often used in preliminary (предварительный) work or for reference. Also in this class are video copiers, units that can copy an image appearing on a CAD/CAM terminal. Basically, a cable is run from the video output of a terminal to the copier. Pressing the button produces a copy of the images on the screen, commands and all. Some units have buffers so the terminal can be used during copying.

NOTES

1. **unless it can make hardcopies**—если она не может изготавливать печатные копии
2. **photocopier**—фотокопировальное устройство
3. **in terms of clarity and precision**—с точки зрения чистоты и точности
4. **in dots per inch or addressable points per inch**—в точках на дюйм или в адресуемых точках на дюйм
5. **primarily with regards to whether a hardcopy is black-and-white or colour**—главным образом относительно того, является ли печатная копия черно-белой или цветной
6. **highlight changes**—изменения в высвечивании информации на экране
7. **3D design**—трехмерное проектирование

14. Read Text B attentively. Make up a list of key words. Divide Text B into logical parts.

15. Find answers in Text B for the following questions:

1. When is a CAD/CAM system considered complete? 2. What equipment is used for producing hardcopies? 3. What is it necessary to know for determining the best hardcopy device for a particular CAD/CAM system application?

Write down the answers into your exercise-book.

16. Speak on the process of selecting a hardcopy device best suited for a CAD/CAM application. Begin with the words:

"In order to select a hardcopy device best suited for a CAD/CAM application, it is quite necessary to develop application requirements ... ."

17. Write an abstract of Text B (see p. 126) in English.

18. Look through Text C. Guess the subject-matter of it. Find the topic sentences of Text C. Write them down into your exercise-book.

TEXT C

In the past, CAD for electronic design was limited to automated drafting of printed circuit board (PCB) and integrated circuit (IC) production masks. More recently, however, CAD has been expanded to cover the entire range of tasks required to design and manufacture PCBs and ICs. These aids include analysis programs that help produce systems with a higher performance (характеристика) and reduce errors that have to be fixed after a product is manufactured.

Electronic design performed with CAD is typically done in a hierarchical process. This approach allows designers first to specify overall logic functions in terms of so-called behavioural models.[1] Software then helps generate architecture from these specifications. Such programs may also produce a physical layout based on design rules[2] of the selected IC or PCB design technology. Users work with the program interactively to synthesize logic functions and produce functional designs. With this process, several engineers can work on different parts of the logic simultaneously (одновременно) with coordination ensured by their high-level relationship.[3]

Workstations—graphics terminals combined with appreciable computing power—are typically used for all types of electronic design. Software residing (постоянно находиться) on these systems can handle most tasks involved in electronic design, including design capture,[4] analysis, and simulation. Often, the workstations are connected in a local area network to allow many users to share (распределять) expensive peripherals such as plotters, printers, and large mass memories. Engineers working on the same project can communicate among themselves, share information, and off-load highly analytical tasks to mainframes.

PCB are getting smaller but must hold an increasing number of complex ICs. Boards with a high density (плотность) of components present two problems to designers. First, tolerances (допуск) are so tight (жесткий) that even dimensional variations of tapes used to manually construct board artwork[5] can lower manufacturing. The other problem caused by small, densely populated boards is the time required to manually layout circuits, which can be prohibitive (запретный) for multi-layer boards.[6] These boards common to some computer systems are so complex that they cannot be made by anything but computer-aided methods.

CAD for PCBs is generally divided into two different areas: drafting and photoplotting, and full-board design with automatic placement and routing[7] in addition to drafting and photoplotting.

NOTES

1. **behavioural model** — поведенческая модель
2. **based on design rules** — основанная на правилах проектирования
3. **with coordination ensured by their high-level relationship** — и при этом координирование между ними будет обеспечиваться их взаимоотношениями на высоком уровне
4. **design capture** — сбор данных для проектирования
5. **used to manually construct board artwork** — используемые для ручного изготовления оригинала фотошаблона платы интегральной схемы
6. **multi-layer boards** — многослойные платы
7. **placement and routing** — размещение модулей больших интегральных схем и трассировка (между точками схемы)

19. Choose the title for Text C from those given below:

1. CAD systems. 2. Printed circuit boards. 3. Description of workstations. 4. CAD for electronic design. 5. CAD system software.

20. Read Text C again. Divide it into logical parts.

21. Say whether the following statements are true or false:

1. Nowadays, CAD systems cannot be used to design PCBs and ICs. 2. CAD/CAM systems used in electronic design reduce errors in manufactured products. 3. A hierarchical process is not used during manufacturing PCBs and ICs. 4. Software helps generate architecture from IC specifications. 5. Users cannot work with the program interactively to synthesize logic functions. 6. Several engineers can work on different parts of the logic simultaneously. 7. Workstations are not used for electronic design.

22. Using the chosen title and topic sentences from Text C, write a brief summary of it (see p. 126).

SUMMARY AND REVIEW TO UNITS 3 AND 4

1. Graphics-based systems are now often evaluated on the basis of how "friendly" these systems are to human beings when operating them.

2. The user constructs images or models by specifying points and lines on the CRT screen.

3. The model or image is a mathematical representation of the diagram or picture in the computer database.

4. The CRT screen is used by the operator in much the same manner as a drawing board.

5. Interactive graphics is used for speeding the design process and helps manufacturing.

6. The computer system choosing from a function menu specifies points and commands, constructs the lines and figures.

7. As interactive computer graphics increases design and drafting productivity, users can perform outline tasks more quickly and accurately compared with traditional methods.

8. Graphic terminals (raster-scan, vector-refresh, or storage-tube) produce images of the CRT screen.

9. The CRT principle consists of deflecting a finely-focused electron beam in a glass-enclosed tube onto a phosphor-coated screen, which then glows and produces a visible trace.

10. Resolution, colour, animation, and brightness are the characteristics of any CRT screen.

11. Resolution may be viewable or addressable. The difference between them consists in the fact that the first one indicates the level of sharpness displayed on the CRT screen and is limited by physical construction of the tube, while the second one refers to the amount of memory allocated for image description.

12. The number of horizontal and vertical pixels define the screen resolution.

13. Workstations consist of the three basic components: a primary processor and associated memory, a graphic display system, and software; they are divided into two categories (classes): low-end and high-end workstations.

14. Low-end workstation consists of a standard personal computer as a base and proprietary software.

15. High-end workstation contains more powerful hardware consisting of a high-resolution graphic display (512×512 pixels), a processor capable of performing up to 2.0 million instructions per second, 1 Mbyte of main memory, mass storage up to 50 Mbytes, the ability to operate in a computer network with other workstations or host computers.

16. Workstations can act as dedicated stand-alone processors for certain design or analysis tasks or as front-ends or large host computers.

17. Data entry devices may be of several types used as graphic inputs in CAD/CAM systems. They are: keyboards with buttons, lightpens, joysticks, trackballs, mice, digitizer tablets, and voice data entry devices.

18. A CAD/CAM system is not complete if it cannot make hardcopies, which can be produced by the following equipment: graphic printers, pen plotters and photocopiers.

All of them produce high-quality drawings and different documentation.

19. The digitizer tablet is used for converting graphic data into digital data so that the computer can accept and process it.

20. The processor is the "brain" of the computer-aided design system. It has a control unit and arithmetic/logic unit like all CPUs, but it also has special design features for handling the various types of graphic data associated with design.

SELF-TEST

1. Indicate whether each of the following statements is true or false:

a) The CRT workstation is the primary device in a CAD system. b) The processing unit is the "brain" of a CAD system. c) A hardcopy output is used primarily as an input device in a CAD system. d) The plotter converts digital data back into graphic form so that they can be used by human beings. e) Workstations cannot act as dedicated stand-alone processors for certain design or analysis tasks. f) Resolution, animation, colour and brightness are the characteristics of any CRT screen. g) Interactive graphics is not used for speeding the design process, on the contrary, the manual drafting speeds it.

2. Define the term "resolution". 3. Define the term "menu". 4. What are graphic input devices used for? 5. What types of graphic entry devices do CAD/CAM systems use? 6. What components does interactive graphic hardware consist of? 7. Name two classes of engineering workstations. 8. List the basic components that make up a complete workstation. 9. Define the term "hardcopy". 10. Explain how the plotter actually plots a line in a CAD system. 11. What is the purpose of the digitizer tablet? 12. How do operators enter the data into a computer?

UNIT 5

Text A. Geometric Modelling in CAD/CAM. Text B. Text C.

EXERCISES

1. Recognize the following international words:

geometry, geometric, structure, stress, location, to differentiate, object, physical, interpretation, section, to generate, parallel, perpendicular, tangent, critical, detail, tabulated, cylinder, sculptured, representation, contour, elementary, cube, sphere, primitive, nature, natural, moment, block, combination, family, axial, symmetry, specific, classical, characteristic, matrix, realistically, commercial, static, constant, material, elastic, plastic, deformation, vibration, dynamic, experimental, harmonic, sinusoidal, structural, history

2. Practise the reading of the words given below:

finite ['faınaıt] конечный
wire-frame ['waıəfreım] каркасный (скелетный)
precise [prı'saıs] точный
surface ['sə:fıs] поверхность
discontinuity ['dıs,kɔntı'nju:ıtı] неоднородность
ambiguous [æm'bıgjuəs] неоднозначный
space [speıs] пространство
comprise [kəm'praız] *v* включать
straight [streıt] прямой
tangent ['tændʒənt] касательная
curve [kə:v] кривая
circle ['sə:kl] окружность
circumference [sə'kʌmfərəns] окружность
hyperbola [haı'pə:bələ] гипербола
spline [splaın] сплайн
arbitrary ['ɑ:bıtrərı] произвольный
boundary ['baundərı] граница
envelope ['envıloup] огибающая (линия)
sweep [swi:p] изогнутый
solid ['sɔlıd] твердое (объемное) тело
expose [ıks'pouz] *v* выявлять
successive [sək'sesıv] последовательный
contour ['kɔntuə] контур

3. Memorize the following word combinations:

finite-element analysis метод конечных элементов
wire-frame models каркасные (скелетные) модели
surface discontinuities неоднородности поверхности
straight lines прямые линии
curved lines кривые линии
arbitrary points произвольные точки
surface menus меню поверхностей
solid models модели твердых (объемных) тел
part geometry геометрия детали
elementary shapes элементарные очертания
two (three)-dimensional surfaces двух (трех) мерные поверхности

4. Look through Text A. List its main points.

TEXT A. GEOMETRIC MODELLING IN CAD/CAM

The most important feature of CAD/CAM is the geometric model, representing part size and shape in the computer. These models are the starting point for virtually (фактически) every function in CAD/CAM. For example, the geometric model may be used to create a finite-element model of the structure for stress (напряжение) analysis, or it may serve as input for automated drafting. In CAD/CAM, the geometric model can be used to create numerical control (NC) tapes[1] for making parts on automated machine tools (станок) or to produce process plans outlining steps required to make the part.

Wire Frames. Wire-frame models are generally part shapes with interconnected line elements. Wire frames represent the simplest models. Consequently, they expend relatively little computer time and memory, and they provide precise information about the location of surface discontinuities of the part. Wire frames, however, contain no information about the surface themselves nor do they differentiate between the inside and outside of objects. Thus, wire frames can be ambiguous in representing complex physical structures and often leave much interpretation to users.

Wire-frame models are created by specifying points and lines in space. To create the model, the interactive terminal screen is usually divided into sections showing various views of the model. Some systems use only a single view with a movable work place on which points and lines lie.

The designer uses the CRT in much the same manner as a drawing board to create top, bottom, side, isometric, and other views of the model. Unlike mechanical drafting systems, however, CAD systems provide many features to speed design. Essentially, the designer need not manually draw each line in a wire frame. Rather, the CAD system constructs the lines based on user-specified points and commands[2] chosen from an instruction menu.

Most lines comprising a wire-frame model are straight. To generate a line, the user may designate two end points and give the computer a LINE command. Or a line may be automatically produced parallel or perpendicular to another line or tangent to a curve. Some CAD systems produce straight-line elements with up to 40 such techniques.

Similar automatic features can also produce curved lines. Circles may be produced by specifying a point and a radius, three points on a circumference, or tangent points to two or three other curves. And conics—complex curves such as ellipses, hyperbolas, and parabolas—may be produced by specifying appropriate points. Most CAD systems can also generate splines—smooth, continuous curves fit through a series of arbitrary points specified by the user.

Surface Models. Many ambiguities of wire-frame models are overcome with surface models, which define the outside part geometries precisely and help produce NC machining instructions where the definition of structure boundaries is critical. However, surface models represent only an envelope of part geometry, even though features such as automatic hidden-line removal [3] make the model appear as a solid.

Surface models are created by connecting various types of surface elements to user-specified lines. The entire model may be comprised of different types of interconnected surfaces. With surface modelling, however, an entire structure may provide more detail than necessary for many applications, so some models combine surfaces for detailed faces, with wire frames representing the rest of the part.

CAD systems provide extensive surface menus from which to model. Typical surface menus include planes, ruled surfaces, surfaces of revolution, along with (вместе с) sweep, fillet (линейчатый), and sculptured surfaces.

Solid Modelling. Solid models are the highest level of models, completely defining the external and internal geometry of a part. This approach uses combinations of elementary cubes, spheres, and other so-called primitives to create complex models. Although (хотя) solid models may appear to be similar to wire-frame or surface models with hidden lines removed, solid models allow the solid nature of an object to be represented in the computer. As a result, computations of parameters such as weights (вес) and moments (крутящий момент) are possible. And cross-sections, which are usually crosshatched (заштриховывать), can be cut through the model to expose internal details with minimal user interaction.

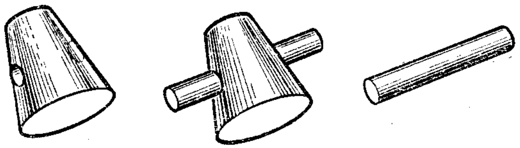

Fig. 5

Solid models are constructed in two ways: with primitives or with boundary definition. [4] Both of these methods develop complex geometries from successive combinations of simple geometric operations.

In the primitive approach, elementary shapes such as blocks and cylinders are combined in building-block fashion. [5] The user positions these primitives as required and then creates a new shape with the proper Boolean logic command (union, difference, or intersection).[6] (Figure 5)

With boundary definition, two-dimensional surfaces are swept through space to trace out volumes.[7] A linear sweep translates the surface in a straight line to produce an extruded (путем выдавливания) volume, etc.

Most industrial parts, for example, consist of planar, cylindrical, or other simple shapes and are readily (просто) modeled with primitives. But components with complex contours, such as automobile body, or turbine blades, or shiphulls, which are 3D, are easily modeled by boundary definition. In this case, arbitrary curves can be fit to a mathematical function known as a cubic spline, or cubic (bicubic) basic spline (B-spline function).[8]

NOTES

1. **to create numerical control (NC) tapes** — для создания перфолент числового программного управления (ЧПУ)
2. **based on user-specified points and commands** — основанные на точках и командах, конкретно указанных пользователем
3. **hidden-line removal** — удаление скрытых линий
4. **with primitives or with boundary definition** — с помощью базисных элементов или с помощью задания координат границ тела
5. **in building-block fashion** — блочным способом
6. **with the proper Boolean logic command (union, difference, or intersection)** — путем соответствующей команды Булевой логики (объединение, разность или пересечение)
7. **to trace out volumes** — для вычерчивания объемов
8. **or cubic (bicubic) basic spline (B-spline function)** — или кубический (бикубический) базисный сплайн (Б-сплайновая функция)

5. Find the Russian equivalents to the following English words and word combinations:

a) 1. external and internal geometry; 2. surface models; 3. NC machining instructions; 4. arbitrary points; 5. complex curves; 6. wire-frame models; 7. interconnected surfaces; 8. extensive surface menus; 9. the rest of the part; 10. solid models; 11. virtually; 12. machine tools; 13. interconnected line elements; 14. surface discontinuities; 15. ambiguity; 16. an isometric view; 17. similar; 18. several; 19. although; 20. even though; 21. along with; 22. a mathematical approach; 23. elementary cubes; 24. hidden lines; 25. cross-sections; 26. to crosshatch; 27. to expose; 28. boundary definition; 29. the Boolean logic command; 30. volume; 31. shiphulls; 32. complex contours; 33. a cubic basic spline; 34. an envelope

b) 1. токарные станки; 2. в действительности; 3. взаимосвязанные поверхности; 4. расширенные меню поверхностей; 5. вместе с; 6. элементарные кубы; 7. команда Булевой логики; 8. кубический базисный сплайн; 9. огибающая кривая; 10. скрытые линии; 11. внешняя и внутренняя геометрия (детали); 12. контурная настройка; 13. математический подход; 14. оставшаяся часть детали; 15. машинные команды для ЧПУ; 16. поверхностные неоднородности; 17. модели поверхностей; 18. произвольные точки; 19. модели твердых (геометрических) тел; 20. взаимосвязанные элементы линий; 21. подобный; 22. поперечные сечения; 23. сложные контуры; 24. объем; 25. оставлять открытыми (экспонировать); 26. несколько; 27. даже если; 28. неопределенность; 29. корпуса кораблей; 30. заштриховывать; 31. хотя; 32. каркасные (скелетные) модели; 33. изометрический вид (проекция); 34. сложные кривые

6. Memorize the words the meanings of which are often mixed:

single—signal, some—same, then—than, also—always—almost, principle—principal, quite—quiet, since—science

single один, единый—**a signal** сигнал
some некоторый, несколько—**(the) same** тот же самый
then затем, тогда—**than** чем
also также—**always** всегда—**almost** почти
principle принцип—**principal** главный
quite [kwaɪt] совершенно, полностью—**quiet** ['kwaɪət] тихий, бесшумный
since [sɪns] так как, с, с тех пор—**science** ['saɪəns] наука

7. Translate the following definitions and memorize the terms which they describe:

Display is a device for visual mapping (отображение) of output results for the operator or the user, which are received from a computer. Such devices are designed so that they are able to provide time visual mapping of graphical and/or alphanumeric (буквенно-цифровая) information. Examples of displays are cathode-ray tubes (CRT) or light-emitting diodes (LED) (светоизлучающий диод).

Model is mathematical representation of a device or process. Models which can be manipulated by computers are sets of equations which represent some condition or set of operations in the real world. Models are used for analysis and planning purposes.

Modelling is simulating a condition with the use of a model. Modelling simulates an activity by performing a set of equations on a set of data.

Geometry is science of properties and relations of lines, angles, surfaces and solids.

Process means to manipulate information. Processing is any action taken on information in a computer. Processing can mean: (1) any work done by the computer system, or (2) just the work done internally on the information by the computer.

8. Read Text A attentively. Divide it into logical parts.

9. List the key words and the topic sentences from Text A.

10. Choose the suitable title for each logical part from those given below:

A. 1. Outlining steps. 2. The most important feature of CAD/CAM. 3. Finite-element models. 4. Numerical control tapes.

B. 1. Computer's time and memory. 2. The simplest models. 3. Surface discontinuities. 4. Representation of wire-frame models.

C. 1. Ambiguities of wire-frame models. 2. The structure boundaries definition. 3. Surface modelling. 4. An automatic hidden-line removal.

D. 1. The highest model level—solid models. 2. Constructing solid models with primitives. 3. Simple shapes in models. 4. Constructing solid models with boundary definition.

11. Check up yourself how much you have memorized from Text A.

a) Complete the following sentences:

1. The most important feature of CAD/CAM is (the starting point, the part size and shape, the geometric model). 2. Wire frames represent (computer time, the simplest model, precise information). 3. Wire-frames models are created by specifying points and lines (in space, in sections, in views). 4. Surface models are created (by modifying, by simplifying, by connecting) various types of surface elements. 5. Components of different machines with complex (conditions, descriptions, contours) are easily modeled by boundary (position, definition, construction).

b) Say what two approaches are used in constructing solid models. c) Compare wire-frame and solid models. d) Name components with complex contours of some industrial parts. e) Recall which models solid models resemble. f) Explain with your own words the notion (понятие) "hidden lines removed".

12. **Write an abstract of Text A in English (see p. 126).**

13. **Look through Text B. List its main points.**

TEXT B

Surface models are of different types. The plane is the most basic surface type. The system merely (просто) creates a flat plane between two user-specified straight lines. The tabulated cylinder is the projection of a free-form curve into the third dimension. Basically, this is a curved plane between two arbitrary parallel curves. A ruled surface is produced between two different edge curves. The effect is a surface generated by moving a straight line through space with the end-points resting on the edge curves. A surface of revolution is created by revolving an arbitrary curve in a circle about an axis. The sweep surface is an extension

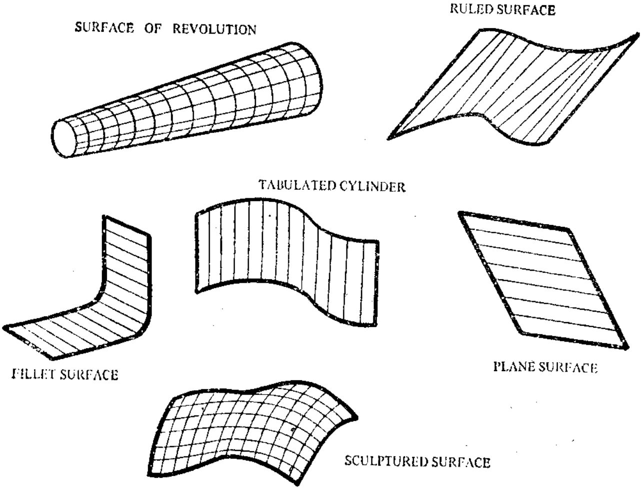

Fig. 6

(удлинение) of the surface of revolution. Sweep surfaces, however, sweep an arbitrary curve through another arbitrary curve instead of a circle. The fillet surface is a cylindrical surface connecting two other surfaces in a smooth transition. This is a tedious (утомительный) operation that has been done manually in industry for years. But CAD systems quickly solve the problem of blending surfaces (поверхность смещения) with the precise mathematical continuity required by many applications. Sculptured surfaces represent the most general surface representation. A sculptured surface is a differential surface created from two families of curves. These families are not restricted (ограничивать) to being orthogonal, nor are the curve types fixed. Curves need not even be parallel. The two curve families intersect (пересекать) one another in criss-cross (крест-накрест) fashion. Sculptured surfaces are complex contours that cannot be described with the usual lines and curves of conventional modelling. Typical structures containing such contours range from helicopter blades and automobile bodies to camera cases and glass bottles. (Fig. 6)

14. Read Text B attentively. Divide it into the paragraphs and logical parts. Choose the title to Text B from those given below:

1. Sculptured surfaces. 2. Sweep and fillet surfaces. 3. Different surface model types. 4. Ruled surfaces.

15. Read Text B again and answer the question:

Why cannot sculptured surfaces be described with the usual lines and curves of conventional modelling?

16. Speak on sculptured surfaces. Begin with the words:

"As sculptured surfaces represent the most general group of surfaces, they are differential surfaces ... ."

17. Look through Text C. Guess the subject-matter of the text to be read. Write it down into your exercise-book. Give the title to Text C.

TEXT C

1. Finite-element analysis (FEA) is a computer-based technique for determining stresses and deflections[1] in a structure too complex for classical analysis. Essentially, the method divides a structure into small elements with easily defined stress and deflection characteristics. The finite-element method is based on arrays (массив) of large matrix equations that can only be realistically solved by computer. Most often, FEA is performed with business programs. In many cases, these programs require that the user only knows how to prepare a program input.

2. The finite-element method is applicable in several types of analyses. The most common is static analysis, which solves deflections, strains (деформация), and stresses in a structure under a constant set of applied loads. The material is generally assumed to be linearly elastic, but special cases such as plastic deformation, creep (ползучесть), large de-

flections, and stress stiffening can be handled in some moments.

3. Natural frequency (частота) analysis calculates the free vibration natural frequencies and associated mode shapes of a structure.[2] This analysis predicts critical operating conditions for machinery and is used in conjunction with experimental analysis.

4. Transient dynamic analysis[3] determines the time-response history[4] of a structure subjected to a forced displacement function.[5] The structure may behave linearly, or in some cases, friction (трение), plasticity, large deflections, or gaps (зазор) may produce nonlinear behaviour. Once the time-response history is known, complete deflection and stress information can be obtained for specific times. A similar method is forced under harmonic response analysis, which calculates the steady-state response of a structure to a continuous set of sinusoidal loadings. Complex displacements and phase angles are calculated. Deflections and stresses may again be calculated at specific times.

5. Heat transfer analysis[6] can solve steady-state and transient heat transfer problems. In most cases, thermal output data are applied as input to a structural analysis program to determine thermal deflections and stresses.

6. The first step in finite-element analysis is creation of a model that breaks a structure into simple standardized shapes or by a common coordinate grid (сетка) system. The coordinate points called nodes (узел) are locations in the model where output data are taken.

NOTES

1. **for determining stresses and deflections** — для определения напряжений и отклонений
2. **the free vibration natural frequencies and associated mode shapes of a structure** — собственные частоты при свободном вращении и связанные с ними наиболее вероятные очертания структуры
3. **transient dynamic analysis** — динамический анализ переходных процессов
4. **the time-response history** — описание временнóй характеристики
5. **subjected to a forced displacement function** — находящейся под воздействием функции смещения
6. **heat transfer analysis** — анализ процесса передачи тепла

18. Read Text C again. Find all international words in it, write them down into your exercise-book.

19. Translate the second, third and sixth paragraphs in writing.

UNIT 6

Text A. CAD Software. Text B. Database Management System. Text C. Text D. Text E. Text F.

EXERCISES

1. Practise the reading of the following words:

reference ['refrəns] справочный, эталонный
tutorial [tju:'tɔ:rɪəl] консультационный
tailor ['teɪlə] *v* рассчитывать; подгонять
jointly ['dʒɔɪntlɪ] совместно
deliver [dɪ'lɪvə] *v* поставлять, доставлять
modifiable ['mɔdɪfaɪəbl] поддающийся изменению
available [ə'veɪləbl] доступный
avoid [ə'vɔɪd] *v* избегать
assignment [ə'saɪnmənt] предназначение
immediately [ɪ'mi:djətlɪ] немедленно, сразу
broaden ['brɔ:dn] *v* расширять
facilities [fə'sɪlɪtɪz] средства
support [sə'pɔ:t] обеспечение, поддержка
procedure [prə'si:dʒə] процедура
decision [dɪ'sɪʒən] решение
imply [ɪm'plaɪ] *v* означать
authorize ['ɔ:θəraɪz] *v* санкционировать
request [rɪ'kwest] запрос
access ['ækses] доступ
maintain [men'teɪn] *v* обслуживать
environment [ɪn'vaɪərənmənt] (вычислительные) средства, окружающее оборудование

2. Memorize the following word combinations:

general-purpose programs универсальные (общесистемные) программы
special-purpose programs специализированные программы
reference manuals справочные руководства
off-the-shelf software готовое программное обеспечение
stock programs запасные (резервные) программы
base (kernel) software базовое программное обеспечение (ПО)
applied (special) software прикладное ПО
a mathematical support математическое обеспечение
application packages пакеты прикладных программ (ППП)
storage media накопители
reference information справочная информация
design decisions проектные решения
database management system система управления базой данных (СУБД)

3. Look through Text A. List the main ideas of it.

TEXT A. CAD SOFTWARE

CAD software provided by manufacturers includes all general-purpose programs and application programs needed to operate the system. The application programs consist of all operating, utility, and graphics programs. Several sets of reference manuals and other tutorial material on software are also often supplied. Generally, software is tailored to user's applications.

A set of off-the-shelf software is selected jointly by the user and manufacturer from a list of stock programs. This software generally is delivered in object (working) form and not in source (modifiable) form, although some manufacturers make both types available.

Special-purpose software is usually not provided by the manufacturer. These programs may depend on a user's application, and most manufacturers avoid such programming assignments. For example, special-purpose programs to create families of parts are normally developed by users, after the system is delivered. This type of software is not immediately essential but makes the system more convenient (удобный) to use or broadens capabilities.

CAD software is divided into general system software, kernel software and applied (special) software. The first one is used for organizing technical facility functioning, i. e. for planning and computing process controlling, allocating resources available. It is represented by operating systems of computers, and is not used in CAD systems.

Kernel and applied (special) softwares are especially created for CAD. The kernel software contains all programs intended for correct functioning application programs. In the applied software, a mathematical support for direct performing design procedures is realized. It is usually given in the form of application packages, each of which provides service to a certain stage of the design process.

CAD software also combines different data which are necessary for performing an automated design. These may be represented in the form of various documents on various storage media, which contain reference information of materials, standard (типовой) design decisions, component parameters, current information about intermediate and final design decisions, structure and dimensions of designed objects, etc.

The basic part of CAD software is a data bank representing the set of facilities for centralized accumulating and using the data. The data bank is simply electronic depository (хранилище) of data. The data bank consists of a database and a database management system (DBMS).

Technically, a database is an electronic organization of data and information organized and maintained by a database management system. A database implies integration of data across the entire environment that it serves. It also implies central control of data for consistency (согласованность) and accuracy, with users having authorized access to them.

The data/information stored in a database depends on the functions of its organization. The database structure into which the data are designed (hierarchical, network,[1] relational,[2] etc.) depends on the volume and frequency of the daily transactions and management's requirements[3] for information. Database design is often a compromise between operational requirements for efficient daily transaction processing and management's requirements for queries and reports.[4]

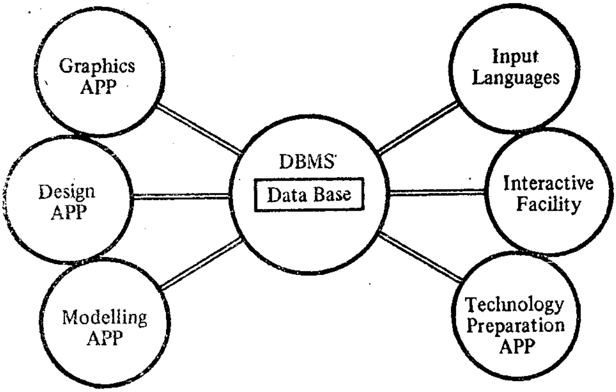

Fig. 7

The DBMS is the set of programming aids (средство) providing data banks functioning. By the DBMS data recording is performed to data banks; fetching (вызов) them according to users' requests; data protection from errors and from an unauthorized access is provided, etc. (See Fig. 7)

Programming languages used in CAD systems are the same languages used in computing systems intended for writing software. They are manufacturers' aids. There are a great deal of high-level programming languages, but nowadays it is the FORTRAN language which is the most usable and widespread in CAD systems. FORTRAN is used for numerical analysis object programs.[5] However, for the most complex descriptions of logical character programs, such as monitors and language processors,[6] either assembly language or PL/1, PASCAL, ADA, and C languages are used. The latter four languages are considered to be the high-level programmer(manufacturer)-oriented languages.

Design languages are languages intended for describing information about designed objects and designed tasks. Most of them are related to users' aids of CAD/CAM systems. Among them there are input (source), object (target), debugging and correcting, control, intermediate, and internal languages. All of them are divided into object description languages and job description languages, which in turn are subdivided into circuit, graphics, modelling languages and at last universal intermediate languages. (See Fig. 8)

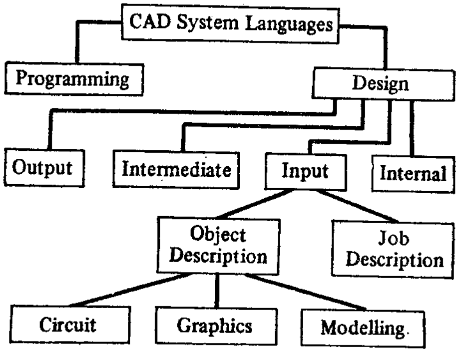

Fig. 8

There are also procedural and non-procedural languages in CAD systems. The first ones are intended for description of processes evolving during the course of time. The second ones are intended for description of designed object structures. As a rule, for CAD users non-procedural languages are more convenient, as by them an initial diagram or drawing is described, and a user needs only keep the language rules without worrying about modelling algorithm development.[7]

Conversational (interactive or dialogue) modes (режим) of the user/computer work are of great importance for CAD systems. They are named interactive languages and serve for an operative information exchange between man and computer. These languages may be used in passive and active modes. In the passive modes the dialogue initiative belongs to a computer. In the active one the dialogue initiative may be twofold—interruptions (прерывание) possibilities are at both a computer and a user. The active conversational languages are close to natural man languages, but with a limited set of possible words and phrases. For the active dialogue a substantially complex software is required than for the passive one.

NOTES

1. **network** — сетевой
2. **relational** — родственный
3. **of the daily transactions and management's requirements** — повседневных транзакций (групповых операций) и требований к управлению
4. **queries and reports** — запросы и сообщения
5. **for numerical analysis object programs** — для объектных программ численного анализа
6. **monitors and language processors** — мониторы и языковые процессоры
7. **a user needs only keep the language rules without worrying about modelling algorithm development** — пользователю нужно лишь соблюдать языковые правила, не беспокоясь о составлении алгоритмов моделирования

4. Read Text A attentively. Divide it into logical parts.

5. Make up a list of the key words and the topic sentences. Write them down into your exercise-book.

6. Choose the suitable title for each logical part from those given below:

A. 1. Application programs. 2. General-purpose programs. 3. Reference manuals. 4. Types of software programs.

B. 1. A user's application. 2. Programming assignments. 3. Special-purpose programs. 4. The more convenient system.

C. 1. General system software. 2. Software types. 3. Kernel software. 4. Applied (special) software.

D. 1. Different data for an automated design. 2. An automated design. 3. Standard design decisions. 4. Reference information.

E. 1. CAD facilities. 2. Electronic depository. 3. Centralized accumulation. 4. A data bank.

F. 1. An electronic organization. 2. Integration of data. 3. A database design. 4. The daily transactions.

G. 1. Programming aids. 2. Database management systems. 3. Data recording. 4. Data protection.

H. 1. Programming languages in CAD systems. 2. FORTRAN. 3. PL/I. 4. The high-level manufacturer-oriented languages.

I. 1. Aids of CAD/CAM systems. 2. Debugging and correcting language. 3. Design languages in CAD/CAM systems. 4. An input language.

J. 1. Description of drawings. 2. Initial diagrams. 3. CAD user languages. 4. Procedural and non-procedural languages.

K. 1. The active and passive interactive languages. 2. An operative information exchange. 3. The dialogue initiative. 4. Interruption possibilities.

7. Write an abstract of Text A in Russian (see p. 126).

8. Look through Text B and say whether the subject-matter of it is "A description of the DBMS".

TEXT B. DATABASE MANAGEMENT SYSTEM (DBMS)

A database management system is software that organizes and retrieves data in a database. A DBMS makes it easier to access all varieties of data/information stored in a computer. It allows users to request data the way they see it rather than the way the computer sees it. The DBMS is a software package which acts as an interface between the user's programs and the physical database. The DBMS allows for the organization of non-redundant (незарезервированный) data in the database. It keeps track of all the data and allows each user to have an individual view of the data. The user's application program asks the DBMS to select that user's view and deliver it to the program (user). Only the DBMS knows where and how to get it. The DBMS acts as a buffer between the programs and the physical structure of the database. Selection of a DBMS can be critical. Since much of the organization's data will be placed into the database, the processing time required to access the database must be carefully (тщательно) evaluated. A data model is first developed which defines the data and their logical relationships with other data. Then the transaction activity that will be processed against this database is evaluated. The resulting selection is the DBMS that will manage (управлять). A portion of the DBMS resides in memory and is called upon (вызывать) by the application program each time data must be transferred to or from the database. Main features of a DBMS are the following: **data independence.** The application programs are not concerned with the location of any data they use. Advanced DBMSs[1] use data dictionaries and non-procedural languages, which may mean that no changes are required in the programs when a structural change to data is made. **Security.** The DBMS can test for user authorization at the application program level, subschema level, or field level, depending on the DBMS. **On-line query.**[2] An interactive query capability allows users access to their data using a query language. **Application development language.**[3] A high-level non-procedural language developed around the DBMS may allow programmers and users to develop application programs faster than with conventional (традиционный) programming languages.

NOTES

1. **advanced DBMSs** — СУБД с улучшенными свойствами
2. **on-line query** — неавтономный запрос (запрос от основного оборудования вычислительной системы)
3. **application development language** — непроцедурный язык высокого уровня, позволяющий программисту составлять прикладные программы

9. Read Text B attentively. Divide it into paragraphs.

10. List the main features of a DBMS in the following way:

"The main features of a DBMS are the following: (1) data independence, (2) . . . ."

Write them down into your exercise-book.

11. Analyse and translate the following sentences from Text B:

1. It allows users to request data the way they see it rather than the way the computer sees it. 2. A portion of the DBMS resides in memory and is called upon by the application program each time data must be transferred to or from the database.

Write down the translation of the sentences above into your exercise-book.

12. Write a brief summary of Text B (see p. 126).

13. Analyse the text below and the translation given. Practise the oral back translation. Give the title to the text.

TEXT C	ТЕКСТ C
In 1956, an artificial language, FORTRAN, was created as a hybrid of English and mathematics and a program was written to translate statements in the FORTRAN language into instructions for a computer.	В 1956 г. появился искусственный язык ФОРТРАН, который можно рассматривать как некоторый гибрид английского языка и системы математических обозначений. Была разработана программа перевода предло-

Subsequently, similar programs have been made available for almost all computers.

The word FORTRAN is contracted from FORmula TRANslator.

A dictionary definition of the adjective FORTRAN might be as follows: FORTRAN. Of or pertaining to:

1) any dialect of the English language; 2) a program called a source program for the solution of any problem which is written in the FORTRAN language; 3) a machine language program called a compiler, the input to which is a FORTRAN source program and the output of which is an equivalent machine language; 4) a machine language program produced by the FORTRAN compiler called an object program; 5) any special coding forms, special card designs, etc. intended to be used in the preparation of a FORTRAN program.

As a noun FORTRAN is used to stand for the FOR-

жений, записанных на языке ФОРТРАН, в команды для вычислительной машины.

В дальнейшем аналогичные программы были разработаны почти для всех типов вычислительных машин.

Слово «ФОРТРАН» образовано из начальных слогов двух английских слов "FORmula TRANslator" (переводчик формул).

Если попытаться дать определение термина «ФОРТРАН», как это делается в словаре, то окажется, что с ним связаны:

1) любой диалект английского языка; 2) программа, называемая исходной программой решения любой задачи, которая написана на языке ФОРТРАН; 3) программа на машинном языке, называемая компилятором, по отношению к которой входными данными является исходная программа на ФОРТРАНе, а выходными — эквивалентная программа на машинном языке; 4) программа на машинном языке, полученная после обработки исходной программы компилятором ФОРТРАНа и называемая объектной программой; 5) специальные бланки (или формы), специальные карты и т. п., употребляемые при подготовке программ на ФОРТРАНе.

Слово ФОРТРАН как существительное обозначает

TRAN language; thus we say that a program is written in FORTRAN if it is written in the FORTRAN language.

One of the main features of the FORTRAN language is that it is relatively free of dependence on any particular computer; because of this FORTRAN is said to be a machine-independent programming language.

FORTRAN, like any other living language, has evolved over the years. The version in common use today is FORTRAN-IV.

Two FORTRAN compilers are available: FORTRAN-IV (also called H-level FORTRAN) and Basic FORTRAN. H-level FORTRAN requires a computer with at least 256 K core. Basic FORTRAN comes in five versions to match the following supervisors: OS-E level (32 K), TOS (16 K), DOS (16 K), Tape BPS (16 K), and Card BPS (16 K).

Programming languages are similar to ordinary spoken and written languages

язык ФОРТРАН. Поэтому говорят, что программа составлена на ФОРТРАНе, если она написана на языке ФОРТРАН.

Одной из важнейших особенностей языка ФОРТРАН является то обстоятельство, что он относительно свободен от специфики конкретной вычислительной машины. В связи с этим говорят, что ФОРТРАН является машинно-независимым языком программирования.

Подобно любому другому существующему языку ФОРТРАН эволюционировал в последние несколько лет. Вариантом языка, используемым повсеместно на сегодняшний день, является ФОРТРАН-IV.

Компилятор для ФОРТРАНа-IV существует в двух вариантах. Вариант, требующий память объемом 256 Кбайт (уровень Н), и вариант Basic ФОРТРАН. Компилятор для Basic ФОРТРАН предусматривается в пяти вариантах соответственно для следующих супервизоров: операционная система (OS) уровня Е (32 К), ленточная OS (16 К), дисковая OS (16 К), базовое программное обеспечение (BPS) на ленте (16 К), базовое программное обеспечение (BPS) на картах (16 К).

Языки программирования аналогичны обычным разговорным и письменным in that they gradually develop and change with time, i. e., new language versions appear.

языкам в том отношении, что они постепенно совершенствуются и со временем подвергаются некоторым изменениям, т. е. появляются новые версии языка.

14. Look through Texts D, E, F and say to what parts of scientific papers they belong (introduction, summary, abstract).

TEXT D

A CAD/CAM system for the design of ship hulls and the production of their models is described. The design portion of the system is implemented on and supported by a three dimensional interactive graphics device and a microcomputer. The hull surface is modeled using B-spline surfaces. The use of a fast incremental algorithm for modifying these surfaces dynamically in real time is described for real ships. A simple algorithm for obtaining accurate sections or contours of B-spline surface is represented. Its use on real ship hulls in a model production environment is considered.

The paper is of interest for graphics designers and engineers.

TEXT E

Engineers have long been aware of the computer's enormous capability analysing a wide range of engineering problems. Many programs have been developed for engineering purposes. Nevertheless, not all the programs have been widely accepted by the engineers. The main obstacles to the acceptance of the CAD systems are probably due to the design engineers' reluctance to learn sufficiently the input data definitions and to prepare the usually tedious and error-prone data.

Conventional simulation systems usually accept data cards of the design, while drafting a design is a graphical process in its nature. In a typical process, the designer must transcribe the design from a graphical draft into data cards, errors are often made. Moreover, since alphanumeric strings cannot be so immediately understood as the design draft, errors in the data cards are usually less detectable than in the design draft.

Providing an easy-to-use interactive graphic processor to collect the design data graphically for the simulation systems seems to be a good approach to solve the above-mentioned problems.

A graphic processor will let the designer graphically create and edit his design draft. Utility programs should also be provided. After a designer has completed his design draft, he can use the utility program to extract the required design information for the following simulation system. For example, a CAD/CAM system for the Norwegian electronic industry collects the design information graphically, and transmits the collected information to the simulation system through an input translation utility program.

TEXT F

Compared with business applications, database concept was not widely accepted in engineering applications. Currently available are rather independent programs such as engineering calculations and analysis programs, and turnkey computer-aided design (CAD) systems which emphasize drawing. In recent years, however, active efforts have been made to build integrated design support systems. Engineering databases play a key role for integration. Three types of data are included in engineering databases: geometric data, engineering data, and administration data. Engineering data include several kinds of data such as design results and maintenance histories of completed products, design data for products being designed, reliability data, and design standards. It is accessed in a trial and error manner by engineers and has been least integrated into databases.

By retrieving and calculating engineering data produced are design documents which are the most important output of designers as well as drawings. In the paper, we describe the features of design documents and the architecture of a design document generation support system.

15. Read Text E again. Find key words in it. Write them down into your exercise-book.

16. Make up a plan of Text E and render it according to the plan with your own words in Russian.

SUMMARY AND REVIEW TO UNITS 5 AND 6

1. The geometric model is the most important feature of CAD/CAM, because it represents the part size and shape in the computer. It can also be used for creation of numer-

ical control (NC) tapes to make parts on automated machine tools or for producing process plans outlining steps required to make the part.

2. Geometric models may be represented as wire frames, surface models, and solid models, which are the highest level of models. The latter use combinations of elementary cubes, straight lines, cylinders, etc., which are called primitives. As a result, we have rather simple industrial parts.

3. When it is necessary to design industrial parts with complex contours (automobile bodies, turbine blades, ship hulls, etc.), i. e., 3D parts, we have to use the boundary definition.

4. Finite-element analysis is a computer-based technique for determining stresses and deflections in a structure too complex for classical analysis. Under this method a structure is divided into small elements with easily defined stress and deflection characteristics. The finite-element method (analysis) is mostly used with business programs.

5. The first step in finite-element analysis is creation of a model by breaking a structure into simple standardized shapes or by a common coordinate grid system. The coordinate points called nodes are locations in the model.

6. Splines are named from the devices used by draftsmen (чертежник) to draw curves. A physical spline is used much like a French curve (лекало) to draw a smooth curve between specified data points. It is held in place by attaching lead weights (свинцовый грузик). By varying the number and position of the weights, the spline can be forced to pass through the specified data points. The physical spline is considered to be a thin elastic beam (рейка). A mathematical spline is described by the cubic polynomial and it has continuity of the 2nd degree.

7. CAD software which is provided by manufacturers includes all general-purpose programs and application programs.

8. The application programs contain operating, utility and graphics programs, reference manuals, and tutorial material on software.

9. CAD software is selected jointly by the user and manufacturer from a list of stock programs.

10. Special-purpose software is not provided by manufacturer because it is developed by a user after the system is delivered.

11. CAD software is divided into general system soft-

ware, kernel software, and applied (special) software. The first one is not used in CAD systems.

12. Kernel software and application software are created for CAD. The former includes all programs designed for correct functioning application programs. The latter provides a mathematical support for direct service of the design process and is usually given in the form of application packages.

13. CAD software includes also various documents on materials, standard design decisions, component parameters, current information of intermediate and final design decisions, structure and dimensions of designed objects, etc.

14. A data bank is the basic part of CAD software. It is simply electronic depository of data and consists of a database and a DBMS. A database is an electronic organization of data and information which is maintained by a DBMS. It implies integration of data across the environment that it serves. The data and information which are stored in a database depend on the function of its organization.

15. The DBMS provides data banks functioning. With the help of it data recording, fetching, data protection from errors and an unauthorized access are provided. The DBMS is a software package which acts as an interface between the user's programs and the physical database.

16. A portion of the DBMS resides in a computer's memory and is called upon by application program. Main features of a DBMS are: data independence, security, online query, application development language.

17. After completing the design draft a designer uses the utility program for extracting the required design information for the simulation system.

18. Engineering calculations and analyses programs are independent programs, not included in databases.

19. Engineering data include several kinds of data: design results and maintenance histories of completed products, reliability data, and design standards.

20. There are a great deal of programming languages used in computing systems for writing software. Some of them are used in CAD systems. But nowadays the most usable and widespread is the FORTRAN language. Sometimes, when complex descriptions of logical character programs, such as monitors and language processors, the assembly language or PL/1, PASCAL, ADA, and C are used. The

latter four languages are called high-level manufacturer-oriented languages.

21. Design languages are used for description of information about designed objects and tasks. They are related to users' aids in CAD/CAM systems. There are source, object, debugging, control, intermediate and internal languages among them. They are divided into two types of languages: for description of an object and for description of a job. These are subdivided into circuit, graphics, modelling, and general-purpose (universal) intermediate languages.

22. Languages intended for description of processes evolving during the course of time are called procedural. Languages intended for description of designed object structures are called non-procedural. For CAD users non-procedural languages are more convenient.

23. Conversational (interactive, dialogue) languages serve for an operative information exchange between a user and a computer. They are used in passive and active modes. In the first one the dialogue initiative belongs to a computer. In the second—the dialogue initiative belongs either a computer or a user. For the active dialogue a substantially complex software is required.

SELF-TEST

1. Indicate whether each of the following statements is true or false:

a) The geometric model is not the most important feature of CAD/CAM because it does not represent the part size and shape. b) The geometric model is used for creation of numerical control tape to make parts machine tools. c) Wire frames, surface models, and solid models are not represented as geometric models because they do not use combinations of primitives. d) We use boundary definition when it is necessary to design industrial parts with complex contours. e) The finite-element method is mostly used with business programs. f) A physical spline is a device as a French curve with lead weights, and a mathematical spline is a function.

2. Recall what the wire frames and surface models are. 3. What two approaches are used when designing simple and complex contours of mechanical parts on the CRT screen? 4. Speak on a computer-based technique for determining stresses and deflections, and what must be done in this case as the first step. 5. Define a physical spline and

a mathematical spline. 6. The following statements are contrary to fact. Correct them:

a) A mathematical spline is not described by the cubic polynomial. b) CAD software does not consist of general system software, kernel and application softwares. c) Design languages are not used for designing information about objects and tasks. d) Conversational languages do not serve for an operative information exchange. e) High-level languages are not used with CAD systems. f) A data bank is not the basic part of CAD software.

7. What provides data banks functioning? 8. Do data banks consist of databases and DBMSs? 9. What does the DBMS help to do with data? 10. What kind of program and when does a designer use? 11. List all kinds of CAD software programs and documentation. 12. Choose design languages among the following: FORTRAN, Source, Pascal, Object, Debugging, Intermediate, ADA, PL/1, Control, Circuit, Graphics, Modelling.

13. Why FORTRAN is the most usable and widespread in CAD systems? 14. What is the difference between special-purpose and general-purpose software? 15. Name the high-level languages which are used in CAD systems. 16. Explain what passive and active modes in conversational languages mean. 17. What do application programs contain? (operating, utility, recording, fetching, graphics programs; an unauthorized access; data protection from errors; reference manuals; tutorial materials on software; software packages; databases) 18. What is CAD software selected jointly by the user and manufacturer from? 19. Recall whether the kernel/application softwares for CAD are created by manufacturers or users. 20. Speak on the main feature of a DBMS (data independence, graphics programs, security, protection from errors, on-line query, reference manuals, application development languages, tutorial materials). 21. Define an application package. 22. Define the term "software". 23. What does a CAD software thoroughly (полностью) include?

UNIT 7

Text A. Expert Systems Used in CAD. Text B. Knowledge Base in CAD. Text C. Function of Knowledge and Drafting Systems.

EXERCISES

1. Practise the reading of the following words:

knowledge ['nɔlɪdʒ] знания; эрудиция
artificial [,ɑ:tɪ'fɪʃəl] искусственный
intelligence [ɪn'telɪdʒəns] интеллект, разум
domain [də'meɪn] область; *зд.* банк
devise [dɪ'vaɪz] *v* изобретать, разрабатывать
advice [əd'vaɪs] совет
expertise [,ekspə:'ti:z] специальные знания; эрудиция
acquisition [,ækwɪ'zɪʃən] сбор (данных)
inference ['ɪnfərəns] вывод, заключение
fail [feɪl] *v* выходить из строя
redundancy [rɪ'dʌndənsɪ] избыточность
ramifications [,ræmɪfɪ'keɪʃənz] последствия

2. Memorize the following word combinations:

a knowledge-based expert system экспертная система с базой знаний
an artificial intelligence искусственный интеллект
symbolic representations символические представления
a knowledge base база знаний
an inference mechanism механизм логического вывода
an explanation facility объясняющее устройство
a knowledge acquisition facility устройство для сбора знаний (сведений, информации)
an expert system shell оболочка (каркас) экспертной системы
files of knowledge файлы знаний
a windowing capability возможность кадрирования

3. Translate the following words in positive and negative meanings:

suitable—unsuitable, important—unimportant, to do—to undo, ability—inability, possible—impossible, necessary—unnecessary, consistency—inconsistency, completeness—incompleteness, advantage—disadvantage, known—unknown, experienced—unexperienced, like—unlike, useful—useless, charge—discharge, to agree—to disagree, equal—unequal, explicit—unexplicit, adequately—unadequately

4. Look through Text A and say what its main points are. Guess the subject-matter of Text A.

TEXT A. EXPERT SYSTEMS USED IN CAD

1. A knowledge-based expert system is a computer program which uses artificial intelligence techniques[1] to do the same type of task as an expert does, i. e. complex inferential reasoning[2] based on a wide knowledge of a limited

domain, and which differs from a conventional program in sequencing, completeness, and uniqueness.[3]

2. Artificial intelligence (AI) is "brain function" executed by a computer. AI, also sometimes referred as machine intelligence or heuristic (эвристический) programming, is a technology that has recently attracted considerably publicity (известность). Many applications of it are now under development. One simple view of AI is that it is concerned with devising computer programs to make computers smarter («умнее»).

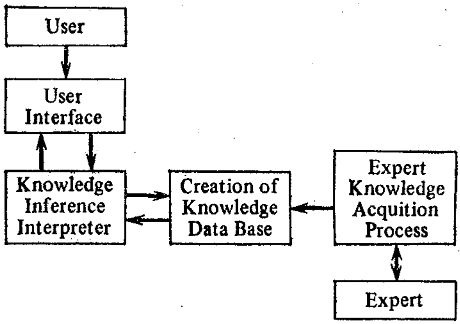

Fig. 9

3. In other words, an expert system is a computer program which deals with a specialized field requiring some expertise to provide solutions to problems and/or to give advice. Expertise is that knowledge which is acquired (приобретать) over many years of experience. It is well known that knowledge is of two kinds: we know a subject ourselves, or we know where we can find information upon it. (See Fig. 9)

4. An expert has both kinds of knowledge. He can analyse a problem, assemble facts, use knowledge to infer (выводить) other facts, evaluate, postulate, make decisions, give advice, explain his reasoning and learn. Much of his knowledge, acquired over time, is of the experiential type. An expert system attempts to emulate (соперничать) an expert but does not necessarily model precisely his process. Like a human expert an expert system may occasionally err (ошибаться). Moreover there are many levels of expertise.

5. An expert system dealing with building regulations[4] must be able to carry out those functions which an expert provides; namely, the ability to provide a coherent (гармоничный) and consistent (сообразный) structure to the know-

ledge and provide a solution to a particular problem by applying the available knowledge in as efficient a manner as possible.

6. Since expert systems deal with knowledge they must have the ability to handle symbolic representations. The main components of an expert system are an interface, a database (or context), a knowledge base, an inference mechanism, an explanation facility and a knowledge acquisition facility. In addition, a system for building regulations

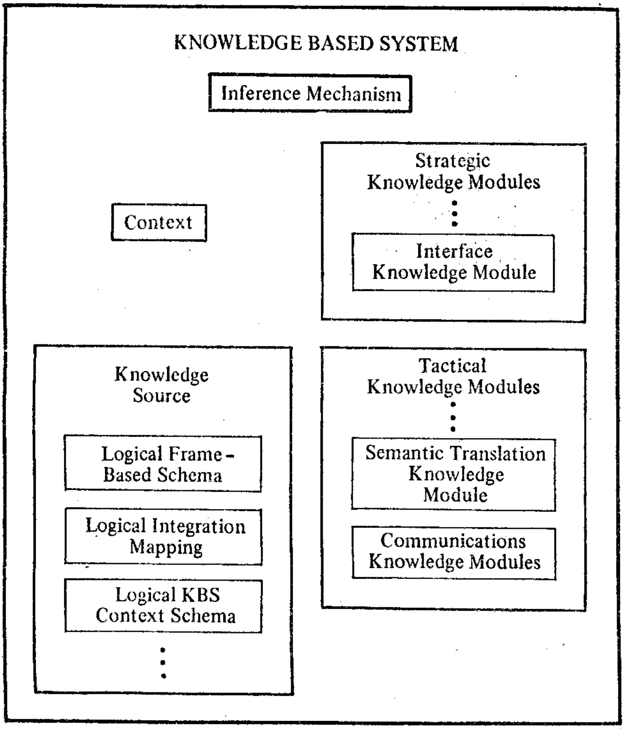

Fig. 10

should have an interpretation facility for accepting and translating general queries into a form suitable for the program and from program form into a form suitable for display. Finally, expert systems should, if possible, have a learning capacity. (Fig. 10)

7. Expert system shells are expert systems with empty (пустой) databases and knowledge bases. In theory, an expert system shell can be used with a number of different appli-

cation (files of knowledge). In practice, the structure and requirements imposed (налагать) by the shell make some applications unsuitable.

8. A comprehensive interface is an important requirement of any expert system. Its task is to facilitate (облегчать) the dialogue between the user and the computer. Ideally it should accommodate various levels of user expertise. The dialogue should be in as natural and simple a manner as possible. A suitable environment would be menu-driven with mouse-input and windowing capabilities,[5] where the user could scroll (прокрутить) through various lists before selecting appropriate items to use in other windows.

9. The inference mechanism controls the strategy of the system. It should be capable of handling both goal-driven and data-driven strategies.[6] The querying strategy should be such that only the information required is asked and the user should be able to provide information at as high a level as he is capable. It must have an efficient selection mechanism and the capability of undoing any portion processed if required. It should distinguish between the inability to arrive at a particular consequence and that consequence failing.

10. The explanation facility must be able to explain why the system needs a particular piece of information; how it arrived at a particular conclusion; which conclusions failed and why; and why a particular conclusion was not reached.

11. The knowledge acquisition facility should have full screen text editing capacity for entering the knowledge with aids and prompts (подсказка) where possible. It should have a mechanism for analysing the input, checking for inconsistencies (несовместимость), incompleteness (неполнота) and redundancies and for providing any extra knowledge which the system may require, e. g. any indexing, etc.

12. Knowledge-based computer-aided design (KBCAD) represents a novel approach to computer-aided design which brings together concepts from artificial intelligence, language theory and computation theory. It opens up the possibility of closer cooperation between the designer and the system he or she is using by tailoring the knowledge to the designer's needs and preferences (предпочтение). This has important ramifications in terms of the acceptability of CAD systems and in terms of increasing individualization of the design process when using computers.

NOTES

1. **artificial intelligence techniques** — технические приемы, используемые в искусственном интеллекте
2. **complex inferential reasoning** — сложное рассуждение на основе логического вывода
3. **in sequencing, completeness, and uniqueness** — последовательностью, полнотой и уникальностью
4. **building regulations** — правила (инструкции) по строительству
5. **would be menu-driven with mouse-input and windowing capabilities** — обычно бывают возможности меню, управляемого с помощью устройства «мышь» на входе для отработки положения указателя на экране, и возможности кадрирования
6. **both goal-driven and data-driven strategies** — как стратегия управления целью, так и стратегия управления данными

5. Look through Text A again and find the Russian equivalents for the following English word combinations according to the text:

a) 1. a limited domain; 2. a knowledge domain; 3. complex inferential reasoning; 4. artificial intelligence techniques; 5. a conventional program; 6. "brain function"; 7. a machine intelligence; 8. heuristic programming; 9. now under development; 10. a knowledge base; 11. an inference mechanism; 12. an explanation facility; 13. an expert system shell; 14. a knowledge acquisition facility; 15. an interpretation facility; 16. a comprehensive interface; 17. windowing capabilities; 18. a querying strategy; 19. full screen text editing capacity; 20. a user expertise; 21. a knowledge-based CAD; 22. any extra knowledge; 23. knowledge-based expert systems

b) 1. каркас (оболочка) для экспертной системы; 2. объясняющее устройство; 3. эвристическое программирование; 4. механизм логического вывода; 5. интерпретирующее устройство; 6. интеллектуальный интерфейс; 7. автоматизированное проектирование с базами знаний; 8. любые дополнительные знания; 9. ограниченная область; 10. технические приемы, используемые в искусственном интеллекте; 11. «функция человеческого мозга»; 12. разрабатываемый в настоящее время; 13. устройство для сбора знаний (сведений); 14. способность редактирования полного текста с экрана; 15. экспертные системы с базами знаний; 16. специальные знания пользователя; 17. банк знаний; 18. машинный интеллект; 19. база знаний; 20. рассуждение, полученное в результате сложного логического вывода; 21. традиционная программа; 22. возможности кадрирования; 23. стратегия запросов

6. Translate the following definitions and memorize the terms which they describe:

Artificial intelligence. It is machine intelligence. Artificial intelligence (AI) refers to applications of the computer which, in operation, resemble human intelligence. AI is used in robots with sensory capabilities which detect and recognize sound, pictures, textures, etc. AI is also used in knowledge-based systems which contain a base knowledge about a subject and can assist us in solving a problem.

Database. A database is an electronic organization of data and information maintained by a database management system. A database implies integration of data across the entire environment that it serves.

Knowledge base. It is a database of knowledge about a particular subject; a knowledge base contains the knowledge required for a knowledge-based system.

Knowledge-based system is a problem-solving application based on accumulated knowledge; a knowledge-based system utilizes a database of knowledge (knowledge base) about a subject for its operation.

Expert system is a problem-solving application at an expert level. Expert systems are knowledge-based systems which contain a database of knowledge about a particular subject (the knowledge base). The degree of expertise relies on the quality of data obtained from human experts on the subject. Expert systems are designed to perform at a human expert level. However, in practice, they will perform more than that of an individual expert. The expert system also incorporates as inference program, which derives a conclusion based on the data contained in the knowledge base and the data entered by the user.

7. Read Text A attentively. Divide it into logical parts. Find key words and topic sentences in every logical part. Write them down into your exercise-book.

8. Translate the paragraphs 4, 6, 8, 11, 12 into Russian in writing.

9. Choose the suitable title for each logical part from those given below:

A. 1. Conventional programs. 2. Heuristic programming. 3. Artificial intelligence.

B. 1. User's knowledge. 2. Acquired knowledge. 3. Two knowledge kinds.

C. 1. Knowledge acquisition facilities. 2. The main expert system components. 3. Inference mechanism.

D. 1. Expert system shells. 2. Databases. 3. Knowledge bases.

E. 1. Suitable environments. 2. Windowing capabilities. 3. Comprehensive interface.

F. 1. The goal-driven strategy. 2. The kind of strategies. 3. The querying strategy.

G. 1. Facilities used in expert systems. 2. A particular conclusion. 3. Any extra knowledge.

H. 1. Language theory. 2. Computational theory. 3. Conclusion.

10. Check up yourself how much you have memorized from Text A.

a) Complete the following sentences from Text A:

1. AI is "brain function" executed (by a program, by a user, by a manufacturer, by a computer). 2. Many applications of AI are now (under continuation, under development, under questions, under planning). 3. Expertise is that knowledge which is acquired over many years of (experience, usage, application, reception). 4. The inference mechanism controls (the philosophy, the program, the computer, the strategy) of the system. 5. The knowledge acquisition facility should have full screen text editing capacity (for planning, for acquiring, for accepting, for entering) the knowledge with aids and prompts. 6. Knowledge-based computer-aided design represents (a novel application, a novel representation, a novel utilization) to computer-aided design.

b) Say what the following acronyms mean:

DBMS, KBS, AI, APP, FEA, OS, DOS, CRT, BPS, KBCAD

c) What are the main components of an expert system?

d) Speak on the two kinds of expert's knowledge. Begin with the words: "There are two kinds of knowledge a human expert knows ... ."

e) What concepts does a novel approach (knowledge-based CAD) to CAD bring together?

11. Write an abstract of Text A using key-patterns (p. 127) in English.

12. Look through Text B. Say whether the subject-matter of it is "The knowledge base is the main feature of any expert system".

TEXT B. KNOWLEDGE BASE IN CAD

The key bottleneck (узкое место) in developing an expert system is building the knowledge base by having a knowledge engineer interact with the experts. The first body of knowledge extracted from the expert are terms, facts, standard procedures, etc. for CAD, as one might find in CAD textbooks and journals. However, this information is insufficient to build a high performance system.[1] This fact forces the expert to introspect (вникать) on what additional knowledge is needed. In such a case, judgemental and heuristic rules[2] are required. As more and more heuristics are added to the program, the CAD system gradually approaches the competence of the expert at the task. There are some well known expert systems such as DENDRAL which interprets data from mass spectrometers, XCON which configures VAX computer systems,[3] PROSPECTOR which is an advisor in field exploration for minerals, and PUFF which analyses pulmonary disorders.[4] All of these expert systems use the knowledge bases with the same names. But the most famous of them is MYCIN which diagnoses blood infections and recommends treatment (лечение). For this expert system, the MYCIN's knowledge base tells whether some new piece of information "fits in" to what is already known, and uses this information to make suggestions (совет) to the expert. In many cases an expert may not have all the expertise desired (желать). Thus, other approaches to acquiring the needed expertise are desirable. The most popular approach to representing the domain knowledge needed for an expert system is by production rules[5] which are also referred to as "SITUATION-ACTION rules" or "IF-THEN rules".[6] A knowledge base can be made up mostly of rules which are invoked (вызывать) by pattern matching[7] with features of the task environment as they currently appear in the knowledge database. The rules in knowledge database represent the domain facts and heuristics—rules of good judgement of actions to take when specific situation arises. The power of the expert system lies in the specific knowledge of the problem domain, with potentially the most powerful systems being the ones containing the most knowledge. Most existing rule-based systems contain hundreds of rules, usually obtained by interviewing experts for weeks or months... In any system, the rules become connected to each other to form rule networks. Once assembled, such networks can represent a substantial body of knowledge. An expert usually has many judgemental or empirical rules. In such cases, one approach is to attach numerical certainty (достоверность) to each rule to indicate the degree of certainty associated with that rule. In expert system operation, these certainty values (значение) are combined with each other and the certainty of the problem data, to arrive at a certainty value for the final solution. The cognitive strategies[8] of human experts in more complex domains are based on the mental (умственный) storage and use of large catalogues of pattern-based rules.[9] Thus human chess masters may be able to acquire, organize, and utilize as many as 50,000 pattern-based rules in achieving their remarkable performance.

NOTES

1. **a high performance system** — высокопроизводительная система
2. **judgemental and heuristic rules** — правила, выведенные на основе суждений и эвристики
3. **VAX computer systems** — системы ЭВМ фирмы, выпускающей цифровое оборудование
4. **pulmonary disorders** — заболевание легких
5. **production rules** — порождающие правила
6. **"SITUATION-ACTION rules" or "IF-THEN rules"** — правила «СИТУАЦИЯ — ДЕЙСТВИЕ» или правила «ЕСЛИ — ТО»
7. **by pattern matching** — путем сравнения эталонов
8. **the cognitive strategies** — методы познания
9. **pattern-based rules** — правила на основе эталонов

13. Read Text B attentively and divide it into paragraphs.

14. Find the key words and topic sentences in Text B. Write them down into your exercise-book.

15. Make up the plan of Text B using the topic sentences.

16. Look through Text C. List its main points.

TEXT C. FUNCTION OF KNOWLEDGE AND DRAFTING SYSTEMS

Computer-aided drafting systems originated as a tool to increase productivity by replacing the traditional pen and paper as the drafting medium. In the early systems all knowledge about the artefact (артефакт) being drawn remained with the draftsperson and the computer system dealt only with lines.

Geometrical modelling systems recognized the need to represent the artefact as an entity (объект) with particular characteristics, and much work has been done in generating appropriate modelling schemas. Most of these schemas employ fixed data structures which make use of some implicit (неявный) knowledge about the geometrical form of objects within the domain of application of the system. Thus, computer-aided architectural design (CAAD) systems employ domain specific knowledge about the characteristics of building constructions (e. g., horizontal floor and ceiling planes and predominantly plane surfaces) as a means of simplifying the 3D information needed. Knowledge about geometrical form also allows the use of procedural modelling to generate desired images from specified parameters. Later CAAD systems extend procedural modelling to the automated layout (компоновка) of common constructional elements such as timber floor joists, roof rafters and partition frames.[1]

The knowledge implicit in these procedures is embodied (реализовать) in the computer code which implements the procedures, either internally within the system (and therefore fixed by the system designer and programmer) or externally in a macro language associated with the system.

Macro languages allow users to incorporate some of their own specialized knowledge about the way in which objects are created and represented, but only as extensions (добавление) to a fixed data structure and subject to limitations on the expression (выражение) of knowledge as computer code.

The present alternative to procedural representations of objects are propositional representations.[2] These use the methods of knowledge engineering and are characterized by: dispersion, abstraction, and inference.[3]

Knowledge engineering is concerned with the computer-based representation and manipulation of knowledge in a symbolic form. For the computer system concerned with design synthesis, propositional representations offer considerable advantages. Recent work suggests (подсказывать) that propositional representations may be more effective than procedural representations for many general CAD applications.

NOTES

1. **timber floor joists, roof rafters and partition frames** — деревянные балки для пола, стропила для кровли, рамы для перегородок

2. **propositional representations** — пропозиционные (относящиеся к предложениям, суждениям) представления

3. **dispersion, abstraction, and inference** — разброс (дисперсия), абстракция, логический вывод

17. Read Text C again. Find all international words in it. Write them down into your exercise-book.

18. Choose the Russian equivalents to the following English words and word combinations:

a) 1. the drafting medium; 2. particular characteristics; 3. appropriate modelling schemas; 4. to replace; 5. to recognize; 6. to represent; 7. fixed data structures; 8. to employ;

9. implicit; 10. architectural design systems; 11. the domain of application; 12. specific knowledge; 13. implicit knowledge; 14. building constructions; 15. as a means of; 16. to simplify; 17. 3D information; 18. procedural modelling; 19. desired images; 20. specific parameters; 21. an automated layout; 22. to embody; 23. a macro language; 24. procedural representations; 25. knowledge engineering; 26. design synthesis; 27. propositional representations; 28. to offer; 29. to suggest; 30. CAD applications; 31. considerable advantages

b) 1. значительные преимущества; 2. необходимые (желательные) изображения; 3. реализовать; 4. синтез проектирования; 5. неявный; 6. специфические (особые) характеристики; 7. соответствующие схемы моделирования; 8. системы архитектурного проектирования; 9. трехмерная информация; 10. конкретные параметры; 11. техника представления знаний; 12. подсказывать; 13. чертежное средство; 14. макроязык; 15. представлять; 16. признавать; 17. конкретные знания; 18. строительные конструкции; 19. упрощать; 20. автоматизированная компоновка; 21. процедурные представления; 22. пропозиционные представления; 23. предлагать; 24. применения АП; 25. замещать; 26. структуры фиксированных данных; 27. применять; 28. область применения; 29. неявные знания; 30. в качестве средства; 31. процедурное моделирование

19. Find topic sentences in Text C and retell it using these topic sentences.

20. Write a brief summary of Text C (see p. 126).

UNIT 8

Text A. Flexible Manufacturing Systems. Text B. Computer-Integrated Manufacturing Systems. Text C. Artificial Intelligence, Robots, and Machine Vision.

EXERCISES

1. Memorize the following word combinations:

flexible manufacturing systems (FMS) гибкие производственные системы (ГПС)
computer-integrated manufacturing systems (CIMS) комплексные автоматизированные производственные системы
machine vision машинное «зрение»
design products проектируемые изделия

machine tools металлорежущие станки

material handling equipment оборудование, управляющее потоком материалов

computerized numerical control (CNC) компьютеризированное числовое программное управление

materials requirements planning (MRP) планирование требований к материалам (ПТМ)

machine parts детали машины, механические детали

computer-aided process planning автоматизированное планирование производственным процессом

"islands of automatization" островки автоматизации

flexible manufacturing cells гибкие производственные центры

flexible transfer lines гибкие линии передач; гибкие транспортные линии (конвейеры)

2. Translate the definitions and descriptions of the following terms:

Numerical control is the machine tool control. It is used in manufacturing to automate operations, like milling (фрезеровка), turning (токарная обработка), punching (пробивка отверстий) and drilling (сверление). NC devices are machines which operate automatically by following instructions in an NC program. CNC is a computerized NC.

Robot is a programmable multi-function device; robots are stand-alone hybrid computer systems which perform physical and computational activities. Robots use analog sensors (датчик) for recognizing objects in the real world and digital computers for their direction. Robots can be designed similar to human form, although most industrial robots don't resemble people at all. They have one or more arms and joints designed for specific activities.

Robotics is the art and science of the creation and use of robots.

Management system is the structure and function of the leadership and control of an organization. The management system is people interacting with people and machines. Together they set the objectives (цель) for the organization, outline the strategy and tactics, and develop the plans, schedules (график) and necessary controls to run the organization. AMS is automated management systems.

Frame is a single block of data; a frame is a group of data which makes up a single full picture screen in graphics.

3. Look through Text A. List its main points.

TEXT A. FLEXIBLE MANUFACTURING SYSTEMS

1. CAD/CAM systems imply that the products designed in the CAD system are direct input to the CAM system. CAM includes computerized numerical control (CNC), robotics, process planning and materials requirements planning (MRP).

2. Application under computer control covers the entire range of factory operations. CNC systems for machine tools are the fourth generation systems which make part programming easier and enable the units to communicate with other computers.

3. Process planning is integrated with other functions such as CAD and factory management. It outlines the sequence of production steps needed to make a part, describing step-by-step routing through the shop (цех). This task has traditionally been performed manually, but a shortage (нехватка) of trained process planners and the need for consistent routings (соответствующий маршрут) has brought computers to solve this task. The concept, called computer-aided process planning (CAPP), attempts (делать попытку) fully to automate the function based only on information from CAD and machining database.

4. All these "islands of automatization" are installed to link them together to create so-called flexible manufacturing systems (FMS). Flexibility has become a key word in manufacture and now the trend is towards FMS. These are factories in which machine tools are tied together with material handling equipment and centralized computer control. A FMS greatly increases throughput (производительность) and cuts production time by one-half or more.

5. FMS are designed to produce a variety of products from standard machinery. In the ultimate (завершенный) system raw materials (сырье) in the form of bars, plates and powder[1] would be used to produce an assembly required without manual intervention in manufacture. Clearly, it is a good breeding ground for robots.[2]

6. Flexible manufacturing equipment is considered to be flexible manufacturing cells, flexible manufacturing systems and flexible transfer lines, the definitions and boundaries of which are not yet being handled in a uniform (одинаковый) way, but nevertheless may be interpreted as outlined below.

7. A flexible manufacturing cell consists of a CNC machine tool, and automatic control and supervision sub-

systems. The machine tool is hence capable of performing more than one operation automatically, on more than two workpieces (заготовка). Automatic cleaning, inspecting and deburring devices,[3] and/or devices for other functions may be integrated into a flexible manufacturing cell. Such manufacturing cells have in recent times experienced a rapid growth in both the number of manufacturers and users. Their appearance and frequent application closed an important gap (разрыв) between the individual machine tool and the interlinked systems (Fig. 11).

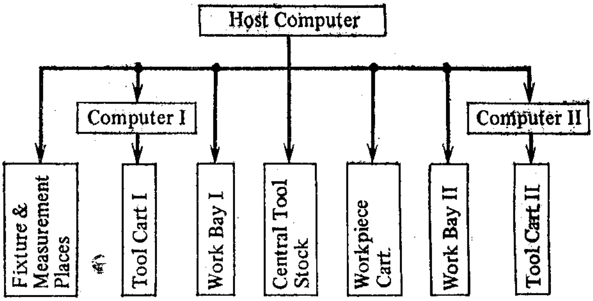

Fig. 11

8. A flexible manufacturing system contains several automated machine tools of the universal or special type, and/or flexible manufacturing cells and, if necessary, manual or automated workstations. These are interlinked by an automated workpiece-flow system[4] in a way that enables the simultaneous machining[5] of different workpieces which pass through the system along different routes. Thus, automated multi-step and multi-product manufacturing is possible in a flexible manufacturing system.

9. A flexible transfer line contains several automated universal or special-purpose machine tools and automated workstations as necessary, interlinked by an automated workpiece-flow system according to the line principle. A flexible transfer line is capable of simultaneously or sequentially machining different workpieces which run through the systems along the same path. In order to balance differences in cycle time, setting times[6] or short faults (кратковременное повреждение) buffers may be allocated between the stations. Actual application of flexible transfer lines is quite difficult to evaluate because the borders between flexible manufacturing system/flexible transfer lines/conven-

tional transfer line in many cases overlap (перекрывать) smoothly (плавно).

10. The actual application of flexible manufacturing systems shows an exploding (*зд.* бурный) growth — there are now approximately 300 FMS exploited worldwide. It is expected that the number of installations will double every two years until the end of this decade.

NOTES

1. **in the form of bars, plates and powder** — в виде стержней, плит и металлического порошка
2. **a good breeding ground for robots** — хорошая почва для «воспитания» роботов
3. **automatic cleaning, inspecting and deburring devices** — автоматические устройства для очистки, осмотра и удаления заусенцев
4. **by an automated workpiece-flow system** — с помощью автоматизированной системы, обеспечивающей поточную подачу обрабатываемых заготовок
5. **the simultaneous machining** — одновременная механическая обработка
6. **setting times** — время установки в определенное положение

4. Read Text A attentively. Find all international words in it and write them down into your exercise-book. Divide Text A into logical parts.

5. Translate the 8th, 9th and 10th paragraphs in writing.

6. Check up yourself how much you have memorized from Text A.

a) Complete the following sentences:

1. Application under computer control covers the entire range of factory (requirements, plannings, operations). 2. CNC systems are the (second, fourth, third, fifth) generation systems. 3. Automated multi-step and multi-product manufacturing is possible in a (special-purpose computer, flexible manufacturing cell, FMS). 4. A flexible transfer line contains several automated universal or special-purpose (computers, machine tools, devices). 5. Actual application of flexible transfer lines is quite difficult to (increase, integrate, evaluate).

b) Answer the following questions:

1. What do CAD/CAM systems imply? 2. What makes the part programming easier? 3. How does process planning outline the sequence of production steps for making a part? 4. Why has the word "flexibility" become a key word? 5. In what form would the raw materials be used in manufacture to produce a product without manual intervention? 6. What is a good breeding ground for industrial robots?

c) Speak on a flexible manufacturing equipment. Begin with words: "A flexible manufacturing equipment consists of . . . ."

7. Make up a list of the key words and topic sentences of Text A writing them down into your exercise-book.

8. Connect the topic sentences from Text A to form a plan.

9. Retell Text A according to your plan.

10. Write an abstract of Text A in Russian using the key-patterns (see p. 127).

11. Look through Text B. List the main points of it.

TEXT B. COMPUTER-INTEGRATED MANUFACTURING SYSTEMS

Smart (intelligence) robots by themselves will not provide the full range of productivity increase possible with current manufacturing technology. Only when combined with a production system, smart robots will be fully used as helpers for economic and productivity increasing, and in this case they are the part of a computer-integrated manufacturing system (CIMS).

CIMSs represent a relatively new strategy to increase productivity. Their technology is especially attractive for manufacturers and, then, for users. In many instances, CIMSs provide a direct hardware/software solution to the management challenge. [1]

A CIMS can be defined as a computer-controlled configuration of semiindependent (полунезависимый) workstations and a material handling system designed efficiently to manufacture more than one machine part number at low to medium volumes. [2] The definition and the illustration highlight (придавать большое значение) the three essential physical components of a CIMS: standard numerically-controlled machine tools and smart robots; a conveyance network [3] to move parts and tools between machines and fixturing stations; [4] and overall (всеобщий) computer control system that coordinates the machine tools and smart robots, the part-moving elements, and the workpieces.

In most CIMS installations (сооружение), incoming raw materials are fixtured onto pallets (транспортный стеллаж) at a load station set apart from the machine tools. They then move via the material handling system to queues at the production machines where they are processed. The flow of parts in the system is directed by the control computer which acts as the traffic coordinator.[5] In properly designed systems, the holding queues are seldom empty, i.e., there is a workpiece waiting to be processed when a machine becomes idle (неработающий). And when pallet exchange times are short, the machine idle times become quite small.

The number of machines in a system typically ranges from 2 to 20 or more. The conveyance system may consist of carousels [ˌkæruˈzel] (карусель), conveyors, carts (тележка), smart robots, or a combination of these. The important aspect of these systems is that the machine, conveyance, and control elements combine to achieve increasing productivity and maximum machine utilization without sacrificing flexibility.

Linking all data processing functions creates CIMSs. Here, management, finance, engineering, and manufacturing all share (совместно использовать) information to increase quality and productivity, as well as shorten a production time. Each factory maintains its own database, but computer networks are used to pass essential data from one function to the next.

CIMS technology has a relatively brief history. The original concept emerged (появляться) in the mid- to late-1960s, a logical outgrowth (результат) of progress in applying numerical control. By the early 1970s, a number of flexible manufacturing systems were installed, and throughout that decade one by one they became operational, following a problem-shakedown period[6] typical of new technology. The computer-integrated manufacturing systems grew from the flexible manufacturing system technology integration.

There are now well over a dozen full-scale CIMSs in operation, and plus a number of installations that use CIMS concepts. Not only is the technology proven, it is increasingly available a growing number of machine-tool builders, and turnkey system developers are able to supply CIMS complete systems.

NOTES

1. **to the management challenge** — запросам управления производством
2. **more than one machine part number at low to medium volumes** — более одного количества механических деталей от низких до средних объемов выпускаемой продукции
3. **a conveyance network** — сеть перевозочных средств
4. **fixturing stations** — пункты зажимных приспособлений
5. **as the traffic coordinator** — в качестве координатора потоков заготовок

6. **following a problem-shakedown period** — вслед за периодом успешных проблемных решений

12. Read Text B attentively. Make up a list of international words and write them down into your exercise-book. Find the key words and the topic sentences, write them down too.

13. Analyse and translate the following sentences from Text B:

1. In many instances, CIMSs provide a direct hardware/software solution to the management challenge. 2. The definition and the illustration highlight the three essential physical components of a CIMS: standard numerically-controlled machine tools and smart robots; a conveyance network to move parts and tools between machines and fixturing stations; and overall computer control system that coordinates the machine tools and smart robots, the part-moving elements, and the workpieces. 3. Linking all data processing functions creates CIMSs.

Your translation must be adequate.

14. Say whether the following statements are true or false:

1. Smart robots by themselves will provide the full range of productivity increase without being the part of a CIMS. 2. CIMSs represent a relatively new strategy to increase productivity. 3. Incoming raw workpieces are not fixtured onto pallets at a load station set apart from the machine tools. 4. Workpieces do not move via the material handling system, and they are not processed at the production machines. 5. When pallet exchange times are short, the machine idle times become quite small. 6. Management, finance, engineering, and manufacturing do not altogether share information to increase quality and productivity. 7. A history of the original concept of CIMS technology goes back a long time into the past.

15. Name three essential physical components of CIMSs.

16. Read Text B again and prepare to retell it.

17. Look through Text C, express the main points of it in three sentences.

TEXT C. ARTIFICIAL INTELLIGENCE, ROBOTS, AND MACHINE VISION

A "smart" or intelligent robot should be able to think, sense, move, and manipulate material, parts, tools or specialized devices through variable programmed motion for the performance of a variety of tasks. The thinking or "brain function", executed by a computer, is the domain of artificial intelligence (AI). Sensing and manipulation are "body functions". They are based on physics, mechanical engineering, electrical engineering, and computer science. Planning and execution of tasks entail both the brain and the body, and so they are affected by both AI and robotics. AI and robotics are really in their infancy,[1] but their promise is great. Some practical applications of research are appearing, although in most cases they are limited and aimed at solving specific problems. Current effort is directed towards extending the capabilities of current applications and finding more general solutions to the problems they address. Figure 12 can be viewed as a simplified model of a smart robot system. The major components of this model are: **sensing, effecting, interpreting, generating, reasoning.** The last three of these are based on knowledge about the application world and how it works. This model of AI and robotics emphasize intelligent functions that are performed. Underlying them are more fundamental research issues that are concerned with: **representing** the knowledge needed to act intelligently; **acquiring** knowledge and **explaining** it efficiently; **reasoning:** drawing conclusions,[2] making inferences, making decisions;[3] **acting** with knowledge that is incomplete, uncertain, and perhaps conflicting; **evaluating** and **choosing** among alternatives. Advances in AI and robotics require advances in these fundamental areas and the capabilities of intelligent functions, e. g. machine vision. The general purpose of machine vision systems is the development of mechanisms for effectively interpreting visual images. Interpreting images can be described as the process of going from a video signal to a symbolic description of it. The same image may, in fact, have many descriptions depending on the reasons for processing it. One purpose may be to count all the objects in an area, another may be to describe them, the third may be to determine their exact location, and the fourth—to find irregularities in the terrain[4] that can put navigation problems. Among

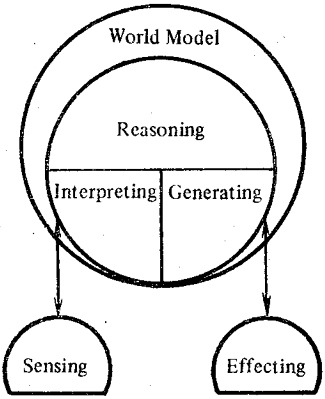

Fig. 12

the reasons for interpreting images with machine vision are: identifying objects, locating objects, detecting changes, navigating, describing a scene,[5] making maps and charts.

NOTES

1. **in their infancy** — на заре своего развития
2. **drawing conclusions** — выведение заключений
3. **making decisions** — принятие решений
4. **in the terrain** — в наземном ориентире
5. **describing a scene** — описание сцены (сценария)

18. Read Text C attentively. Divide it into 8 paragraphs.

19. Make Text C five times as short. Do it in writing.

20. Write an abstract of Text C in English using key-patterns **(see p. 127).**

21. Look through Texts D, E, and F and say to what part of scientific papers they belong (introduction, conclusion, abstract).

TEXT D

A method of applying Bezier curves to the data interpolation problem was proposed. Four computer outputs indicate that the proposal in this paper is promising, and that it can eliminate unpleasant undulations in interpolating curves. Further studies include the following actions: increase the order of interpolating curve described by equation (4), determine the value of *c* depending on the shape of the CT, improve the algorithm to derive the CT.

Improving the algorithm to derive the CT is a common problem as most of the calculation time is used in this process. Efficient algorithms for deriving tangent lines will enable our method to use on-line representations of complicated objects in the future.

TEXT E

A method of using Bernstein-Bezier curves for data interpolation is proposed. The curves obtained satisfy the required conditions for 'visual content'. A numerical example is executed not only on data points in a plane but also on the data points of a 3D object. Comparisons of the new interpolating curves with cubic splines demonstrate their merits.

TEXT F

B-splines are the most widely used curves in the field of computer-aided geometric design (CAGD). These splines are formed by generalizing Bezier curves in order to include the property of locality. (Strictly speaking they should be called Bernstein-Bezier curves.) Although their equations have complicated forms, B-splines are widely used in CAGD because of their responsiveness to user control. The ultimate aim in this field is to find curves which describe designers' ideas correctly on a display.

There exists another field called 'data interpolation' (or curve interpolation). The final operation in this field deals with curves that can depict faithfully the information contained in the given data points. No measurement has been proposed to assess results of the data interpolation, except the 'visual content'. Visual content is a human judgement and inevitably vague; the criterion is always discussed when speaking of interpolated curves.

In this paper, Bezier curves will be used to interpolate data points. As these curve segments will be calculated separately under characteristic triangle (CT) the requirement for local calculation is satisfied. Further, it will be shown that the requirement for concave/convex retainment can also be satisfied using this CT. The composition of CT is done by introducing two ideas: 'faithfulness' and 'effectiveness'.

REVIEW AND SUMMARY TO UNITS 7 AND 8

1. CAM includes computerized numerical control (CNC), robotics, process planning, and materials requirements planning (MRP).

2. Application under computer control covers the entire range of factory operations: CNC systems for machine tools which make part programming easier and enable the units to communicate with other computers; process planning integrated with other function (CAD and factory management) which outlines the sequence of production steps for making a part through description step-by-step routing in the shop, etc.

3. It was necessary to create computerized planning, i. e. computer-aided process planning (CAPP) to avoid a shortage of trained process planners and the need for proper routings. CAPP has brought to fully automation of the function based only on information from CAD and machining database.

4. Flexible manufacturing equipment includes flexible manufacturing cells, flexible manufacturing systems (FMSs), and flexible transfer lines. The first one consists of a CNC machine tool, automated control and supervision subsystems. The second contains several automated machine tools of the universal or special type, flexible manufacturing cells, and manual or automated workstations. And the last one comprises several automated universal or special-purpose machine tools, automated workstations, setting time and short faults buffers. As can be seen the borders between FMSs and flexible transfer lines in many cases smoothly overlap each other.

5. There are now approximately 300 FMSs used in the world, but it is expected that the number of FMS installations will double every two years until the end of this decade.

6. "Smart" robots by themselves do not provide the full increase of productivity. It is necessary to use them as the part of computer-integrated manufacturing systems (CIMSs).

7. CIMSs represent a relatively new strategy for increasing productivity. Their technology is attractive for manufacturers and for users.

8. A CIMS consists of standard NC machine tools, smart robots, a conveyance network and an overall computer control system for coordinating the work between the machine tools, smart robots, the part-moving elements, and the workpieces.

9. In most CIMS installations incoming raw workpieces are fixtured onto pallets at a load station, then they move via the material handling system to queues at the production machines for processing. The flow of workpieces in the system is under direction of the control computer actions as the traffic controller.

10. The conveyance network (system) consists of carousels, conveyors, carts, smart robots or their combinations.

11. In CIMSs management, finance, engineering, and manufacturing share information to increase quality and productivity as well as shorten a production time.

12. CIMS technology has a brief history. The original concept of NC application appeared in the mid- to late-1960s. By the early 1970s a number of FMSs were installed and during the decade the new technology emerged. And so CIMSs grew from FMSs using technology integration.

13. A "smart" robot should think, sense, move, and manipulate material, parts, tools or specialized devices through programmed motion for different tasks.

14. The "brain function" executed by a computer is the domain of artificial intelligence (AI); and sensing and manip-

ulation are "body functions" of AI. "Body functions" are based on physics, mechanical engineering, electrical engineering, and computer science.

15. AI and robotics are actually in their infancy, but they promise a lot of useful things to do.

16. The major components of a smart robot system are sensing, effecting, interpreting, generating, reasoning. The last three are based on knowledge about the application world and how it works.

17. More fundamental research in the field of AI and robotics is: representing the knowledge needed to act intelligently, acquiring knowledge and explaining it efficiently, drawing conclusions, making inferences, making decisions, acting with knowledge which is incomplete, uncertain, and conflicting, evaluating and choosing among alternatives — all of the last six are reasoning.

18. Advances in AI and robotics require advances in the previously mentioned fundamental research (see item 17), especially in machine vision.

19. The general purpose of machine vision systems is the development of mechanisms for effectively interpreting visual images. It can be described as the process of going from a video signal to a symbolic representation of it.

20. There are four reasons for processing vision images: counting all the objects in an area, describing them, determining their exact location, finding irregularities in the terrain.

21. There are six reasons for interpreting images with machine vision: identifying objects, locating objects, detecting changes, navigating, describing a scene, making maps and charts.

SELF-TEST

1. Say whether the following statements are true or false:

a) CAM includes CNC, robotics, and does not include process planning and material requirement planning. b) CNC systems for machine tools are the third generation systems. c) Process planning is integrated with the other functions such as CAD and factory management. d) A flexible manufacturing cell includes a CNC machine tool, automatic control and supervision subsystems. e) The machine tool is capable to perform automatically only one operation on one workpiece. f) CIMSs represent a relatively old strategy. g) Flexibility of CIMSs sacrifices productivity of them.

2. *Answer the following questions:*

a) What does a FMS greatly increase and cut? b) What form may raw materials be in? c) What would raw materials be used for without manual intervention? d) Why is a FMS considered to be a good breeding ground for robots? e) In what way are automated workstations interlinked to perform simultaneous machining of different workpieces? f) What is the domain of AI? g) What are "body functions" of AI? h) What is the purpose of machine vision systems? i) What is the difference between interpreting images with machine vision and processing vision images? (Answering this question begin with the words: "Interpreting images is the process of going from a video signal to ... and processing vision images ... .")

3. Complete the following sentences choosing the right word:

a) Process planning, making a part, etc. describe step-by-step a workpiece routing through (the class, the laboratory, the shop, the room). b) The need for consistent routings has brought computers to (require, perform, make, solve) this task. c) The acronym CAPP means computer-aided process (performing, planning, producing, processing). d) Smart robots by themselves do not (serve, perform, provide, use) the full increase of productivity. e) The major components of a smart robot system are sensing, effecting, interpreting, generating and (performing, reasoning, solving, doing). f) Advances in AI and robotics require advances in the fundamental research, especially in (machine process, machine construction, machine vision, machine exploitation). g) Smart robots help a CIMS to provide the full increase of (flexibility, productivity, complexity, activity).

4. Define the term "flexibility". 5. Name more fundamental research in the field of AI and robotics. 6. List the main devices of a flexible manufacturing cell. 7. Describe the process with the help of FMSs. 8. Say why FMSs are called factories. 9. Speak on advances in AI and robotics nowadays. 10. Name the reasons for interpreting images with machine vision. 11. Name the reasons for processing video signals. 12. Speak on CIMSs obligations. 13. Speak on a smart robot obligation. 14. Write briefly the work of CIMSs.

PART II

SUPPLEMENTARY TEXTS

Дополнительные тексты предназначены для различных видов самостоятельной работы студентов.

The USSR Achievements in CAD/CAM Systems

The 27th CPSU Congress outlined the main trends of further economic and social development in the period of 1986-1990 stressing the urgent need of introducing automated systems, primarily CAD, CAM, CIM and FMS, to every field of management.

At present in the USSR a lot of application program packages (APPs) are utilized. Among them one may find, for example, APPs for modelling and optimizing gas turbine engines. These APPs realize engine component mathematical models in a CAD system. Besides, APPs with a dialogue monitor for analysing temperature, strengths and strains in cylinder-piston Diesel engines are used. This monitor provides a user interactive dialogue mode by means of the package PARK.

GRAPHOR and FAP-KF are applied in CAD systems for computer graphics APPs. GRANIT and DISFORP serve for solving problems of planning national economy whereas MAVR does for computer-aided design and dispatching control.

There exists also MRAMOR[1] workstation, i. e. a multifunctional editorial board service workstation. It is successfully used for automatization of editor activity in entry, editing and preparing to print different publications—newspapers, books, journals, magazines, etc., i. e. to do all that without subsequent typesetting of various printing plates.[2]

Using MRAMOR an editor is able to read a text at the screen "window", to debug it, to reconstruct a typesetting for any given formats, etc.

MRAMOR uses a microcomputer with floppy disks and hard disks and a high-speed laser printer for setting up types and spacing. [3]

MRAMOR has been developed under the guidance of academician A. Yershov in the specialized laboratory at the Computing Centre of the Siberian Branch of the USSR Academy of Sciences.

In our country the most widespread systems of today are expert systems. Their task is to accumulate experience of those working in poorly formalized fields such as medicine, biology, history, etc. Expert systems possess a special explanation system, whose purpose is to explain a human being the reasons for recommendations of specialists, and as a result, such systems raise the confidence degree of specialists to an "electronic adviser".

PIKOM [4] is a computational equipment system with image dialogue facilities for interactive modelling of robotics systems and flexible automated ones. PIKOM enables to realize a wide range of functional possibilities. They are divided into the following basic groups:

— image information sensing and analysing in visual and speech forms;

— interactive graphics;

— interactive image modelling.

PIKOM makes use of microcomputer "Electronica-6OM" representing a system with a single processor, 64 Kbyte main memory, 1 Mbyte floppy-disk external memory, and an external interface on the basis of CAMAC system. [5]

PIKOM capabilities may be essentially extended due to the application of powerful microcomputers and highly developed peripheral technology.

In the future PIKOM systems for flexible automated manufacturings modelling will be based not only on powerful microcomputers, but on their networks. Hence, they will feature a different system design hardware/software technology with custom VLSI circuits,.[6] special architecture synthesis, and developed peripherals of the kind of powerful graphics workstations.

Thus, in the Soviet Union creation and development of new ways for automatization and intensification of modern production mean deep and all-round transformation of economy, science and technology.

NOTES

1. **MRAMOR**—многофункциональное рабочее автоматизированное место обслуживания редакции
2. **to do all that without subsequent typesetting of various printing plates**—делать все это с последующим безнаборным получением печатных форм
3. **a high-speed laser printer for setting up types and spacing**—быстродействующее лазерное печатающее устройство для набора типографских литер и пробельного материала (материала пробелов)
4. **PIKOM**—программно-инструментальный комплекс моделирования
5. **on the basis of CAMAC system (computer-aided measurement and control system)**—на базе системы КАМАК (системы автоматизированных средств измерения и управления)
6. **a different system design hardware/software technology with custom VLSI circuits**—отличающаяся аппаратно-программная технология проектирования систем на основе заказных СБИС (сверхбольших интегральных схем)

CAD in Industry Abroad

ASIC Design Software. Software for the design of application specific integrated circuits (ASIC) has been introduced in the UK by Mikron Microelectronics.

According to Mikron, the package can do the full automatic layout of 600 gate arrays (вентильная матрица) with 100 per cent utilization in 15 minutes on a VAX II/750 computer. It takes 20 minutes to do a 1500 gate array on the same computer but only achieves 99.8 per cent utilization.

The Mikron package has been developed to aid the design and testing of semicustom (полузаказной) integrated circuits. According to Mikron it features schematic entry, netlist extraction, logic simulation, placement, routing, timing extraction, PG tape generation, fault simulation and test program generation. The package is available for several hardware configurations including DEC's MicroVax and VAX systems, the IBM PC AT and Tektronix systems. The price varies according to the configuration.

Software to Suit Models and Moulds. 3D modelling and mould making software for micros has been developed by Lewill Systems. It is called CHEOPS. It works by creating a model from sections which are defined using a 2D CAD system and then assembled in 3D. The final result can be viewed from any angle, and volumes can be calculated.

A cutter path (путь режущего инструмента) is automatically generated to produce the finished mould. Further programming is required to achieve a fine finishing cut.[1]

CHEOPS can be integrated with the 2D drafting system to parametrically vary the dimensions of critical sections (критическое сечение). According to Lewill Systems a turnkey system would cost approximately £35,000 and would include CHEOPS software, a 2 1/2D NC programming facility, 2D drafting input to CHEOPS and an appropriate microcomputer.

AI Systems from Tektronix. Tektronix has introduced two artificial intelligence systems: the 4405 and the 4406. It has also announced a price reduction of its 4404 AI system.

The 4406 is powered by Motorola 68020 microprocessor assisted by a 68881 floating point coprocessor.[2] It includes a 19 in, 60 Hz display with a resolution of 1280×1024. It has 2 Mbytes of RAM, 32 Kbytes of virtual memory address space[3] and a 90 Mbyte hard disk.

The 4405 is also powered by the Motorola 68020 with the 68881 floating point coprocessor, however it has a 13 in, 60 Hz screen with a 640×640 viewable display acting as a window onto the 1024×1024 addressable bit map (отображение). It has 1 Mbyte of RAM, 8 Kbytes of virtual memory address space and a 45 Mbyte hard disk.

According to Tektronix, these systems are aimed at artificial intelligence applications and include the Smalltalk-80 programming environment, a Unix-like operating system and a C compiler as standard features.

Colour Plotter from Versatec. A new plotter has been announced by Versatec Electronics. It was demonstrated for the first time at DEC'85 in Birmingham, UK.

The 24 in colour plotter uses Versatec's multipass colour plotting technique. The media is marked to end of plot on the first pass to ensure proper registration, the media is then rewound (перематывать) to the plot starting position. Four subsequent passes overlay the four colours: black, cyan (бирюзовый), magenta (красный), and yellow to produce the full colour output.

The plotter will plot on both paper and film. It is aimed at applications such as CAE, CAD, mapping (отображение) and general computer graphics. It has a resolution of 200 dots/in.

HP Workstations. Hewlett-Packard has expanded its HP 9000 computer family by adding a series of technical workstations, known as the Series 300.

Two CPUs are available: an entry level Motorola 68010 and a 32-bit 68020 for faster performance. Both configurations have 1 Mbyte of RAM as standard, but can be expanded to 7,5 Mbytes.

There are four bit-mapped displays on offer: two of medium resolution (512×400 pixels) on a 12 in screen, and two of higher resolution (1024×768 pixels), with 19 in colour screen and a 17 in monochrome screen.

The programming languages and operating systems available with the Series 300 include BASIC 4.0, PASCAL 3.1 and HP-UX (a Unix derivative[4]). The Series 300 will run most of Hewlett-Packard's Series 200 applications software.

Finite Element Analysis on Micro. A 3D structural analysis tool for IBM PC is being offered by Control Data. It is called the Cybernet Express Structures program.

According to Control Data, it is the first in a range of micro-based engineering workstation programs to be released. The whole range will be marketed under the Cybernet Express label (маркировочный знак) and will include piping (пересылка данных), power systems analysis, and project management systems.

Cybernet Express Structures can be used to perform finite element structural design and analysis. An interactive computer graphics facility is included in the system. Control Data said that the system is capable of analysing problems of up to 300 nodes, but larger problems can be transferred into mainframe codes such as Nastran or Ansys.

Automated VLSI Design. The Genesil family of automated VLSI design turnkey products has been extended by two further systems: the Genesil 100 and the Genesil 500. The manufacturers of the Genesil range provide their customers with service support and this includes training.

The Genesil system enables the user to work at the functional level as Genesil will generate timing and simulation models, power estimates, test vectors and finished layouts (топология). It supports VLSI designs in dual-layer metal CMOS and single-layer NMOS.[5]

The Genesil 100 system configuration includes a DEC Micro-Vax II with 2 Mbytes of RAM, 184 Mbytes of disk storage, a 95 Mbyte magnetic tape drive, a colour graphics terminal and DEC's Ultrix version of Unix.

The Genesil 500 system five-user configuration includes a DEC 11/785 VAX, 8 Mbytes of RAM, 450 Mbytes of disk storage, a 9 track magnetic tape drive and the Berkeley 4.2 version of Unix.

FORTRAN Graphics. GT-2-LIB is a graphics software library for 2D drafting and design. The library is written in FORTRAN and allows the standard features such as scale, shift, rotate, mirror and shear (срез) and also selective erase (стирание) and area fill (заполнение площади). It will drive any of the Counting House rasterscan terminals and is compatible with the Tektronix graphics terminals. GT-2-LIB is the first in a suite of CAD/CAM programs from Counting House.

AutoCAD has 3D Capabilities. Autodesk Inc., CA, has developed a new version of the AutoCAD program. Version 2.1 contains 3D visualizations, internal services, and other enhancements (модернизация) including support of many dot matrix and laser printers.[6] Improvements include an interactive pick function, nonlimits on drawing complexity, and a variable and macro facility, providing tools to create custom commands and functions. Wire-frame drawings can be viewed and plotted, with hidden line removal providing a realistic 3D image of solid objects.

NOTES

1. **a fine finishing cut** — снятие тонкой чистовой стружки
2. **a 68881 floating point coprocessor** — сопроцессор 68881 (в многопроцессорной системе) с плавающей точкой
3. **32 Kbytes of virtual memory address space** — адресное пространство виртуальной памяти в 32 килобайта
4. **a Unix derivative** — производный (язык) фирмы ЮНИКС
5. **in dual-layer metal CMOS and single-layer NMOS** — в двухслойных металлических комплементарных МОП-структурах и однослойных канальных МОП-приборах
6. **of many dot matrix and laser printers** — от многоточечной матрицы и лазерных печатающих устройств

CAD/CAM in Industry Abroad

Computers Help Build Cars. The automotive industry continues to be a leader in CAD/CAM, having some of the most extensive computer networks in the world. Ford Motor Co. has over 300 Prime Computers linking workstations in 30 different design and manufacturing sites. Through local-area networking and patch-switching,[1] operators can access data stored anywhere in the network. This allows, for example, the Body and Chassis Engineering Div.[2] to transfer design data to the Truck (грузовой автомобиль) Engineering Div. for review and analysis. The automaker uses the Product Design Graphics Systems (PDGS), a package developed internally by Ford and now marketed exclusively by Prime Computer Inc. Using this package, the company plans to produce 90% of its automotive designs on CAD systems by 1989.

Colour Monitor for CAD/CAM. Conrac has extended its range of high resolution graphic displays by adding a new model: the Conrac 7311 colour monitor.

The monitor has a 19 in screen with a resolution of 1280×1024 pixels. It has a 110 MHz video bandwidth (полоса частот), a 65 KHz horizontal scan rate and a 60 Hz vertical refresh rate.

According to Conrac the monitor is 'suited for CAD/CAM, CAE and other applications'. It is available in full cabinet (корпус). Conrac offers service and engineering support.

The basic monitor is priced at £742, but further options such as antiglare facilities[3] are available at extra cost. Conrac is aiming it at the OEM market.[4]

32-bit CAD/CAM. Graftek has introduced the Series 32 CAD/CAM system, based on a SEL 32/27 32-bit mini. The system can handle 12 workstations, but a typical configuration of CPU, hardware floating point, 300 Mbyte disk, 75 in/s magnetic tape, four monochrome raster displays and a 24 in/s plotter is rather expensive. Software is GMS, based on MCS's AD-2000.

Phoenix Launch. Phoenix Digital Computers Ltd. had launched in the UK 32-bit single board supermicro called the GS-32. It is aimed at OEM system builders supplying the CAD/CAM, CAE and industrial process control application areas.

The GS-32 uses the NatSemi 32032 chip and was designed in the USA by Goodspeed Systems Inc. Design software tools will be offered by Phoenix, including the GS-3200 development system which uses the Genix operating system (Genix is the National Semiconductor version of Berkeley Unix).

Drawings Annotated on PC. Auto-trol has produced a software package called Redliner which runs on the IBM PC, PC XT and PC AT systems. It allows Auto-trol's users to view and annotate (пояснять) drawings that have been created on its AGW (Advanced Graphics Workstations) family of workstations or on VAX-based CAD/CAM systems.

Auto-trol suggests that this provides a lower cost approach to shopfloor or on-site plant applications where users can review and edit CAD/CAM drawings as well as access PC software. However any annotations (комментарий) carried out affect only the copy of the drawing held on the PC and this prevents accidental tampering (случайная закалка) with the primary graphics file. These annotations are displayed as a reference file over the original at the host workstation.

CADAM — Auto CAD Translator. IBM's mainframe-based CAD system CADAM can be linked to Autodesk's AutoCAD which is microcomputer-based. CADCOR has developed a software translator that allows translation of drawings between AutoCAD and CADAM databases. CADCOR's software runs on IBM's 4300 series and 308X series mainframes and is executable from a PC linked to a mainframe.

CADCOR supports communication between AutoCAD on a PC and CADAM on a mainframe via an IBM 3270 coax (соосный) connection or a serial asynchronous ASCII transmission over a modem.[5]

CADCOR is a Californian company specializing in the integration of micro and mainframe systems particularly in the CAD/CAM field. It became an IBM complementary (дополнительный) marketing orgınization program participant for the CADAM system.

NOTES

1. **patch-switching** — переключение вставок в программе
2. **the Body and Chassis Engineering Div.** — отдел проектирования (конструкторское бюро) корпусов и ходовой части автомобиля
3. **such as antiglare facilities** — такие, как устройства по предотвращению ослепления (слепимости)
4. **at the OEM market** — рынок сбыта фирмы, являющейся основным изготовителем оборудования
5. **a modem (modulator-demodular)** — модуляр-демодуляр

Teaching CAD/CAM

Teaching the use of computer-aided design is growing field. Teachers, like pupils have widely varying levels of expertise. Courses and tutorials (консультация) are held by various commercial or institutional bodies, often employing knowledgeable practitioners of CAD as tutors (наставник). The content of these lectures may cover what CAD is, why and how to use it, how to select the best soft-/hardware for one's application and whom to buy it from.

This is the first in an occasional series of articles that look at the courses currently available for the manager, the first-time user and the CAD specialist. The aim of the course appears to be to give an inexperienced user of CAD/CAM, or a manager who intends to purchase (приобретать) a CAD system, a thorough briefing, and technology of the field. He (she) then is given more specific advice on what kind of software system would suit his (her) needs, and the advantages that computerization can bring. The three-day course is structured as follows: introduction; the computer graphics environment; the basic computer graphics technologies; what CAD/CAM is; CAD, CAM, CAE, CIM examples; CAD/CAM market today and tomorrow; how CAD/CAM is justified; what the choices are; management issues; other computer graphics applications; open workshop (открытый семинар).

In the course it is especially emphasized the importance of the 'New user', who should be able to use CAD without needing to know how the technology works. An analogy between the new CAD user and a car driver who has no idea of how to maintain his car is drawn.

The first day's programme covered a broad outline of CAD/CAM, what it does, and how it can help a business. There are some technical details of the hardware and software used in CAD and description of their functions. The course is well structured. It leads the inexperienced user in the more complex parts of the subject gradually (постепенно) and relates each fact to the wider background (фон) of the CAD/CAM field. The more experienced user is continually given fresh aspects of familiar subjects.

The documentation which accompanies the seminar is a volume (книга) of papers on various aspects of CAD/CAM with graphs and representative lists of CAD/CAM suppliers (поставщик) and service bureaus; a useful reference for anyone interested in using CAD/CAM after the course will be over.

A Model and Its Implementation in a Practical CAD/CAM Database (An abstract)

A practical CAD/CAM database system concept and a CAD specialized database are discussed. The CAD/CAM database system is organized with three-layered databases: global, local and working databases. A CAD specialized database is represented. Its comparison with the conventional or CODASYL database systems[1] is considered.

Key words: Database, CAD, CAM, CAD/CAM, DBMS, Geometric Model, Multi-layer Database.

1. Introduction. With the progress achieved in practical two- or three-dimensional CAD/CAM systems, file management functions have been required for effective management of a large volume of pictorial data. Especially, a lot of connection information, such as relationships (взаимосвязь) between arcs and nodes, has to be stored to manipulate three-dimensional objects effectively.

From a system development viewpoint, it is necessary to construct user application CAD systems using a core CAD/CAM system [2] which has been developed beforehand (ранее). The core system is customized with the user-dependent information introduction left to the users themselves. This leads to the necessity of data independency, the same as with conventional database management systems (DBMS). On the other hand, CAD/CAM systems are intended to include interactive functions. Therefore, CAD/CAM systems should process geometric operations as fast as possible.

The above factors mean that both performance and independency problems have to be resolved in order to realize CAD/CAM databases, though the problems are mutually (взаимно) related and hard to separate. To overcome (преодолевать) the problem, many researchers have worked in the field of engineering databases, where all the design information is stored.

The authors have already presented the multi-layered database architecture. This architecture includes three kinds of database called working, local and global databases.

This paper describes the multi-layered database architecture and the working database management system.

2. The CAD/CAM Database Concept. CAD/CAM databases have been recognized by researchers as a key facility to integrate a variety of product and manufacturing design activities, and have become the subject of renewed interest as an important factor for realizing an incorporate information system, the CIM. However, there are few effective CAD/CAM database architectures which conform to practical design activities, and few CAD/CAM database systems are practically used. For resolving this inherent problem, it seems to be necessary to reconsider CAD/CAM database concepts from the following viewpoints: 1) CAD/CAM Database Application Environments; 2) Design Organization Views; 3) Data Utilization Views; 4) Multi-Layered Database Systems.

We shall consider the last one. To realize a practical CAD/CAM database system, which conforms to the manufacturing organizations and design activities discussed, a multiple organized database system will be proposed. In the multi-layered database system the database is subdivided into three database organizations: **global**, **local** and **working databases**. (See Fig. 13.)

The **global database** maintains the common data, which is logically integrated in the enterprises. It is a permanent database, which is preserved during the product life-time.

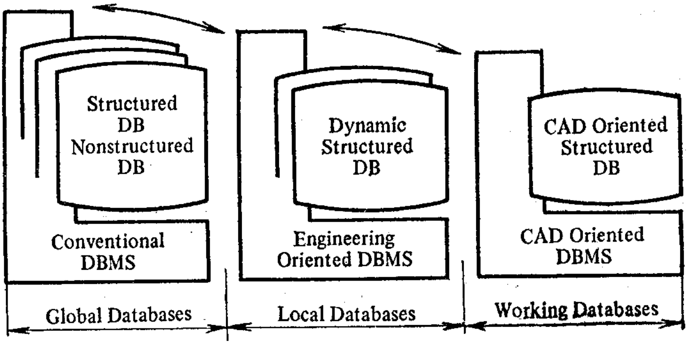

Fig. 13

The **local database** is maintained for an individual department and/or a designers group, according to CAD/CAM application distribution. The local database seems to be a subset of the global database; however, CAD/CAM applications only communicate with each other through the database which is organized with resulted design data, preserved data, common data in the department.

The **working database** supports an individual designer's work, and is organized with data relevant (рассматриваемый) as regards the individual designer. This database is a temporary database which is retained (сохранять) until termination of the design, such as in resulting design data, intermediate design data, current designing data, and reference object data. Since designers most frequently communicate with the personal database, it is necessary to realise interactive processing within a short period around time. Therefore, this database management system should be a CAD specialized database management system.

3. Working DBMS Implementation. The working DBMS implementation, i. e., functions and storage structures, is presented. The performance evaluation results are also described to show the system effectiveness.

3.1. CAD DBMS Functions. The interface between this system and application programs are as follows:

— View mechanism: view are defined by data type and ordering transformations.[3] No other transformations are employed, because of performance degradation and less usage.

— Interface region: application programs have to prepare the interface region through which data are stored in the database and extracted from the database. The size of this region can be determined by application needs; i. e., application programmers only allocate enough of their regions to use the database.

— A large number of data access: data accessing the same entity-type data at one time occurs frequently in CAD systems. Therefore, "bundle" data manipulation functions[4] are provided.

3.2. Internal Storage Structures and Performance Evaluation. The storage data structure for this system is, to a certain extent, the same as compared with a conventional storage structure. But to reduce internal processing overheads, the following features are considered: data transfer reduction, pointer access reduction, data directory compaction.

The CAD database management system was compared with both the conventional relational and CODASYL database management systems, from the performance viewpoint. The result is that this system is about three times faster than the CODASYL DBMS[5] and is also about ten times faster than the relational DBMS.[6]

4. Applications. To confirm the effectiveness of this system, the system has been included in a solid geometric model which can manipulate complete three-dimensional objects in a computer model. From the pointed above it is confirmed that the solid modeler with this system works well, especially faster than the other modelers with their special file management systems.

Engineering database architecture is an open but important problem in CAE research. Information structures stored in the engineering database have to be defined first. The working DBMS can be employed as one of the engineering DBMSs. The non-structured data and scientific data can be stored in the database of the system, as they are. However it is impossible to control this data transformation into the structured form. On the other hand, a lot of picture data can easily be stored and are well-organized efficiently, whether two-dimensional or three-dimensional.

5. Conclusion. This paper presented the CAD/CAM database concept and the working DBMS. The presented

CAD/CAM database concept called multi-layered database architecture, makes it possible to develop flexible application systems, step-by-step, and to optimize the system utilization from the performance, management and operational viewpoints. The working DBMS is a component of multi-layered database systems. It has been included in a real geometric modeler. This system can be used not only in CAD/CAM systems besides modelers, but also in interactive systems, because of good performance and functions relevant to non-structured data access.

(*The paper above is considerably abridged*)

NOTES

1. **CODASYL database systems** — кодасиловские системы баз данных, основанные на использовании указателей и индексов
2. **a core CAD/CAM system**—САПР/АСУ ТП с ферритовой памятью
3. **by data type and ordering transformations** — путем преобразования типов данных и команд
4. **"bundle" data manipulation functions** — функции по обработке «пучка» данных (информации)
5. **CODASYL DBMS** — кодасиловская СУБД
6. **the relational DBMS** — реляционная СУБД

A Machine Should Work, and Man—Think

The short, dynamic word "robot" was first coined back in the 1920s by Karel Čapek, a Czech writer and playwright.

Finishing work on his play "R.U.R", the only thing left for Čapek was to think up a word to designate the play's characters—humanoid machines. True, Karel Čapek was thinking of calling them "labors" from the Latin word for *work*.

"Don't you think it might be a little too pretentious?" — he asked his artist brother, Iosef Čapek. "Labors, la-bors. But why not base it on the Czech language? Call them robots."

That was how the Čapek brothers coined the word "robot", now included in practically all the world's languages.

The robots of our time resemble humans very little. According to specialists, the main thing is for them not to look like people, but to just do their work for them. Factories equipped with automatic machine tools, transfer lines and management information systems place a lot of hope in them.

Automation has stepped up the machining of the most sophisticated items, improving precision and quality of output, but it has demanded that the fulfilment of all the auxiliary operations be likewise as precise and quick. And this became the job for modern robots.

Automation sought (искать) out areas where a robot can operate as well as a person but where people are reluctant (делать с неохотой) to work. In other words man has created the robot so as not to become a robot himself.

What They Can Do. By borrowing (заимствовать) Karel Čapek's name, sci-fic[1] writers did a disservice[2] to the first production robots. They appeared in the 1960s and were a far cry[3] from their literary prototypes which were superendurable (сверхвыносливый), superquick, superstrong and superintellectual. In addition to that, they were complex and capricious (капризный) in maintenance.

One of the first-generation robots could perform operations of the type "take off — put on" or "pick up — bring". It replaced several stevedores (портовый грузчик) and riggers (такелажник). However, it could pick up billets (заготовка) or other items only from definite positions determined by a rigid programme.

Today, to avoid errors, robots are supplied with vision (TV camera) and hearing (microphone). Man entrusts (поручать) to second-generation robots the performance of more complex production operations — painting, soldering (пайка), welding (сварка) and assembly work.

A more complex task lies ahead — to remove people completely from production areas where there are harmful fumes (вредные испарения), exclusively high or low temperatures and pressure. People should not work in conditions that are hazardous (опасный). Let the robot replace them there — and the sooner, the better. That is how Soviet scientists understand one of the main humanistic tasks of robotics of our time.

Variations Are Possible. Does this mean that first-generation robots have done what they could and can leave the production scene? The experts say not at all. The USSR and the other socialist countries have a great need for such machines, especially during loading-unloading operations.

Variations are possible, too — robots of several generations operate together, within a single team. And the machine of the higher class secures the necessary working condition for the other, rigidly-programmed robots.

Generally speaking, a single robot by itself is hardly of any use in production. It must be coupled in design with other equipment — with a system of machines, machine tools and other devices. The task is to set up robotized complexes and flexible productions capable of transferring easily and quickly to an output of new goods.

Flexible production systems (FPSs) consist, as a rule, of several machine tools with numerical programmed control (NPC), or of processing centres—machine tools equipped with microprocessors. The FPSs also include robot loaders, which deliver and take off items, and transport robots. All-purpose computers control the entire cycle, including the storage facilities.

The USSR started making FPSs in the 70s and now has more than 60 such systems for different purposes. In 1985 a large-scale production of robots started at the Krasny Proletary plant in Moscow. The Soviet programme, calculated till 2000, provides for building over 1,800 FPSs in different parts of the country.

Robots Steal Jobs. Japan holds the lead in the world for robot production. No wonder it is called "the land of robots". It was precisely robots that served as the main "task force" of the Japanese automotive firms in their struggle against their US rivals. Because of robots, the Japanese automotive industry produces some 60 cars per worker per year as against 20 cars—in the USA. In order to start the output of a new model the US General Motors Corporation stops the assembly line for several weeks, whereas this conversion takes only a few hours at the Japanese plants equipped with robots.

According to the Organization for Economic Cooperation and Development (OECD) the number of jobs to be liquidated by 1990 due to introduction of robots in the manufacturing industry alone, will reach 3 per cent in Japan and Sweden, 1.5 per cent in West Germany, 1—in the USA and 0.5 per cent—in France and the United Kingdom.

Each such per cent stands for hundreds and thousands of people who are to be laid off in the near future. According to the NBC TV network in the USA, when unemployment in the USA rises 1 per cent, the suicide rate (количество самоубийств) goes up by 4 per cent, the number of murders (убийство)—by over 5 per cent, the number of patients at mental institutions—by 3, the number of prisoners in jails (тюрьма)—by 4 and the death rate by 2 per cent.

The Social Goal is in the Forefront. In the USSR robotization will not, to the contrary, lead to unemployment. The society and the state is concerned well in advance that the workers freed from different sections and whole industries would be transferred to other industries, where (also in a planned way) the necessary jobs are set up and conditions are brought about for training personnel. After taking special training at state expense, the workers become highly skilled operators of automatic systems and adjusters of robots and are able to work at places where they are needed. And we must say that in the socialist countries the replacement of people by a robot in harmful and dangerous operations is justified even when it doesn't produce profit. The social goal is in the forefront.

This, of course, doesn't mean at all that robotization problems are automatically solved under socialism. The first steps taken by robots in the USSR, too, were not plain sailing. Not everybody, especially conservative-minded administrators, liked the innovation. However, now there are less and less economic managers who fail to grasp the ideas concerning the acceleration of scientific and technical progress.

'The Russian Robots Are Coming.' An article so entitled was published several years ago in *Business Work* magazine. The US magazine expressed the opinion that the USSR would occupy a high place in the world as far as the number of operating robots is concerned.

And indeed, at the end of the last five-year period the fleet of industrial robots in the USSR numbered 50,000 which is quite comparable with the situation in the industrialized countries in the West. Today Soviet enterprises produce over 1,000 robots every month.

The new edition of the CPSU Programme says that robotization will be introduced at an ever bigger scale together with electrification, chemicalization and computerization of production and also with the development of biotechnology.

Simultaneously the task has been posed to close the gap (разрыв) between us and the majority of the leading Western countries in the number of the more sophisticated robots. By 1990 many of the Soviet robots will be able to "see", will have other "senses", and some "egg-heads" («интеллектуалы») will be able to make independent decisions.

"It is possible to assemble robots of all degrees of sophistication, including those with elements of artificial intellect out of a large number of such modules, as if out of children's cubes," says Professor Yevgeny Yurevich, a Leningrad scientist, who heads the council of industrial robotics of the CMEA countries.

It seems that the term "artificial intellect", which only recently used to generate so many sharp agreements, is becoming as familiar as computer "memory" or "machine logic". There is already talk of making thinking robots. How is this work progressing? "Not as quickly as we scientists thought it would at first," Professor Yurevich says. "It cannot be done without real profound knowledge. We must analyse human behaviour, study the human thinking processes, so as to be able to recreate (воссоздавать) them later on artificially. But personally I am absolutely convinced that a thinking robot, once it gets the ability for self-perfection, will enter the process of evolution. But in this case human possibilities are not the limit. Starting at the point at which the evolution of living beings created man, the evolution of robots promises to surpass (превосходить) man's possibilities in certain fields. Apparently, robots will appear which will be able to discourse (рассуждать), understand and acquire the ability to study. Who knows, maybe they will be able to enrich (обогащать) our concepts about the world around us.

"We can guess all we like about the capabilities of the robot generation yet to come, but one thing is certain — a robot will never be able to grasp even the semblance (подобие) of such emotions as love, honour, pride, compassion, pity, courage and selflessness, i. e., of all that comprises the innate essence of humanity."[4]

NOTES

1. **sci-fic = science fiction** — научная фантастика
2. **to do disservice** — оказывать плохую услугу
3. **to be a far cry** — *зд.* очень отличаться
4. **the innate essence of humanity** — прирожденная сущность гуманизма

PART III

ТЕРМИНОЛОГИЧЕСКИЙ СЛОВАРЬ ПО САПР И ГПС

A

access ['ækses] выборка (из памяти); обращение (к памяти); доступ; **memory a.** выборка из памяти; обращение к памяти

accuracy ['ækjurəsı] четкость, точность (изображения)

acquisition [ˌækwı'zıʃən] сбор (данных, информации)

acronym ['ækrənım] акроним

advanced [əd'vɑ:nst] прогрессивный; усовершенствованный; улучшенный; продвинутый; **a. DBMS** СУБД с улучшенными свойствами

advantage преимущество (*напр.*, в проектировании)

aid [eıd] помощь; метод; средство; пособие (учебное); **debugging aa.**[1] средства отладки; **symbolic aa.** символические средства

allocation [ˌælə'keıʃən] размещение; распределение; **memory a.** распределение памяти

alphanumeric ['ælfənju:'merık] буквенно-цифровой

analysis [ə'næləsıs] анализ; теория, теоретические исследования; **cost-effectiveness a.** инженерно-экономический анализ; **finite-element a.** анализ конечных элементов; **heat transfer a.** анализ процессов передачи тепла; **numerical a.** численный анализ; **system a.** системный анализ; **transient dynamic a.** динамический анализ переходных процессов

animation [ˌænı'meıʃən] оживление (динамическое); мультипликация

application [ˌæplı'keıʃən] применение; использование; прикладная задача; работа; прикладная система

applied [ə'plaıd] прикладной

approach [ə'proutʃ] подход; приближение; метод; принцип; **basic aa.** основные подходы

array [ə'reı] матрица; массив; решетка; сетка; таблица; **gate a.** вентильная матрица

artefact=artifact ['ɑ:tıfækt] артефакт (структура, полученная в результате обработки человеком или ЭВМ)

assembling [ə'semblıŋ] сборка; монтаж; компоновка

auxiliary [ɔ:g'zıljərı] вспомогательный; дополнительный

available [ə'veıləbl] доступный, пригодный; имеющийся в про-

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[1] Здесь и далее повторение первой буквы слова означает множественное число.

даже; **commercially a.** реально существующий; серийно выпускаемый
axis ['æksɪs] (*pl* axes) 1. ось; 2. осевой

B

base [beɪs] база; основа; основание; **datab.** база данных; **knowledge b.** база знаний
bit map битовое (разрядное) отображение
board [bɔ:d] плата; доска (коммутационная); панель; **drawing b.** чертежная доска; **multi-layer b.** многослойная плата; **printed b.** печатная плата
boundary ['baundərɪ] 1. граница; 2. граничный
brightness ['braɪtnɪs] яркость (изображения на экране)
built-in ['bɪlt'ɪn] встроенный, вмонтированный; внутренний

C

carousel [,kæru'zel] карусель
cart [kɑ:t] транспортная тележка
cell [sel] ячейка; модуль; секция; элемент; станция; **flexible manufacturing cc.** гибкие автоматизированные производственные станции (центры)
certainty ['sə:tntɪ] достоверность; **numerical c.** численная достоверность
chip [tʃɪp] кристалл, чип, интегральная схема; **single-c.** на одном кристалле (чипе)
circle ['sə:kl] круг, окружность
circuit ['sə:kɪt] схема; цепь; контур; **large-scale integrated c.** большая интегральная схема; **printed c.** печатная схема; **solid-state c.** полупроводниковая схема
command [kə'mɑ:nd] команда; **Boolean logic cc.** команды Булевой логики; **difference c.** команда разности; **intersection c.** команда пересечения; **union c.** команда объединения
compatible [kəm'pætəbl] совместимый; сочетаемый
compiler [kəm'paɪlə] компилирующая программа; компилятор
component [kəm'pounənt] деталь; элемент; компонента
computer [kəm'pju:tə] вычислительная машина, компьютер; **dedicated c.** специализированный компьютер; **"friendly" c.** «дружественный» компьютер; **front-end c.** связующий компьютер (для предварительной обработки данных); **general-purpose c.** универсальный компьютер; **host c.** центральный (главный) компьютер; **special-purpose c.** специализированный компьютер; **uploaded host c.** загруженный центральный компьютер
conclusion [kən'klu:ʒən] заключение, вывод; **drawing cc.** выведение заключений, выводов
condition [kən'dɪʃən] условие; состояние; режим; ситуация
conductor [kən'dʌktə] проводник; провод
constraint [kən'streɪnt] ограничение
continuity [,kɔntɪ'nju:ɪtɪ] непрерывность
contour ['kɔntuə] контур; очертание; **complex cc.** сложные контуры (очертания)
control [kən'troul] 1. управление; контроль; 2. управлять; **job. c.** управление потоком заданий; **numerical c.** числовое программное управление (ЧПУ); **off-line c.** автономное управление; **on-line c.** управление от центрального процессора; **process c.** управление процессом
controller [kən'troulə] контроллер; регулятор
conventional [kən'venʃənl] традиционный; общепринятый
conversion [kən'və:ʃən] преобразование; превращение
conveyance [kən'veɪəns] перевозочное средство
conveyor [kən'veɪə] конвейер
copy ['kɔpɪ] 1. экземпляр; копия; 2. копировать; печатать
core [kɔ:] сердечник; память на магнитных сердечниках
courseware ['kɔ:swɛə] учебное обеспечение; учебный курс

criss-cross ['krɪskrɔs] крест-накрест
crosshatch ['krɔshætʃ] заштриховывать
cross-section ['krɔs,sekʃən] поперечное сечение
current ['kʌrənt] (электрический) ток; текущая запись; поток; **alternating c.** переменный ток; **direct c.** постоянный ток
curvature ['kə:vətʃə] кривизна (детали, образца)
curve [kə:v] кривая; характеристика; **complex cc.** сложные кривые; **envelope c.** огибающая кривая; **French c.** лекало
cybernetics [,saɪbə:'netɪks] кибернетика
cycle ['saɪkl] 1. цикл; период; 2. работать циклами

D

data ['deɪtə] данные; информация; **alphanumeric d.** буквенно-цифровые данные; **built-in d.** встроенные (в программу) данные; **fixed d.** фиксированные данные
database ['deɪtəbeɪs] база данных
debugging [dɪ'bʌgɪŋ] отладка (программы); наладка (машины)
deburring [dɪ'bɑ:rɪŋ] удаление заусенцев
decision [dɪ'sɪʒən] решение; выбор; **design dd.** проектные решения; **d. making** принятие решений
dedication [,dedɪ'keɪʃən] выделение (назначение) ресурсов системы для одного какого-нибудь применения или одной цели
deflection [dɪ'flekʃən] отклонение
degree [dɪ'gri:] степень; порядок; градус
depository [dɪ'pɔzɪtərɪ] хранение; хранилище; **electronic d.** электронное хранилище
description [dɪs'krɪpʃən] описание; характеристика; **model d.** описание модели
design [dɪ'zaɪn] 1. проектирование; конструирование; 2. проектировать; **d. draft** проектный чертеж; **d. capture** сбор данных для проектирования; **computer-aided d.** автоматизированное проектирование; **three-dimension d.** трехмерное проектирование; **two-dimension d.** двухмерное проектирование
designer [dɪ'zaɪnə] разработчик; проектировщик; конструктор
destination [,destɪ'neɪʃən] место назначения (записи) информации
determine [dɪ'tə:mɪn] определять; вычислять; детерминировать
detour [dɪ'tuə] уход; обход; удаление
development [dɪ'veləpmənt] разработка; развитие; усовершенствование; развертывание; разложение
device [dɪ'vaɪs] устройство; прибор; механизм; элемент; **hard-copy d.** устройство выдачи печатных копий
digit ['dɪdʒɪt] 1. цифра; число, разряд; символ; 2. цифровой
digitizer ['dɪdʒɪtaɪzə] цифрователь; цифровой преобразователь; **graphic d.** преобразователь из графической формы в цифровую; **picture d.** преобразователь изображения в цифровой код
direction [dɪ'rekʃən] направление; управление; инструкция
discontinuity ['dɪs,kɔntɪ'nju:ɪtɪ] неоднородность
disk [dɪsk] диск; круг; **floppy d.** гибкий диск; **hard d.** жесткий диск
displacement [dɪs'pleɪsmənt] смещение; сдвиг; перемещение
display [dɪs'pleɪ] 1. дисплей; устройство отображения; 2. отображать; **graphic d.** графический дисплей; отображение графической информации
dissemination [dɪ,semɪ'neɪʃən] распространение
distribution [,dɪstrɪ'bju:ʃən] распределение
division [dɪ'vɪʒən] деление; раздел; отделение
domain [də'meɪn] область; домен (в реляционных базах данных); **application d.** область применения (приложения); **knowledge d.** область (банк) знаний
dot [dɔt] 1. точка; пунктир; 2. наносить пунктир

drafting ['drɑːftɪŋ] черчение; изготовление чертежей
draftsman ['drɑːftsmən] чертежник
draw [drɔː] чертить; рисовать; тянуть
drawback ['drɔːbæk] недостаток; препятствие; помеха
drawing ['drɔːɪŋ] чертеж; рисунок; изображение; **shop dd.** рабочие чертежи
drive [draɪv] привод; передача; накопитель
driver ['draɪvə] драйвер; привод; возбудитель; формирователь

E

edge [edʒ] край (карты, ленты); фронт (импульса); грань (кристалла)
edit ['edɪt] редактировать
efficiency [ɪ'fɪʃənsɪ] эффективность; к. п. д.
elaboration [ɪˌlæbə'reɪʃən] развитие; реализация; разработка
eliminate [ɪ'lɪmɪneɪt] устранять; исключать; заменять
emergency [ɪ'məːdʒənsɪ] непредвиденный случай; авария
engineering [ˌendʒɪ'nɪərɪŋ] проектирование; техника; инженерия
enterprise ['entəpraɪz] предприятие; предметная область (базы данных)
entity ['entɪtɪ] объект; сущность; категория
entrance ['entrəns] вход; введение (в программу)
entry ['entrɪ] вход; ввод; запись; подача; компонента; элемент
envelope ['envɪloup] огибающая линия
environment [ɪn'vaɪərənmənt] вычислительные (функциональные) средства; окружающее оборудование; окружающая среда
equation [ɪ'kweɪʃən] уравнение; равенство
equipment [ɪ'kwɪpmənt] оборудование; аппаратура; приборы; **computer e.** аппаратура компьютера; **control e.** аппаратура управления; **material handling e.** оборудование, управляющее потоком материалов; **peripheral e.** периферийное (внешнее) оборудование
erase [ɪ'reɪz] стирать (запись); разрушать (информацию)
error ['erə] ошибка; погрешность; **e.-free** свободный от ошибок
execute ['eksɪkjuːt] исполнять, выполнять; осуществлять
existence [ɪg'zɪstəns] существование
expanded [ɪks'pændɪd] расширенный (о языке)
experience [ɪks'pɪərɪəns] опыт; опытность; квалификация
expertise [ˌekspəː'tiːz] экспертиза; эрудиция; специальные знания
expose [ɪks'pouz] экспонировать; выставлять
expression [ɪks'preʃən] выражение
extension [ɪks'tenʃən] расширение; продолжение; протяженность
external [eks'təːnəl] внешний; наружный

F

face [feɪs] поверхность; сторона; уровень; экран
facility [fə'sɪlɪtɪ] устройство; *pl* средства; оборудование; **antiglare f.** устройство по предотвращению слепимости (на экране); **explanation f.** объясняющее устройство; **interpretation f.** интерпретирующее устройство; **knowledge acquisition f.** устройство для сбора знаний (сведений)
fail [feɪl] выходить из строя (о приборе, детали и т. п.)
failure ['feɪljə] повреждение; сбой; неудача; проигрыш
fault [fɔːlt] повреждение; ошибка; недостаток; дефект; **short f.** кратковременное повреждение
feature ['fiːtʃə] 1. черта; особенность; признак; 2. отличаться
feed [fiːd] (fed) 1. подача; питание; 2. подавать; питать
fetching ['fetʃɪŋ] вызов; выборка (данных из памяти)
figure ['fɪgə] цифра; число; рисунок; чертеж; **animated ff.** оживленные (динамические) рисунки
file [faɪl] файл; картотека; комплект

fitting ['fɪtɪŋ] сборка; монтаж; подгонка; сглаживание
fixed [fɪkst] фиксированный, неподвижный; постоянный
fixture ['fɪkstʃə] 1. зажимное приспособление; 2. зажимать (деталь, заготовку)
flexibility [,fleksə'bɪlɪtɪ] гибкость; **software f.** гибкость программного обеспечения
floating ['floutɪŋ] плавающий; отключенный; **f.-point** с плавающей точкой (запятой)
flow [flou] поток (данных, информации); **f.-chart** блок-схема; схема потока информации
font [fɔnt] комплект шрифта; **lettering ff.** буквенные шрифты
frame [freɪm] фрейм (единичный блок данных в графике); кадр
framework ['freɪmwə:k] основа; структура; каркас; строение
frequency ['fri:kwənsɪ] частота; повторяемость; **natural f.** собственная частота
friction ['frɪkʃən] трение; сила трения
front-ends ['frʌnt'endz] фронтальные (связные) компьютеры
function ['fʌŋkʃən] функция; зависимость; **B-spline f.** Б-сплайновая функция

G

gap [gæp] зазор; разрыв; интервал; пробел; отсутствие сигнала
gate [geɪt] 1. вентиль; логический элемент; 2. пропускать
generation [,dʒenə'reɪʃən] производство; создание; поколение (ЭВМ)
geometry [dʒɪ'ɔmɪtrɪ] геометрия; **part g.** геометрия детали
grid [grɪd] сетка; механизм захвата (перфокарт)

H

handle ['hændl] 1. ручка; рукоятка; 2. управлять; оперировать
hardcopy ['hɑ:dkɔpɪ] копия на твердой основе
hardware ['hɑ:dwɛə] аппаратура; аппаратное обеспечение; **drafting h.** чертежное оборудование
heading ['hedɪŋ] заголовок; рубрика
high-speed ['haɪ'spi:d] быстродействующий; скоростной
holding ['houldɪŋ] хранение (информации); блокировка

I

identification [aɪ,dentɪfɪ'keɪʃən] идентификация; отождествление
image ['ɪmɪdʒ] 1. образ; изображение, отображение; 2. изображать; **screen ii.** экранные изображения (образы); **solid-state i.** полупроводниковое изображение; **wire-frame ii.** каркасные (скелетные) изображения (образы)
implement ['ɪmplɪmənt] 1. орудие; инструмент; 2. выполнять; осуществлять
implementation [,ɪmplɪmen'teɪʃən] внедрение; реализация; ввод в работу
impression [ɪm'preʃən] отпечаток; оттиск; впечатление
incompatibility ['ɪnkəm,pætə'bɪlɪtɪ] несовместимость
inference ['ɪnfərəns] логический вывод; следствие; заключение
informatics [,ɪnfɔ:'mætɪks] информатика
information [,ɪnfə'meɪʃən] информация; сведения; **reference i.** справочная информация
initiate [ɪ'nɪʃɪeɪt] начинать; включать; записать; инициировать
inquiry [ɪn'kwaɪərɪ] запрос; опрос; исследование; спрос
installation [,ɪnstə'leɪʃən] сооружение; установка; оборудование
instruction [ɪn'strʌkʃən] команда; инструкция; **NC machining ii.** машинные команды для ЧПУ
instrument ['ɪnstrumənt] прибор; орудие; инструмент
intelligence [ɪn'telɪdʒəns] интеллект; сведения; сообщения; **artificial i.** искусственный интеллект; **machine i.** машинный интеллект
interaction [,ɪntər'ækʃən] взаимодействие; взаимосвязь
interactive [,ɪntər'æktɪv] интерактивный; взаимодействующий

interconnection [ˌɪntəkə'nekʃen] внутреннее соединение; межсоединение; разводка; взаимосвязь; взаимозависимость
interface ['ɪntəfeɪs] 1. интерфейс; устройство сопряжения; 2. сопрягать; **comprehensive i.** интеллектуальный интерфейс
interrelation ['ɪntə:rɪ'leɪʃən] взаимозависимость; взаимосвязь
interruption [ˌɪntə'rʌpʃən] прерывание; прерывистость
item ['aɪtəm] элемент; позиция; пункт; единица; статья

J

job [dʒɔb] задание; задача; работа
jump [dʒʌmp] 1. переход; команда перехода; 2. переходить; **conditional j.** условный переход; **unconditional j.** безусловный переход
joystick ['dʒɔɪstɪk] координатная ручка; рычажный указатель; джойстик

K

kernel ['kə:nl] 1. ядро; 2. ядерный; базовый
key [ki:] 1. клавиша; ключ; код; шифр; 2. ключевой
keyboard ['ki:bɔ:d] клавиатура
know-how ['nouhau] умение; знание дела; секреты производства
knowledge ['nɔlɪdʒ] знание; **implicit kk.** неявные знания; **specific kk.** конкретные знания

L

label ['leɪbl] 1. метка; маркировочный знак; 2. помечать; маркировать
language ['læŋgwɪdʒ] 1. язык; 2. языковой; **application development l.** непроцедурный язык высокого уровня, позволяющий программисту выполнять прикладные программы; **object l.** объектный язык; выходной язык; **problem-oriented l.** проблемно-ориентированный язык; **reference l.** эталонный язык; **source l.** исходный язык; входной язык
layer ['leɪə] слой; уровень (иерархии); **dual-l.** двухслойный; **multi-l.** многослойный
layout ['leɪ'aut] компоновка; топология
level ['levəl] уровень; степень
lever ['li:və] рычаг; балансир; рукоятка
life-time ['laɪftaɪm] время жизни; срок службы (работы)
lightpen ['laɪtpen] световое перо
light-sensitive ['laɪt 'sensɪtɪv] светочувствительный
line [laɪn] линия; шина; провод; строка; **curved ll.** кривые линии; **flexible transfer ll.** гибкие линии передач; гибкие транспортные линии (конвейеры); **hidden ll.** скрытые линии; **off-l.** вне ЭВМ; автономно; отдельно от ЭВМ; **on-l.** непосредственно; неавтономно (с управлением от ЭВМ); **straight ll.** прямые линии
link [lɪŋk] 1. звено; связь; команда возврата; 2. связывать; соединять
linkage ['lɪŋkɪdʒ] связь; возврат; переход с возвратом
list [lɪst] 1. список; перечень; 2. составлять список (перечень)
listing ['lɪstɪŋ] распечатка; листинг
load [loud] 1. нагрузка; загрузка; ввод; 2. загружать; нагружать
location [lou'keɪʃən] ячейка; адрес ячейки; размещение; расположение
loop [lu:p] петля; контур; цикл; цепь
loss [lɔs] потеря; потери; проигрыш
low-speed ['lou'spi:d] медленный, малого быстродействия

M

machinery [mə'ʃi:nərɪ] машины; механизмы; оборудование
main [meɪn] главный; основной; *pl* электросеть
mainframe ['meɪn'freɪm] большая ЭВМ
maintenance ['meɪntɪnəns] эксплуатация; уход; обслуживание;

operating m. текущее обслуживание и ремонт; **preventing m.** профилактический ремонт; **program m.** обслуживание программного обеспечения

malfunction [mæl'fʌŋkʃən] сбой; неправильное срабатывание

management ['mænɪdʒmənt] управление; организация; руководство; **industrial process m.** управление производственными процессами; **job m.** управление заданиями

manual ['mænjuəl] 1. руководство; справочник; 2. ручной; **computer m.** инструкция (руководство) к ЭВМ; **reference m.** справочное руководство; справочник

manufacturer [,mænju'fæktʃərə] разработчик; изготовитель

map [mæp] карта; план; схема; отображение

mapping ['mæpɪŋ] отображение; составление карты (схемы); **visual m.** визуальное отображение

master ['mɑ:stə] главный; ведущий; основной

matching ['mætʃɪŋ] согласование; сравнение; подгонка; **pattern m.** сравнение эталонов (образцов)

material [mə'tɪərɪəl] материал; вещество; **raw m.** сырье, исходный материал

matrix ['meɪtrɪks] матрица; дешифратор; сетка из резисторов; **dot m.** точечная матрица

mean [mi:n] 1. средняя величина; 2. средний; 3. *pl* средство; 4. значить, означать; иметь значение

meaning ['mi:nɪŋ] значение; символ; содержание

measure ['meʒə] 1. мера; масштаб; 2. измерять; вычислять

measurement ['meʒəmənt] измерение; вычисление; размер

medium ['mi:djəm] (*pl* media) среда; средство; носитель; среднее число; **drafting m.** чертежное средство

memory ['memərɪ] память, запоминающее устройство (ЗУ); **addressable m.** оперативная память (с присвоенными адресами); **external m.** внешняя память; **internal m.** внутреннее запоминающее устройство; оперативная память (ОЗУ); **main m.** основная память; оперативная память (ОЗУ); **mass m.** массовая память; память большой емкости; **magnetic bubble m.** память на магнитных доменах; **virtual m.** виртуальная память

menu ['menju:] меню (предлагаемый системой набор данных); **extensive surface mm.** расширенные меню поверхностей; **functional m.** меню функций; набор функций; **hierarchical mm.** иерархические меню (команды) (в машинной графике); **plastic m.** пластмассовая клавиатурная карта (для дистанционного сенсорного управления клавиатурой в системе машинной графики)

mode [moud] режим (работы); способ; метод; принцип (работы); **interruption m.** режим прерываний

model ['mɔdl] 1. модель; образец; 2. моделировать; **behavioural mm.** поведенческие модели; **solid m.** объемная модель; модель твердого тела; **surface m.** модель поверхности

modelling ['mɔdəlɪŋ] моделирование; **procedural m.** процедурное моделирование

module ['mɔdju:l] модуль; модульный отсек; блок

monitor ['mɔnɪtə] 1. монитор; диспетчер; 2. управлять; контролировать

motion ['mouʃən] движение (элементов изображения на экране)

mouse [maus] (*pl* mice) «мышь» (устройство для отработки положения указателя на экране дисплея); **rolling m.** перемещающаяся «мышь»

movement ['mu:vmənt] движение, перемещение

multiaddress [,mʌltɪə'dres] многоадресный

multiple ['mʌltɪpl] 1. многократный; 2. кратное число

multiprocessing [,mʌltɪ'prousesɪŋ] многопроцессорная обработка

N

net [net] сеть; сетка; схема

network ['netwə:k] сеть; сетка; схема; контур; сетевой график; **conveyance n.** сеть перевозочных средств

node [noud] узел (графика); точка пересечения (в математике)

notation [nou'teıʃən] система счисления; запись; представление

O

off-line ['ɔf'laın] автономный; независимый

offset ['ɔ:fset] смещение; сдвиг

off-the-shelf ['ɔ:fðə'ʃelf] готовая продукция (изделие)

on-line ['ɔn'laın] неавтономный, зависимый

on-the-shelf ['ɔnðə'ʃelf] неготовая продукция

operation [,ɔpə'reıʃən] действие; операция; работа; режим; **conversational o.** работа в диалоговом режиме; **database o.** работа (операция) над (с) базой данных

option ['ɔpʃən] выбор; вариант, версия; возможность; опция; **default o.** выбор по умолчанию; стандартный выбор, выполняемый операционной системой при отсутствии указаний пользователя; **drum o.** вариант операционной системы на барабане; **off-grid o.** возможность выхода за пределы сетки; **off-screen o.** возможность выхода за пределы экрана; **time-sharing o.** возможность работы с разделением времени

options ['ɔpʃənz] факультативное оборудование; факультативные программные средства; **editing o.** факультативные средства редактирования; **prewired o.** предварительно замонтированное факультативное оборудование; **time-sharing o.** средства обеспечения режима работы с разделением времени; **user o.** возможности (системы), доступные пользователю

overflow ['ouvəflou] переполнение, избыток

own [oun] собственный (в языках программирования)

P

package ['pækıdʒ] пакет; модуль; блок; **application pp.** прикладные программы; **application program p.** пакет прикладных программ (ППП)

pallet ['pælıt] транспортный стеллаж; накладка; шпатель

part [pɑ:t] часть; запасная часть; деталь; совокупность; **machine pp.** детали машин, механические детали

path [pɑ:θ] траектория; путь; дорожка; маршрут; цепь; **cutter p.** путь режущего инструмента

pattern ['pætən] образец; модель; шаблон; набор; схема

performance [pə'fɔ:məns] характеристика; производительность; выполнение

peripherals [pə'rıfərəlz] периферийное оборудование (устройства)

photocell ['foutəsel] фотоэлемент

photocopier ['foutoukɔpıə] фотокопировальное устройство

picture ['pıktʃə] изображение; шаблон; образец

pipeline ['paıplaın] конвейер; шина; магистраль

pipelining ['paıplaınıŋ] конвейерная обработка (режим)

piping ['paıpıŋ] конвейерная пересылка (данных, информации)

pixel ['pıksıl] элемент изображения

placement ['pleısmənt] размещение (данных, БИС, деталей, заготовок)

planning ['plænıŋ] планирование; **computer-aided process p.** автоматизированное планирование производственного процесса; **materials requirements p.** планирование требований к материалам

plate [pleıt] пластина; плата; диск (в памяти); анод; **printing pp.** печатные формы (типографские)

playback ['pleıbæk] воспроизведение; считывание

plot [plɔt] график; кривая; диаграмма
plotter ['plɔtə] графопостроитель; самописец; **drum p.** барабанный графопостроитель; **flatbed p.** планшетный графопостроитель; **graph p.** графопостроитель; **pen p.** перьевой графопостроитель
plug-in ['plʌgɪn] съемный, сменный
point [pɔɪnt] точка; пункт; место; запятая (в математике); **binary p.** двоичная точка (запятая); **decimal p.** десятичная точка (запятая); **fixed p.** фиксированная точка (запятая); **floating p.** плавающая точка (запятая)
power ['pauə] мощность; энергия; способность; степень; **computing p.** вычислительная мощность (ресурс); **processing p.** производительность (ЭВМ)
primitives ['prɪmɪtɪvz] базисные элементы; примитивы
printer ['prɪntə] печатающее устройство; **high-speed laser p.** быстродействующее лазерное печатающее устройство
priority [praɪ'ɔrɪtɪ] приоритет
procedure [prə'si:dʒə] процедура; методика проведения
process ['prouses] 1. процесс; режим; ход; 2. обрабатывать
processor ['prousesə] процессор; устройство для обработки данных; **custom p.** заказной процессор, изготовленный по техническим условиям заказчика; **bit-slice p.** микропроцессор с разрядно-модульной структурой; **dedicated p.** специализированный процессор; **floating-point p.** процессор с плавающей точкой (запятой); **primary p.** первичный (исходный) процессор; **stand-alone p.** автономный процессор
produce [prə'dju:s] производить; порождать; синтезировать
product ['prɔdəkt] продукт; изделие; **design p.** проектируемое изделие
program(me) ['prougræm] 1. программа; 2. программировать; **application p.** прикладная программа; **conventional p.** традиционная программа; **debugging p.** программа отладки; **general-purpose p.** универсальная (общесистемная) программа; **graphics display p.** программа графического воспроизведения; **heuristic p.** эвристическая программа; **source p.** исходная программа; **object p.** объектная программа; **special-purpose p.** специализированная программа; **stock pp.** запасные (резервные) программы
programming ['prougræmɪŋ] программирование; планирование

Q

quality ['kwɔlɪtɪ] качество; достоинство
quantity ['kwɔntɪtɪ] количество; величина; размер
query ['kwɪərɪ] запрос; **on-line q.** неавтономный запрос; запрос от основного оборудования вычислительной системы
queue [kju:] очередь; очередность (запросов); список очередности

R

raster ['ræstə] 1. растр; строки на экране телевизора; 2. растровый; **r. graphics** растровая (сеточная) графика
reasoning ['ri:zənɪŋ] рассуждение; доказательство; **inferential r.** доказательство на основе логического вывода
recognition [,rekəg'nɪʃən] опознавание, распознавание; различение
redundancy [rɪ'dʌndənsɪ] избыточность (информации); резервирование
reference ['refrəns] 1. справка; ссылка; эталон; 2. справочный
reinforcement [,ri:ɪn'fɔ:smənt] усиление, укрепление; арматура
relational [rɪ'leɪʃənl] реляционный; родственный (о данных)
relationship [rɪ'leɪʃənʃɪp] взаимосвязь; взаимоотношение; соотношение
reliability [rɪ,laɪə'bɪlɪtɪ] надежность
removal [rɪ'mu:vl] удаление; исключение (из); чистка; **hidden line**

r. удаление скрытых линий (в графике)
replace [rɪ'pleɪs] заменять; подставлять; перемещать
representation [,reprɪzen'teɪʃən] представление; способ задания; **logic rr.** логические представления; **mathematical r.** математическое представление; **procedural rr.** процедурные представления; **propositional rr.** пропозиционные (относящиеся к суждениям) представления
request [rɪ'kwest] запрос; требование
requirement [rɪ'kwaɪəmənt] требование; необходимое условие
resolution [,rezə'lju:ʃən] разрешающая способность (прибора); **high r.** высокая разрешающая способность; **low r.** низкая разрешающая способность
response [rɪs'pɔns] 1. ответ; реакция; 2. реагировать; **time r.** временная характеристика
retain [rɪ'teɪn] сохранять, удерживать информацию (в памяти)
retrieval [rɪ'tri:vəl] поиск (информации, данных)
retrieve [rɪ'tri:v] отыскивать
robotics [rou'bɔtɪks] робототехника
route [ru:t] трасса, путь; маршрут; тракт
routine [ru'ti:n] (стандартная) программа
routing ['ru:tɪŋ] маршрутизация; трассировка
rule [ru:l] правило; масштаб; линейка; **empirical rr.** эмпирические правила; **judgement and heuristic rr.** правила, выведенные на основе суждений и эвристики; **pattern-based rr.** правила, выведенные на основе эталонов; **production rr.** правила порождения
run [rʌn] 1. прогон; работа; 2. прогонять (программу); работать; выполнять

S

scan [skæn] сканирование; просмотр; поиск; развертка
scanner ['skænə] сканирующее устройство
scheduling ['ʃedju:lɪŋ] составление графика; планирование
screen [skri:n] 1. экран; экранная сетка; 2. экранировать
semiconductor ['semɪkən'dʌktə] полупроводник
sense [sens] считывать; опознавать; воспринимать; определять
sensing ['sensɪŋ] считывание; опознавание; восприятие
sensitivity [,sensɪ'tɪvɪtɪ] чувствительность
sensor ['sensə] датчик; чувствительный элемент
service ['sə:vɪs] 1. служба; работа; обслуживание; 2. служебный; **dedicated s.** стандартный набор услуг
set [set] 1. установка; набор; множество; 2. устанавливать в положение
setting ['setɪŋ] положение, расположение; **drafting s.** положение на чертеже
setting-up ['setɪŋ'ʌp] сборка; монтаж; наладка; настройка
setup ['setʌp] устанавливать; формировать; образовывать
shape [ʃeɪp] очертание; форма; конфигурация; **elementary ss.** элементарные формы (очертания); **geometric s.** геометрическая форма
sharing ['ʃɛərɪŋ] деление, разделение; совместное пользование; **time s.** разделение времени; работа с разделением времени
sharpness ['ʃa:pnɪs] резкость (изображения); четкость
shell [ʃel] оболочка; каркас; корпус; скорлупа; **expert system s.** оболочка (корпус) экспертной системы
shop [ʃɔp] цех; мастерская; *pl* завод; **s. floor** производственная (цеховая) площадь
shortage ['ʃɔ:tɪdʒ] нехватка (*напр.*, оборудования, площади)
sign [saɪn] знак; обозначение; символ; признак
simulation [,sɪmju'leɪʃən] моделирование; имитация
sketch [sketʃ] набросок; эскиз; схема
smart [sma:t] умный; сильный; энергичный; резкий

softcopy ['sɔftkɔpɪ] копия на «мягкой» основе
software ['sɔftwεə] программное (математическое) обеспечение; **applied s.** прикладное программное обеспечение; **base (kernel) s.** базовое программное обеспечение; **proprietary s.** запатентованное программное обеспечение; **support s.** вспомогательное программное обеспечение
solid ['sɔlɪd] твердое (геометрическое) тело
solid-state ['sɔlɪd,steɪt] полупроводниковый
solution [sə'lu:ʃən] решение; разрешение; раствор
solve [sɔlv] решать; разрешать; растворять
sophisticated [sə'fɪstɪkeɪtɪd] усложненный; сложный; современный; тонкий (о приборе); замысловатый
space [speɪs] 1. пространство; область; 2. располагать с интервалами
spacing ['speɪsɪŋ] пробельный материал
speed [spi:d] скорость; быстродействие
spline [splaɪn] сплайн (*физ.* лекало, *мат.* функция); **B-s. (basic s.)** базисный сплайн (Б-сплайн); **bicubic s.** бикубический сплайн; **cubic s.** кубический сплайн
standard ['stændəd] типовой; стандартный
stand-by ['stændbaɪ] резервное (запасное) оборудование
state-of-the-art ['steɪtəvðɪ'ɑ:t] реальный; достигнутый; внедренный; производимый в промышленном масштабе; серийно выпускаемый
station ['steɪʃən] станция; пункт; остановка; **fixturing ss.** пункты (станции) зажимных приспособлений
step [step] шаг; ступень; стадия; этап (вычислений, разработки)
storage ['stɔ:rɪdʒ] запоминающее устройство, память
strain [streɪn] деформация; усилие; напряжение
strategy ['strætɪdʒɪ] стратегия; поведение; методология; методика; **query s.** стратегия запросов
stress [stres] напряжение; нагрузка; усилие
stylus ['staɪləs] (*pl* styli) перо прибора; пишущий узел
supply [sə'plaɪ] 1. подача; питание; 2. снабжать; обеспечивать; **power s.** источник питания
support [sə'pɔ:t] 1. обеспечение; поддержка; 2. обеспечивать; поддерживать; **mathematical s.** математическое обеспечение
surface ['sə:fɪs] 1. поверхность; плоскость; 2. поверхностный; **s. discontinuities** неоднородности поверхности; **blending s.** поверхность смешения; **compound s.** составная (сложная) поверхность; **interconnected ss.** взаимосвязанные поверхности
switching ['swɪtʃɪŋ] переключение; коммутация; **patch-s.** переключение вставок в программе
synchronize ['sɪŋkrənaɪz] синхронизировать, согласовывать
synthesis ['sɪnθɪsɪs] синтез
system ['sɪstɪm] система; совокупность; установка; устройство; **architectural design s.** система архитектурного проектирования; **binary-coded decimal s.** двоично-кодированная десятичная система счисления; **data-base management s.** система управления базами данных; **flexible manufacturing s.** гибкая производственная система; **computer-integrated manufacturing s.** комплексная автоматизированная производственная система; **high performance s.** высокопроизводительная система; **knowledge-based expert s.** экспертная система с базой знаний; **turnkey s.** высоконадежная система, сдаваемая «под ключ»

T

table ['teɪbl] таблица; стол; доска; плоская поверхность
tablet ['tæblɪt] планшет; «сколка»; **data t.** планшет для ввода данных; **digitizer t.** цифровой

планшет графического ввода; **electronic t.** электронный планшет («сколка»); **graphic t.** графический планшет («сколка»)
technique [tek'ni:k] метод; методика; технический прием; **artificial intelligence tt.** технические приемы, используемые в искусственном интеллекте
technology [tek'nɔlədʒɪ] технология; техника; **integrated circuit t.** технология изготовления интегральных схем
template ['templeɪt] шаблон; трафарет; маска
terminal ['tə:mɪnl] терминал, оконечное устройство; **interactive t.** интерактивный терминал
throughput ['θru:put] производительность
tool [tu:l] инструмент; инструментарий; станок; **machine tt.** металлорежущие станки
touchscreen ['tʌtʃskri:n] сенсорный экран
track [træk] дорожка; канал; тракт; дорожка перфорации
trackball ['trækbɔ:l] шаровой указатель (в графопостроителях)
trace [treɪs] 1. след; трассировка; 2. трассировать; копировать
tracing ['treɪsɪŋ] копирование; слежение; трассировка
traffic ['træfɪk] поток информации (сообщений); уличное движение; **t. coordinator** координатор потоков заготовок (в цехе)
transactions [træn'zækʃənz] транзакции (групповые операции)
turnkey ['tə:nki:] готовый к непосредственному использованию
type fonts ['taɪp,fɔnts] комплекты шрифтов
type [taɪp] типографская литера
typeprinter ['taɪp,prɪntə] буквопечатающий аппарат
typesetting ['taɪp,setɪŋ] (типографский) набор
typewriter ['taɪp,raɪtə] пишущая машинка

U

unit ['ju:nɪt] единица; устройство; блок; элемент
updating [ʌp'deɪtɪŋ] корректировка; модернизация; обновление
uptime ['ʌptaɪm] рабочее (машинное) время
up-to-date ['ʌptə'deɪt] современный, новейший
user ['ju:zə] пользователь; абонент; **high-priority u.** пользователь с высоким приоритетом; **remote u.** пользователь, работающий с дистанционного пульта

V

value ['vælju:] 1. величина; значение; оценка; 2. оценивать; **certainty v.** значение достоверности
version ['və:ʃən] вариант, версия; перевод
view [vju:] вид; представление; проекция; **isometric v.** изометрическая проекция (вид)
viewable ['vju:əbl] визуальный; зрительный
visual ['vɪzjuəl] визуальный; наглядный
vision ['vɪʒən] техническое (машинное) зрение
voice [vɔɪs] 1. голос; 2. речевой
voltage ['voultɪdʒ] напряжение, разность потенциалов
volume ['vɔlju:m] объем; том, книга

W

wave [weɪv] 1. волна, колебание; сигнал; 2. волновой
way [weɪ] способ; путь
winding ['waɪndɪŋ] обмотка; виток; намотка
window ['wɪndou] окно (на экране дисплея); кадр
windowing ['wɪndouɪŋ] кадрирование; **w. capabilities** возможности кадрирования
wire-frame ['waɪəfreɪm] каркасный, скелетный
wiring ['waɪərɪŋ] монтаж; проводка; межсоединения (в ИС)
work bay ['wə:kbeɪ] участок (цеха)
workpiece ['wə:kpi:s] обрабатываемая заготовка, деталь
workshop ['wə:kʃɔp] секция; семинар; симпозиум
workstation ['wə:ksteɪʃən] рабо-

чая станция в ГПС, автоматизированное рабочее место в САПР; **engineering w.** инженерная (техническая) рабочая станция (АРМ); **high-end w.** рабочая станция (АРМ) высшего класса; **low-end w.** рабочая станция (АРМ) низшего класса; **proprietary w.** запатентованная рабочая станция (АРМ)

Z

zone [zoun] зона; область; зона перфокарты; **memory (storage) z.** зона запоминающего устройства

ACRONYMS

CAD (**C**omputer-**A**ided **D**esign) автоматизированное проектирование

CAD/CAM (**C**omputer-**A**ided **D**esign/**C**omputer-**A**ided **M**anufacturing) автоматизированное проектирование/автоматизированное производство

CNC (**C**omputerized **N**umerical **C**ontrol) ЧПУ на базе ЭВМ (компьютеризированное числовое программное управление)

DBMS (**D**ata **B**ase **M**anagement **S**ystem) СУБД (система управления базами данных)

IBM (**I**nternational **B**usiness **M**achine) ИБМ (американская международная фирма, выпускающая вычислительное оборудование)

LASER (**L**ight **A**mplification by **S**timulated **E**mission of **R**adiation) ЛАЗЕР, лазер

LISP (**LIS**t **P**rogramming) ЛИСП (язык программирования для обработки списков и списковых структур)

LSI (**L**arge-**S**cale **I**ntegration) интеграция высокого уровня

MOS (**M**etal-**O**xide-**S**emiconductor) МОП (металл—окисел—полупроводник)

PL/1 ПЛ/1 (язык программирования высокого уровня)

PROM (**P**rogrammable **ROM**) программируемое ПЗУ

RAM (**R**andom **A**ccess **M**emory) оперативная память (ОЗУ)

ROM (**R**ead-**O**nly **M**emory) постоянная память (ПЗУ)

SLSI (**S**uper **LSI**) интеграция сверхвысокого уровня

VLSI (**V**ery **LSI**) интеграция очень высокого уровня

КРАТКИЕ СВЕДЕНИЯ О ЧТЕНИИ И АННОТИРОВАНИИ

Чтение

Чтение—это первичная обработка письменной информации. В зависимости от цели, чтение бывает: (1) просмотровое (skimming reading); (2) ознакомительное (average reading); (3) изучающее или углубленное (study or close reading); (4) поисковое (scanning reading).

При **просмотровом** чтении прежде всего определяется, к какой области познаний относится данная информация, и отбирается интересующий материал. Потом по заглавию, выходным данным, схемам, таблицам, рисункам и подписям к ним, подзаголовкам, аннотации, по первому и последнему абзацам определяется основная тема текста (subject-matter). Далее выделяются ключевые слова, ключевые предложения и основные мысли в абзацах (параграфах). Этот вид чтения предполагает быстрый просмотр текста про себя.

При **ознакомительном** чтении (чтении с общим охватом содержания) происходит знакомство с информацией, заключенной в тексте, с целью понимания общего смысла читаемого. При этом виде чтения выделяется главное, а второстепенное исключается, обобщаются факты, сопоставляются отдельные части текста, а также ведется поиск смысловой структуры, выделяются ключевые слова и предложения, как и при просмотровом чтении. Это чтение для себя.

Изучающее чтение имеет целью полное понимание смысла читаемого текста. Это вдумчивое, тщательное чтение. Грамматический анализ отдельных предложений может помочь при затруднении в понимании смысла читаемого. Здесь также предполагается нахождение ключевых слов и предложений. Этот вид чтения может происходить вслух и про себя.

С целью нахождения какого-либо факта, цитаты, фамилии и т. п. проводится беглый просмотр текста с помощью **поискового** чтения. Этот вид чтения также осуществляется про себя.

Соответствующие приемы чтения применяются всякий раз, когда необходимо выбрать именно тот режим чтения, который соответствует цели чтения, характеру читаемого текста и времени, отводимому для чтения.

Параграф или **абзац** (a paragraph)—это часть текста, имеющая самостоятельное значение и начинающаяся с новой строки. В нем заключена определенная, законченная мысль. **Отрывок** (a passage)—это часть текста, состоящая из нескольких параграфов. Не всегда параграф (абзац) совпадает с **логической частью** или **единицей** (a logical part or unit) текста. Логическая часть текста, в свою очередь, может состоять из нескольких параграфов. В ней может идти речь об описании какого-либо предмета, события, явления, процесса и т. п. **Ключевые слова** (key words)—это слова, несущие основную смысловую нагрузку. В английском языке это чаще всего существительные. **Ключевые (тематические) предложения** (topic sentences) передают основную мысль параграфа и обычно помещаются в начале его.

Научно-техническая статья обычно состоит из следующих частей: 1. Заголовок (Title). 2. Аннотация (Abstract or Summary). 3. Введение (Introduction). 4. Общая часть (Methods, Materials, Procedures). 5. Результаты, обсуждение результатов, заключение (выводы) и рекомендации (Results, Discussions, Conclusion, Recommendations). 6. Благодарности (Acknowledgements). 7. Использованная литература (References, Literature, Bibliography).

Аннотирование

Аннотирование—это вторичная обработка письменной информации. Для того чтобы зафиксировать краткое содержание произведения, пишется аннотация. **Аннотация** (Abstract или Summary)—это краткая справка о статье, патенте, книге, справочнике и т. п. с точки зрения содержания. При аннотировании печатный материал излагается в предельно сжатой форме. Это процесс свертывания (сжатия) информации с очень большим уменьшением по отношению к оригиналу (до 1/10 его части).

Аннотации бывают **описательные, справочные, реферативные, рекомендательные** и **критические.** Остановимся лишь на описательных аннотациях, так как умение составлять их необходимо студентам в учебном процессе для обработки печатной информации на иностранном и русском языках и при оформлении записок к дипломным проектам. Специалисты и ученые обязаны уметь писать аннотации к своим научным статьям, докладам для конференций, на книги и т. д.

Описательная аннотация состоит из трех частей:

1. **Справка к аннотации.** В ней указываются следующие данные: автор; название работы на английском языке, перевод названия; количество страниц, таблиц, рисунков, ссылок на использованную литературу; на каком языке написана работа. Кроме того, для журнала—его название на английском языке, номер и год издания; для патентов — номер патента и страна патентования; для каталогов — фирма, выпустившая данный каталог; для книг, монографий, учебников—название издательства. Эта часть не обязательна при аннотировании учебных текстов.

2. **Основная часть** должна отражать перечень наиболее характерных положений по содержанию работы.

3. **Заключительная часть.** В этой части должен быть общий вывод автора работы или указание на один какой-то вопрос, которому в работе уделено особое внимание, а также рекомендация, для кого данная работа может представлять особый интерес.

К аннотациям как на русском, так и на английском языке предъявляются следующие требования:

1. Лаконичность языка, т. е. использование простых предложений (глаголы употребляются всегда в настоящем времени в действительном или страдательном залоге. Модальные глаголы, как правило, отсутствуют).
2. Строгая логическая структура текста аннотации.
3. Обязательное введение в текст аннотации безличных конструкций и отдельных слов, например: «Сообщается...», «Подробно описывается...», «Кратко рассматривается...», «Излагаются...», «Комментируются...» и др., с помощью которых происходит введение и описание текста оригинала.
4. Недопущение повторений в заглавии и тексте аннотации.
5. Точность в передаче заглавия оригинала, отдельных формулировок и определений.
6. Использование общепринятых сокращений слов, таких как: напр., и т. д., и т. п., и др.
7. Единство терминов и обозначений.

Текст аннотации должен быть максимально кратким, от 500 до 1000 печатных знаков.

Основные штампы (key-patterns) аннотаций на английском и русском языках:

1. The article (paper, book, etc.) deals with...	1. Эта статья (работа, книга и т. д.) касается...
2. As the title implies the article describes...	2. Согласно названию, в статье описывается...
3. It is specially noted...	3. Особенно отмечается...
4. A mention should be made...	4. Упоминается...
5. It is spoken in detail...	5. Подробно описывается...
6. ...are noted.	6. Упоминаются...
7. It is reported...	7. Сообщается...
8. The text gives a valuable information on...	8. Текст дает ценную информацию...
9. Much attention is given to...	9. Большое внимание уделяется...
10. The article is of great help to...	10. Эта статья окажет большую помощь...

11. The article is of interest to...	11. Эта статья представляет интерес для...
12. It (the article) gives a detailed analysis of...	12. Она (статья) дает детальный (подробный) анализ...
13. It draws our attention to...	13. Она (статья, работа) привлекает наше внимание к...
14. The difference between the terms... and... should be stressed.	14. Следует подчеркнуть различие между терминами... и ...
15. It should be stressed (emphasized) that...	15. Следует подчеркнуть, что...
16. ...is proposed.	16. Предлагается...
17. ...are examined.	17. Проверяются (рассматриваются)...
18. ...are discussed.	18. Обсуждаются...
19. An option permits...	19. Выбор позволяет...
20. The method proposed... etc.	20. Предлагаемый метод... и т. д.

Первые два штампа в основном используются при устном аннотировании и кратком изложении содержания оригинала.

Чтобы составить аннотацию статьи, нужно ознакомиться с ее заголовком, просмотреть подзаголовки, иллюстрации, таблицы, прочитать введение и заключение; достаточно одноразового просмотра статьи, т. е. просмотрового чтения. При этом следует иметь в виду, что конкретная тема научно-технического текста обычно излагается в первом или одном из начальных предложений введения и реже заключения.