Міністерство освіти і науки України
НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ
«ОДЕСЬКА ПОЛІТЕХНІКА»

ПРОФЕСІЙНА ІНОЗЕМНА МОВА

Методичні вказівки
до практичних занять з англійської мови
для здобувачів вищої освіти
Інститут цифрових технологій, дизайну та транспорту(ІЦТДТ)
спеціальності: 131 Прикладна механіка

Одеса НУОП – 2022

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Затверджено
на засіданні кафедри
іноземних мов
Протокол № 1 від 08.09 2022р.

Одеса НУОП – 2022

Методичні вказівки до практичних занять з англійської мови для здобувачів вищої освіти Інститут цифрових технологій, дизайну та транспорту(ІЦТДТ) спеціальності: 131 Прикладна механіка / Укл. Т.І. Борисенко, М.Г. Томенко – Одеса- НУОП, 2022. – 45с.

Укладачі: Т.І. Борисенко, кандидат філол. наук, доцент
М.Г. Томенко, ст. викладач

ЗМІСТ

Передмова .... **Ошибка! Закладка не определена.**

Lesson 1 5

Lesson 2 7

Lesson 3 9

Lesson 4 11

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Lesson 6 16

Lesson 7 18

Lesson 8 20

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Передмова

Метою “Методичних вказівок” є формування впродовж 72 годин аудиторних занять у студентів (вхідний рівень володіння мовою – B1) вмінь та навичок читання, письма та говоріння за тематикою спеціальності “Інформаційні технології проектування” на I курсі навчання ІЦТДТ (вихідний рівень володіння мовою – B2). За рахунок тренування і виконання *читання текстів і комунікативних завдань* студенти зможуть досягти практичного володіння англійською мовою за фахом.

Практичне володіння іноземною мовою в рамках даного курсу припускає наявність таких умінь в різних видах мовної комунікації, які дають можливість:

– вільно читати оригінальну літературу іноземною мовою у відповідній галузі знань;

– оформляти витягнуту з іноземних джерел інформацію у вигляді перекладу або резюме;

– робити повідомлення і доповіді іноземною мовою на теми, пов'язані з науковою роботою майбутнього фахівця;

– вести бесіду за фахом.

Кожний урок складається з тексту й комплекса мовних вправ, які розраховані на удосконалення навичок активізації словарного і граматичного мінімуму професійного спрямування.

“Методичні вказівки” забезпечують підготовку до міжнародного усного і письмового спілкування англійською мовою для спеціальних цілей, а саме - оволодіння лексичними, граматичними і стилістичними навичками, а також умінням розмовляти, читати, переписуватися, перекладати, конспектувати, згортати і розгортати усну і письмову англомовну інформацію наукового функціонального стилю, що передбачено вимогами Програми вивчення іноземних мов у нефілологічному ВУЗі.

Lesson 1

Read the text: **Algorithmic Language**

A formal language intended for describing computational processes or, equivalently, for writing down algorithms is to be executed by computers. One distinguishes between problem-oriented algorithmic languages (high-level languages), which are not related to any specific machine, and machine-oriented algorithmic languages (low-level languages), which take the specific features of a given machine into account (instruction set, addressing modes, etc.). The term "algorithmic language" usually refers to a problem-oriented language, as opposed to machine code, which is a notation that is directly interpreted by a machine. For the well-formed texts of an algorithmic language (programs, cf. Program) a general algorithm defines their execution in a unique way, which is the distinction between algorithmic languages and non-algorithmic programming languages, for which the execution process for a text is fully undetermined or the text merely serves as material for the synthesis of an algorithm.

As in natural languages, an algorithmic language is constructed over an alphabet of basic symbols (in which the program is written down) in the form of a hierarchical system of grammatical elements, between which relations are given (similarly to the words, phrases and sentences in a natural language, whose connections are given by syntactic rules). The lowest level elements, formed by chains of basic symbols, are called lexemes, or lexical units. For the lexemes occurring in a program the class to which they belong is defined, and for certain classes of lexemes (e.g. identifiers) also their scope — some uniquely identifiable part of the program to which all occurrences of a given lexeme belong (a block). Exactly one occurrence of such a lexeme is said to be defining; the other occurrences of the lexeme in its scope are called applied.

The further levels of elements of an algorithmic language are formed by notions, or non-terminals. The relation that may hold between the notions of an algorithmic language is that of being a (direct) constituent of (i.e. an immediate constituting part), while the individual constituents of a given notion are related to each other by concatenation (textual sequence). The transitive closure of the constituent relation uniquely assigns to each notion some subword of the text of the program, which is said to be the (terminal) production of this notion. There is one initial notion, the production of which is the entire program text. A tree whose root is the initial notion, whose terminal vertices (leafs) are lexemes and basic symbols, whose internal vertices are concepts and whose branches are constituent relations, is called a production or syntax tree of a program. The construction of such a tree is known as the syntactic analysis or parsing of a program.

Notions and lexemes have attributes, i.e. certain sets fixed by the description of the algorithmic language. Determining the attributes of the elements occurring in a program is called its semantic analysis. Finding the attributes of lexemes begins with the analysis of their defining occurrences, which usually contain explicit information about the attributes. The attribute information is transferred to all the applied occurrences of the lexeme within the corresponding scope (identification). The attributes of a certain notion are found, by induction over the production tree, as a function of the attributes of its constituents. A substantial part of the semantic analysis, which is very valuable for checking the correctness of a program, is a check on the compatibility of the attributes.

The rules of syntactic analysis are laid down by the generative grammar of the algorithmic language (cf. Grammar, generative) or by an analyzing automaton (more precisely, by its different generalizations) for converting the program text into a production tree. The rules of semantic analysis are usually described informally, but attempts have been made to formalize the definition of attribute information and to take the context into consideration with the aid of the mechanism of two-level grammars (cf. Algol-68).

Exercise 1. Read and memorize using a dictionary:

attribute, distinguish, execution, attempt, explicit, occurrence, sequence, precisely, identifiable, notion, root, assign, constituent, consideration, aid, scope, account, entire, parsing, subword

Exercise 2. Answer the questions:

1. What term usually refers to a problem-oriented language, as opposed to machine code?
2. What are the lowest level elements, formed by chains of basic symbols, called?
3. How are the further levels of elements of an algorithmic language formed?
4. What does finding the attributes of lexemes begin with?

Exercise 3. Complete the sentences with the suggested words: **relations, syntax, root, concepts, internal**

A tree whose ____ is the initial notion, whose terminal vertices (leafs) are lexemes and basic symbols, whose ____ vertices are ____ and whose branches are constituent _____, is called a production or _____ tree of a program.

Exercise 4. Ask questions to the given answers:

1. Question: ____ ?
   Answer: The transitive closure of the constituent relation uniquely assigns to each notion some subword of the text of the program.
2. Question: ____ ?
   Answer: Determining the attributes of the elements occurring in a program is called its semantic analysis.
3. Question: ____ ?
   Answer: The rules of syntactic analysis are laid down by the generative grammar of the algorithmic language or by an analyzing automaton.

Exercise 5. Match the left part with the right:

1. Finding the attributes of lexemes begins with the analysis of	a) equivalently, for writing down algorithms is to be executed by computers.
2. The further levels of elements of an algorithmic language	b) their defining occurrences, which usually contain explicit information about the attributes.
3. The attributes of a certain notion are found, by induction	c) are formed by notions, or non-terminals.
4.A formal language intended for describing computational processes or,	d) over the production tree, as a function of the attributes of its constituents.

Exercise 6. Learn the following definitions:

Lexeme is a basic lexical unit of a language consisting of one word or several words, the elements of which do not separately convey the meaning of the whole.

Algorithm (in mathematics and computer science) is a step-by-step procedure for calculations. Algorithms are used for calculation, data processing, and automated reasoning.

Attribute (in computing) is a specification that defines a property of an object, element, or file. It may also refer to or set the specific value for a given instance of such.

Notion is a general understanding; vague or imperfect conception or idea of something.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"The levels of an algorithmic language"

"The attributes of lexemes"

Lesson 2

Read the text: **Object-oriented Programming**

Object-oriented programming is an approach to designing modular, reusable software systems. Although discussions of object-oriented technology often get mired in the details of one language vs. the other, the real key to the object-oriented approach is that it is a modelling approach first. Although often hyped as a revolutionary way to develop software by zealous proponents, the object-oriented approach is in reality a logical extension of good design practices that go back to the very beginning of computer programming. Object-orientation is simply the logical extension of older techniques such as structured programming and abstract data types. An object is an abstract data type with the addition of polymorphism and inheritance.

An object-oriented system integrates code and data using the concept of an "object". An object has state (data) and behavior (code).

The goals of object-oriented programming are: increased understanding, ease of maintenance and ease of evolution.

The overall understanding of the system is increased because the semantic gap—the distance between the language spoken by developers and that spoken by users—is lessened. Rather than talking about database tables and programming subroutines, the developer talks about things the user is familiar with: objects from their application domain.

Object orientation eases maintenance by the use of encapsulation and information hiding. One of the most common sources of errors in programs is when one part of the system accidentally interferes with another part. For example, in the very earliest days of programming, it was common for developers to use "go to" statements to jump to arbitrary locations within only a few routines and functions. Critics called this "spaghetti code" because it is disorganized. Structured programming addresses this by encouraging the use of procedures and subroutines. Appropriate usage sections off responsibility for individual blocks to implement separate functionality. So, for example, one would know that the *square root* function was separate from the *launch missiles* function, and a change to one could not affect the other.

Object-orientation takes this to the next step. It essentially merges abstract data types with structured programming and divides systems into modular objects which own their own data and are responsible for their own behavior. This feature is known as encapsulation. With encapsulation, not only can the "square root" and "launch missiles" functions not interfere with each other, but also the data for the two are divided up so that changes to one object cannot affect the other. Note that all this relies on the various languages being used appropriately, which, of course, is never certain. Object-orientation is not a software silver bullet, and it is not magic that makes all development problems go away.

In addition to providing ease of maintenance, encapsulation and information hiding provide ease of evolution as well. Defining software as modular components that support inheritance makes it easy both to re-use existing components and to extend components as needed by defining new subclasses with specialized behaviors. This goal of being easy to both maintain and reuse is known in the object-oriented paradigm as the "open closed principle". A module is open if it supports extension (e.g. can easily modify behavior, add new properties, provide default values, etc.). A module is closed if it has a well defined stable interface that all other modules must use and that limits the interaction and potential errors that can be introduced into one module by changes in another.

Exercise 1. Read and memorize using a dictionary:

ease, maintenance, in addition to, inheritance, hide, launch, merge, essential, appropriate, responsibility, extend, interfere, missile, source, routine, gap, certain, extension, approach

Exercise 2. Answer the questions:

1. What is object-oriented programming?
2. What is one of the most common sources of errors in programs?
3. What are the goals of object-oriented programming ?
4. How does object orientation ease maintenance ?

Exercise 3. Complete the sentences with the suggested words: **sources, hiding, maintenance, interferes, part**

Object orientation eases _____ by the use of encapsulation and information _____. One of the most common _____ of errors in programs is when one ____ of the system accidentally _____ with another part.

Exercise 4. Ask questions to the given answers:

1. Question: ____ ?

Answer: The object-oriented approach is in reality a logical extension of good design practices that go back to the very beginning of computer programming.

2. Question: ____ ?

Answer: An object is an abstract data type with the addition of polymorphism and inheritance.

3. Question: ____ ?

Answer: Appropriate usage sections off responsibility for individual blocks to implement separate functionality.

Exercise 5. Match the left part with the right:

1. This goal of being easy to both maintain and reuse	a) the developer talks about things the user is familiar with: objects from their application domain.
2. Rather than talking about database tables and programming subroutines,	b) magic that makes all development problems go away.
3. So, for example, one would know that the *square root* function	c) is known in the object-oriented paradigm as the "open closed principle".
4. Object-orientation is not a software silver bullet, and it is not	d)was separate from the *launch missiles* function, and a change to one could not affect the other.

Exercise 6. Learn the following definitions:

Polymorphism is the provision of a single interface to entities of different types

In object-oriented programming, **inheritance** is when an object or class is based on another object or class, using the same implementation; it is a mechanism for code reuse.

In programming languages, **encapsulation** is a language mechanism for restricting access to some of the object's components or a language construct that facilitates the bundling of data with the methods (or other functions) operating on that data.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"Object-oriented programming"

"The most common sources of errors in programs"

"Encapsulation"

Lesson 3

Read the text: **System Analysis and Design**

Systems are created to solve problems. One can think of the systems approach as an organized way of dealing with a problem. In this dynamic world, the subject System Analysis and Design (SAD), mainly deals with the software development activities.

A collection of components that work together to realize some objectives forms a system. Basically there are three major components in every system, namely input, processing and output.

In a system the different components are connected with each other and they are interdependent. For example, human body represents a complete natural system. We are also bound by many national systems such as political system, economic system, educational system and so forth. The objective of the system demands that some output is produced as a result of processing the suitable inputs. A well-designed system also includes an additional element referred to as 'control' that provides a feedback to achieve desired objectives of the system.

Systems analysis is a process of collecting factual data, understand the processes involved, identifying problems and recommending feasible suggestions for improving the system functioning. This involves studying the business processes, gathering operational data, understand the information flow, finding out bottlenecks and evolving solutions for overcoming the weaknesses of the system so as to achieve the organizational goals. System Analysis also includes subdividing of complex process involving the entire system, identification of data store and manual processes.

The major objectives of systems analysis are to find answers for each business process: What is being done, How is it being done, Who is doing it, When is he doing it, Why is it being done and How can it be improved? It is more of a thinking process and involves the creative skills of the System Analyst. It attempts to give birth to a new efficient system that satisfies the current needs of the user and has scope for future growth within the organizational constraints. The result of this process is a logical system design. Systems analysis is an iterative process that continues until a preferred and acceptable solution emerges.

System Design

Based on the user requirements and the detailed analysis of the existing system, the new system must be designed. This is the phase of system designing. It is the most crucial phase in the developments of a system. The logical system design arrived as a result of systems analysis is converted into physical system design. Normally, the design proceeds in two stages: Preliminary or General Design and Structured or Detailed Design.

In the preliminary or general design, the features of the new system are specified. The costs of implementing these features and the benefits to be derived are estimated. If the project is still considered to be feasible, we move to the detailed design stage.

In the detailed design stage, computer oriented work begins in earnest. At this stage, the design of the system becomes more structured. Structure design is a blue print of a computer system solution to a given problem having the same components and inter-relationships among the same components as the original problem. Input, output, databases, forms, codification schemes and processing specifications are drawn up in detail. In the design stage, the programming language and the hardware and software platform in which the new system will run are also decided.

There are several tools and techniques used for describing the system design of the system.

The system design needs to be implemented to make it a workable system. This demands the coding of design into computer understandable language, i.e., programming language. This is also called the programming phase in which the programmer converts the program specifications into computer instructions, which are referred to as programs. It is an important stage where the defined procedures are transformed into control specifications by the help of a computer language. The programs coordinate the data movements and control the entire process in a system.

Exercise 1. Read and memorize using a dictionary:

preliminary, exist, implement, deal with, estimate, demand, feasible, suggestion, improve, gather, objective, current, draw, crucial, bottleneck, solution, growth, constraint, iterative, prefer, emerge

Exercise 2. Answer the questions:

1. What does the subject System Analysis and Design (SAD), mainly deal with?
2. What does the objective of the system demand?
3. What is the most crucial phase in the developments of a system?
4. What does the system design need to make it a workable system?

Exercise 3. Complete the sentences with the suggested words: **feedback, additional, suitable, output, objective**

The _____ of the system demands that some ____ is produced as a result of processing the _____ inputs. A well-designed system also includes an _____ element referred to as 'control' that provides a _____ to achieve desired objectives of the system.

Exercise 4. Ask questions to the given answers:

1. Question: ____ ?
Answer: Basically there are three major components in every system, namely input, processing and output.
2. Question: ____ ?
Answer: Input, output, databases, forms, codification schemes and processing specifications are drawn up in detail.
3. Question: ____ ?
Answer: The programs coordinate the data movements and control the entire process in a system.

Exercise 5. Match the left part with the right:

1. Structure design is a blue print of a computer system solution to a given problem	a) that provides a feedback to achieve desired objectives of the system.
2. System Analysis also includes subdividing of complex process involving	b) the benefits to be derived are estimated.
3. The costs of implementing these features and	c) the entire system, identification of data store and manual processes.
4.A well-designed system also includes an additional element referred to as 'control'	d) having the same components and inter-relationships among the same components as the original problem.

Exercise 6. Learn the following definitions:

An objective is a specific result that a person or system aims to achieve within a time frame and with available resources.

Systems analysis is the act, process, or profession of studying an activity (as a procedure, a business, or a physiological function) typically by mathematical means in order to define its goals or purposes and to discover operations and procedures for accomplishing them most efficiently.

Input is something put into a system or expended in its operation to achieve output or a result.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"A well-designed system "
"Systems design"

Lesson 4

Read the text: **Landscape Simulation Models**

Many, if not most, management decisions concerning the environment affect and are affected by the landscape. City and county planning authorities make decisions about land use and infrastructure that directly affect the landscape. Farmers make decisions about what to grow and how to grow it that affect and are affected by the landscape. Individual homeowners and businesses make decisions about their own behavior that affects and is affected by the landscape. Therefore, understanding and modeling the spatial patterns of landscape processes and changes over time at several different scales is critical to effective environmental management.

In recognition of this, the U.S. Environmental Protection Agency (EPA) has moved away from their traditional "media-based" approach to environmental management and toward a more "place-based" approach. To operationalize this approach, we need to develop a deeper understanding of the complex spatial and temporal linkages between and among ecological and economic systems on the landscape and to use that understanding to develop effective and adaptive policies. This will require new methods that are comprehensive, adaptive, integrative, multiscale, and pluralistic, and which acknowledge the huge uncertainties involved.

Landscape modeling studies at local, regional, and global scales integrate natural and social sciences and develop a common framework for understanding linked ecological economic systems.

Among landscape models there is a large variation in complexity and capabilities. Often, it is this variation that makes one model more suitable for certain applications than others. Landscape models are, by definition, spatially explicit. They can range across several other spectra of characteristics, including empirical to process-based, static to dynamic, simple to complex, and low to high spatial and temporal resolution.

As a rule of thumb, more complex, higher-resolution models will resolve issues in more detail, but are more difficult and time-consuming to calibrate and run, and beyond a certain point, they may, in fact, provide decreasing predictability. The spatially explicit landscape simulation models (SELSMs) are, in general, process-based, medium to high spatial and temporal resolution, relatively complex, dynamic, nonlinear simulations of the landscape. They deal with a range of ecological and socio-economic variables, including carbon, water, nitrogen, phosphorus, plants, consumers (including humans), and a range of ecosystem services under various climate, economic, and policy scenarios. They can exhibit "catastrophic," irreversible changes of system structure and function at specific sites and can, therefore, be used to test hypotheses about system sustainability across a range of scales.

Some landscape models include horizontal fluxes and exchange across cells, whereas others do not. One common horizontal flux for the ecological component of the models is water, controlled by a hydrological model. In addition to water, other possible horizontal fluxes include movement of air, animals, energy (such as fire, water waves, and fuels), and economic goods and services. The least complex interaction between horizontal and vertical fluxes is unidirectional, where horizontal fluxes provide the conditions for calculating vertical fluxes. A more complex approach would include bidirectional exchanges of information between the horizontal and vertical fluxes.

Exercise 1. Read and memorize using a dictionary:

environment, flux, landscape, predictability, explicit, irreversible, spatial, huge, uncertainty, linkage, fuel, approach, sustainability, complexity, comprehensive, temporal, suitable, resolution

Exercise 2. Answer the questions:

1. What do many management decisions concerning the environment affect?
2. How did the U.S. Environmental Protection Agency change their approach to environmental management?
3. What studies integrate natural and social sciences and develop a common framework for understanding linked ecological economic systems?
4. What do the spatially explicit landscape simulation models deal with?

Exercise 3. Complete the sentences with the suggested words: **complexity, explicit, landscape, suitable, one**

Among _____ models there is a large variation in _____ and capabilities. Often, it is this variation that makes _____ model more _____ for certain applications than others. Landscape models are, by definition, spatially _____.

Exercise 4. Ask questions to the given answers:

1. Question: ____?

Answer: City and county planning authorities make decisions about land use and infrastructure that directly affect the landscape

2. Question: ____?

Answer: The spatially explicit landscape simulation models are, in general, process-based, medium to high spatial and temporal resolution, relatively complex, dynamic, nonlinear simulations of the landscape.

3. Question: ____?

Answer: The least complex interaction between horizontal and vertical fluxes is unidirectional, where horizontal fluxes provide the conditions for calculating vertical fluxes.

Exercise 5. Match the left part with the right:

1. Farmers make decisions about what to grow and	a) more suitable for certain applications than others.
2. Often, it is this variation that makes one model	b) how to grow it that affect and are affected by the landscape.
3. They can range across several other spectra of characteristics, including	c) of the models is water, controlled by a hydrological model.
4. One common horizontal flux for the ecological component	d) empirical to process-based, static to dynamic, simple to complex, and low to high spatial and temporal resolution.

Exercise 6. Learn the following definitions:

Sustainability is the ability to be sustained, supported, upheld, or confirmed.

A variable is a characteristic, number, or quantity that increases or decreases over time, or takes different values in different situations.

Modeling is the representation, often mathematical, of a process, concept, or operation of a system, often implemented by a computer program.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"Landscape modeling"

"Landscape simulation"

Lesson 5

Read the text: **Product Design**

Product design is the process of creating a new product to be sold by a business to its customers. A very broad concept, it is essentially the efficient and effective generation and development of ideas through a process that leads to new products.

In a systematic approach, product designers conceptualize and evaluate ideas, turning them into tangible inventions and products. The product designer's role is to combine art, science, and technology to create new products that other people can use. Their evolving role has been facilitated by digital tools that now allow designers to communicate, visualize, analyze and actually produce tangible ideas in a way that would have taken greater manpower in the past.

Product design is sometimes confused with (and certainly overlaps with) industrial design, and has recently become a broad term inclusive of service, software, and physical product design. Industrial design is concerned with bringing artistic form and usability, usually associated with craft design and ergonomics, together to mass-produce goods. Other aspects of product design include engineering design, particularly when matters of functionality or utility (e.g. problem-solving) are at issue, though such boundaries are not always clear.

There are various product design processes and many focus on different aspects. The process shown below, for example, is "The Seven Universal Stages of Creative Problem-Solving," outlined by Don Koberg and Jim Bagnell. It helps designers formulate their product from ideas. This process is usually completed by a group of people, i.e. industrial designers, field experts (e.g. prospective users), engineers, etc. depending upon the products involved. The process focuses on figuring out what is required, brainstorming possible ideas, creating mock prototypes, and then generating the product. However, that is not the end of the process. At this point, product designers would still need to execute the idea, making it into an actual product and then evaluate its success by seeing if any improvements are necessary.

The product design process has experienced huge leaps in evolution over the last few years with the rise and adoption of 3D printing. New consumer-friendly 3D printers can produce dimensional objects and print upwards with a plastic like substance opposed to traditional printers that spread ink across a page.

The design process follows a guideline involving three main sections: analysis, concept and synthesis.

The latter two sections are often revisited, depending on how often the design needs touch-ups, to improve or to better fit the criteria. This is a continuous loop, where feedback is the main component. To break it down even more, the seven stages specify how the process works. Analysis consists of two stages, concept is only one stage, and synthesis encompasses the other four.

Analysis

- **Accept Situation:** Here, the designers decide on committing to the project and finding a solution to the problem. They pool their resources into figuring out how to solve the task most efficiently.
- **Analyze:** In this stage, everyone in the team begins research. They gather general and specific materials which will help to figure out how their problem might be solved. This can range from statistics, questionnaires, and articles, among many other sources.

Concept

- **Define:** This is where the key issue of the matter is defined. The conditions of the problem become objectives, and restraints on the situation become the parameters within which the new design must be constructed.

Synthesis

- **Ideate:** The designers here brainstorm different ideas, solutions for their design problem. The ideal brainstorming session does not involve any bias or judgment, but instead builds on original ideas.
- **Select:** By now, the designers have narrowed down their ideas to a select few, which can be guaranteed successes and from there they can outline their plan to make the product.
- **Implement:** This is where the prototypes are built, the plan outlined in the previous step is realized and the product starts to become an actual object.
- **Evaluate:** In the last stage, the product is tested, and from there, improvements are made. Although this is the last stage, it does not mean that the process is over. The finished prototype may not work as well as hoped so new ideas need to be brainstormed.

Exercise 1. Read and memorize using a dictionary:

tangible, ideate, implement, overlap, objective, execute, brainstorm, bias, judgment, utility, solution, commit, narrow, improvement, involve, issue, restraint, encompass

Exercise 2. Answer the questions:

1. What is the product designer's role?
2. What is the product design sometimes confused with?
3. What can new consumer-friendly 3D printers produce?
4. What stages does synthesis encompass?

Exercise 3. Complete the sentences with the suggested words: **adoption, huge, dimensional, substance, few**

The product design process has experienced ____ leaps in evolution over the last _____ years with the rise and _____ of 3D printing. New consumer-friendly 3D printers can produce _____ objects and print upwards with a plastic like _____ opposed to traditional printers that spread ink across a page.

Exercise 4. Ask questions to the given answers:

1. Question: ____?
   Answer: The product designer's role has been facilitated by digital tools.
2. Question: ____?

Answer: Industrial design is concerned with bringing artistic form and usability, usually associated with craft design and ergonomics, together to mass-produce goods.

3. Question: ____?

Answer: The design process follows a guideline involving three main sections: analysis, concept and synthesis.

Exercise 5. Match the left part with the right:

1. The ideal brainstorming session does not involve any bias or judgment,	a) realized and the product starts to become an actual object.
2. They gather general and specific materials which	b) become the parameters within which the new design must be constructed.
3. The conditions of the problem become objectives, and restraints on the situation	c) but instead builds on original ideas.
4. This is where the prototypes are built, the plan outlined in the previous step is	d) will help to figure out how their problem might be solved.

Exercise 6. Learn the following definitions:

Synthesis is the combining of the constituent elements of separate material or abstract entities into a single or unified entity (opposed to analysis).

Industrial design (ID) is the professional service of creating and developing concepts and specifications that optimize the function, value and appearance of products and systems for the mutual benefit of both user and manufacturer.

Ergonomics is an applied science that coordinates the design of devices, systems, and physical working conditions with the capacities and requirements of the worker.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"Product design processes "

"The stages of synthesis"

"The stages of analysis"

Lesson 6

Read the text: **Ergonomics**

Ergonomics derives from two Greek words: ergon, meaning work, and nomoi, meaning natural laws, to create a word that means the science of work and a person's relationship to that work.

The International Ergonomics Association has adopted this technical definition: ergonomics (or human factors) is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

That is not the most efficient definition of what ergonomics is. Let us keep things simple. Ergonomics is the science of making things comfy. It also makes things efficient. And when you think about it, comfy is just another way of making things efficient. However for simplicity, ergonomics makes things comfortable and efficient.

At its simplest definition ergonomics literally means the science of work. So ergonomists, i.e. the practitioners of ergonomics, study work, how work is done and how to work better.

It is the attempt to make work better that ergonomics becomes so useful. And that is also where making things comfortable and efficient comes into play.

Ergonomics is commonly thought of in terms of products. But it can be equally useful in the design of services or processes. It is used in design in many complex ways. However, what you, or the user, is most concerned with is, "How can I use the product or service, will it meet my needs, and will I like using it?" Ergonomics helps define how it is used, how it meets your needs, and most importantly if you like it. It makes things comfy and efficient.

Comfort is much more than a soft handle. Comfort is one of the greatest aspects of a design's effectiveness. Comfort in the human-machine interface and the mental aspects of the product or service is a primary ergonomic design concern.

Comfort in the human-machine interface is usually noticed first. Physical comfort in how an item feels is pleasing to the user. If you do not like to touch it you won't. If you do not touch it you will not operate it. If you do not operate it, then it is useless.

The utility of an item is the only true measure of the quality of its design. The job of any designer is to find innovative ways to increase the utility of a product. Making an item intuitive and comfortable to use will ensure its success in the marketplace. Physical comfort while using an item increases its utility.

The mental aspect of comfort in the human-machine interface is found in feedback. You have preconceived notions of certain things. A quality product should feel like it is made out of quality materials. If it is light weight and flimsy you will not feel that comfortable using it.

The look, feel, use and durability of a product help you make a mental determination about a product or service. Basically it lets you evaluate the quality of the item and compare that to the cost. Better ergonomics mean better quality which means you will be more comfortable with the value of the item.

Efficiency is quite simply making something easier to do. Efficiency comes in many forms however. Reducing the strength required makes a process more physically efficient. Reducing the number of steps in a task makes it quicker (i.e. efficient) to complete. Reducing the number of parts makes repairs more efficient. Reducing the amount of training needed, i.e. making it more intuitive, gives you a larger number of people who are qualified to perform the task.

Efficiency can be found almost everywhere. If something is easier to do you are more likely to do it. If you do it more, then it is more useful. Again, utility is the only true measure of the quality of a design.

Exercise 1. Read and memorize using a dictionary:

performance, attempt, complex, well-being, feedback, handle, utility, durability, concern, item, repair, likely, measure, quality, strength, evaluate, simplicity, preconceived

Exercise 2. Answer the questions:

1. What does the word "ergonomics" derive from?
2. What is the technical definition of ergonomics?
3. What makes things comfortable and efficient?
4. Where is the mental aspect of comfort in the human-machine interfaces found?

Exercise 3. Complete the sentences with the suggested words: **item, quality, innovative, ensure, utility**

The utility of an_____ is the only true measure of the _____of its design. The job of any designer is to find _____ways to increase the _____ of a product. Making an item intuitive and comfortable to use will _____ its success in the marketplace.

Exercise 4. Ask questions to the given answers:

1. Question: ____?
Answer: At its simplest definition ergonomics literally means the science of work.
2. Question: ____?
Answer: The mental aspect of comfort in the human-machine interface is found in feedback.
3. Question: ____?
Answer: A quality product should feel like it is made out of quality materials.

Exercise 5. Match the left part with the right:

1. The mental aspect of comfort in the human-machine interface	a) how it is used, how it meets your needs, and most importantly if you like it.
2. The job of any designer is to find innovative ways	b) is found in feedback.
3.Making an item intuitive and comfortable to use	c) to increase the utility of a product.
4. Ergonomics helps define	d) will ensure its success in the marketplace.

Exercise 6. Learn the following definitions:

Interface is the way in which two subjects or events affect each other.
Effectiveness is the capability of producing a desired result.
Utility is usefulness, the ability of something to satisfy needs or wants.
Efficiency is the ability to do something or produce something without wasting materials, time, or energy.

Exercise 7. Compose a story on one of the topics (up to 100 words):
"The utility of an item "
"Ergonomics "
"A design's effectiveness"

Lesson 7

Read the text: **Computer-Aided Design and Computer-Aided Manufacturing**

Computer-aided design (CAD) involves creating computer models defined by geometrical parameters. These models typically appear on a computer monitor as a three-dimensional representation of a part or a system of parts, which can be readily altered by changing relevant parameters. CAD systems enable designers to view objects under a wide variety of representations and to test these objects by simulating real-world conditions.

Computer-aided manufacturing (CAM) uses geometrical design data to control automated machinery. CAM systems are associated with computer numerical control (CNC) or direct numerical control (DNC) systems. These systems differ from older forms of numerical control (NC) in that geometrical data are encoded mechanically. Since both CAD and CAM use computer-based methods for encoding geometrical data, it is possible for the processes of design and manufacture to be highly integrated. Computer-aided design and manufacturing systems are commonly referred to as CAD/CAM.

CAD had its origins in three separate sources, which also serve to highlight the basic operations that CAD systems provide. The first source of CAD resulted from attempts to automate the drafting process. These developments were pioneered by the General Motors Research Laboratories in the early 1960s. One of the important time-saving advantages of computer modeling over traditional drafting methods is that the former can be quickly corrected or manipulated by changing a model's parameters. The second source of CAD was in the testing of designs by simulation. The use of computer modeling to test products was pioneered by high-tech industries like aerospace and semiconductors. The third source of CAD development resulted from efforts to facilitate the flow from the design process to the manufacturing process using numerical control (NC) technologies. It was this source that resulted in the linkage between CAD and CAM. One of the most important trends in CAD/CAM technologies is the ever-tighter integration between the design and manufacturing stages of CAD/CAM-based production processes.

The development of CAD and CAM and particularly the linkage between the two overcame traditional NC shortcomings in expense, ease of use, and speed by enabling the design and manufacture of a part to be undertaken using the same system of encoding geometrical data. This innovation greatly shortened the period between design and manufacture and greatly expanded the scope of production processes for which automated machinery could be economically used. Just as important, CAD/CAM gave the designer much more direct control over the production process, creating the possibility of completely integrated design and manufacturing processes.

The rapid growth in the use of CAD/CAM technologies after the early 1970s was made possible by the development of mass-produced silicon chips and the microprocessor, resulting in more readily affordable computers. As the price of computers continued to decline and their processing power improved, the use of CAD/CAM broadened from large firms using large-scale mass production techniques to firms of all sizes. The scope of operations to which CAD/CAM was applied broadened as well. In addition to parts-shaping by traditional machine tool processes such as stamping, drilling, milling, and grinding, CAD/CAM has come to be used by firms involved in producing consumer electronics, electronic components, molded plastics, and a host of other products. Computers are also used to control a number of manufacturing processes (such as chemical processing) that are not strictly defined as CAM because the control data are not based on geometrical parameters.

Exercise 1. Read and memorize using a dictionary:

drafting, data, host, affordable, decline, linkage, attempt, drilling, milling, grinding, semiconductor, advantage, shortcoming, innovation, shorten, overcome, source, create, simulation

Exercise 2. Answer the questions:

1. What systems enable designers to view objects under a wide variety of representations?
2. What innovation greatly shortened the period between design and manufacture?
3. What did the third source of CAD development result from?
4. What does computer-aided manufacturing use geometrical design data for?

Exercise 3. Complete the sentences with the suggested words: **ease, undertaken, enabling, shortcomings, linkage**

The development of CAD and CAM and particularly the _____ between the two overcame traditional NC _____ in expense, _____ of use, and speed by _____ the design and manufacture of a part to be _____ using the same system of encoding geometrical data.

Exercise 4. Ask questions to the given answers:

1. Question: ________________________________?

Answer: CAD systems enable designers to view objects under a wide variety of representations and to test these objects by simulating real-world conditions.

2. Question: ________________________________?

Answer: The use of computer modeling to test products was pioneered by high-tech industries like aerospace and semiconductors.

3. Question: ________________________________?

Answer: Computers are also used to control a number of manufacturing processes that are not strictly defined as CAM because the control data are not based on geometrical parameters.

Exercise 5. Match the left part with the right:

1. The use of computer modeling to test products	a) that geometrical data are encoded mechanically.
2. It was this source that resulted	b) serve to highlight the basic operations that CAD systems provide.
3. These systems differ from older forms of numerical control (NC) in	c) in the linkage between CAD and CAM.
4. CAD had its origins in three separate sources, which also	d) was pioneered by high-tech industries like aerospace and semiconductors.

Exercise 6. Learn the following definitions:

Three-dimensional space is a geometric 3-parameters model of the physical universe (without considering time) in which all known matter exists.

Computer-aided design is the use of computer systems to assist in the creation, modification, analysis, or optimization of a design.

Direct numerical control is known as distributed numerical control (also *DNC*), is a common manufacturing term for networking CNC machine tools.

A semiconductor is a material which has electrical conductivity to a degree between that of a conductor (such as copper) and that of an insulator (such as glass).

Exercise 7. Compose a story on one of the topics (up to 100 words):

"Computer-aided design"
"Computer-aided manufacturing"
"The sources of CAD"

Lesson 8

Read the text: Computer-Aided Design (CAD) and Computer-Aided Manufacturing (CAM) - ADVANTAGES AND DISADVANTAGES

Modeling with CAD systems offers a number of advantages over traditional drafting methods that use rulers, squares, and compasses. For example, designs can be altered without erasing and redrawing. CAD systems also offer "zoom" features analogous to a camera lens, whereby a designer can magnify certain elements of a model to facilitate inspection. Computer models are typically three dimensional and can be rotated on any axis, much as one could rotate an actual three dimensional model in one's hand, enabling the designer to gain a fuller sense of the object. CAD systems also lend themselves to modeling cutaway drawings, in which the internal shape of a part is revealed, and to illustrating the spatial relationships among a system of parts.

To understand CAD it is also useful to understand what CAD cannot do. CAD systems have no means of comprehending real-world concepts, such as the nature of the object being designed or the function that object will serve. CAD systems function by their capacity to codify geometrical concepts. Thus the design process using CAD involves transferring a designer's idea into a formal geometrical model. Efforts to develop computer-based "artificial intelligence" (AI) have not yet succeeded in penetrating beyond the mechanical—represented by geometrical (rule-based) modeling.

Other limitations to CAD are being addressed by research and development in the field of expert systems. This field is derived from research done in AI. One example of an expert system involves incorporating information about the nature of materials—their weight, tensile strength, flexibility, and so on—into CAD software. By including this and other information, the CAD system could then "know" what an expert engineer knows when that engineer creates a design. The system could then mimic the engineer's thought pattern and actually "create" more of the design. Expert systems might involve the implementation of more abstract principles, such as the nature of gravity and friction, or the function and relation of commonly used parts, such as levers or nuts and bolts. Expert systems might also come to change the way data are stored and retrieved in CAD/CAM systems, supplanting the hierarchical system with one that offers greater flexibility. Such futuristic concepts, however, are all highly dependent on our abilities to analyze human decision processes and to translate these into mechanical equivalents if possible.

One of the key areas of development in CAD technologies is the simulation of performance. Among the most common types of simulation are testing for response to stress and modeling the process by which a part might be manufactured or the dynamic relationships among a system of parts. In stress tests, model surfaces are shown by a grid or mesh, that distort as the part comes under simulated physical or thermal stress. Dynamics tests function as a complement or substitute for building working prototypes. The ease with which a part's specifications can be changed facilitates the development of optimal dynamic efficiencies, both as regards the functioning of a system of parts and the manufacture of any given part. Simulation is also used in electronic design automation, in which simulated flow of current through a circuit enables the rapid testing of various component configurations.

The processes of design and manufacture are, in some sense, conceptually separable. Yet the design process must be undertaken with an understanding of the nature of the production process. It is necessary, for example, for a designer to know the properties of the materials with which the part might be built, the various techniques by which the part might be shaped, and the scale of production that is economically viable. The conceptual overlap between design and manufacture is suggestive of the potential benefits of CAD and CAM and the reason they are generally considered together as a system.

Exercise 1. Read and memorize using a dictionary:

spatial, drafting, cutaway, retrieve, flexibility, penetrate, artificial, grid, mesh, distort, facilitate, substitute, implementation, tensile, pattern, viable, overlap, lever, property, shape

Exercise 2. Answer the questions:

1. How can a designer magnify certain elements of a model to facilitate inspection?
2. How do dynamics tests function?
3. What are the most common types of simulation?
4. How are model surfaces shown in stress tests?

Exercise 3. Complete the sentences with the suggested words: **relation, involve, gravity, mimic, nuts.**

The system could then _____ the engineer's thought pattern and actually "create" more of the design. Expert systems might _____ the implementation of more abstract principles, such as the nature of _____ and friction, or the function and _____ of commonly used parts, such as levers or _____ and bolts.

Exercise 4. Ask questions to the given answers:

1. Question: ________________________________?

Answer: The system could then mimic the engineer's thought pattern and actually "create" more of the design.

2. Question: ________________________________?

Answer: Dynamics tests function as a complement or substitute for building working prototypes.

3. Question: ________________________________?

Answer: Simulation is also used in electronic design automation, in which simulated flow of current through a circuit enables the rapid testing of various component configurations.

Exercise 5. Match the left part with the right:

1. One of the key areas of development in CAD technologies	a) can magnify certain elements of a model to facilitate inspection.
2. Thus the design process using CAD involves	b) is the simulation of performance.
3. The system could then mimic the engineer's thought pattern	c) transferring a designer's idea into a formal geometrical model.
4. CAD systems also offer "zoom" features analogous to a camera lens, whereby a designer	d) and actually "create" more of the design.

Exercise 6. Learn the following definitions:

A **cutaway drawing** is a 3D graphics, drawing, diagram and or illustration, in which surface elements a three-dimensional model are selectively removed, to make internal features visible, but without sacrificing the outer context entirely.

Stress testing (sometimes called **torture testing**) is a form of deliberately intense or thorough testing used to determine the stability of a given system or entity. It involves testing beyond normal operational capacity, often to a breaking point, in order to observe the results.

Artificial intelligence (**AI**) is the intelligence exhibited by machines or software, and the branch of computer science that develops machines and software with human-like intelligence.

Gravity is the force of attraction that moves or tends to move bodies towards the centre of a celestial body, such as the earth or moon.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"Advantages of CAD and CAM"

"Disadvantages of CAD and CAM"

Lesson 9

Read the text: 3D Computer Graphics

3D computer graphics (in contrast to 2D computer graphics) are graphics that use a three-dimensional representation of geometric data (often Cartesian) that is stored in the computer for the purposes of performing calculations and rendering 2D images. Such images may be stored for viewing later or displayed in real-time.

3D computer graphics rely on many of the same algorithms as 2D computer vector graphics in the wire-frame model and 2D computer raster graphics in the final rendered display. In computer graphics software, the distinction between 2D and 3D is occasionally blurred; 2D applications may use 3D techniques to achieve effects such as lighting, and 3D may use 2D rendering techniques.

3D computer graphics are often referred to as 3D models. Apart from the rendered graphic, the model is contained within the graphical data file. However, there are differences. A 3D model is the mathematical representation of any three-dimensional object. A model is not technically a graphic until it is displayed. Due to 3D printing, 3D models are not confined to virtual space. A model can be displayed visually as a two-dimensional image through a process called *3D rendering,* or used in non-graphical computer simulations and calculations.

3D computer graphics creation falls into three basic phases:

- 3D modeling – the process of forming a computer model of an object's shape
- Layout and animation – the motion and placement of objects within a scene
- 3D rendering – the computer calculations that, based on light placement, surface types, and other qualities, generate the image

The model describes the process of forming the shape of an object. The two most common sources of 3D models are those that an artist or engineer originates on the computer with some kind of 3D modeling tool, and models scanned into a computer from real-world objects. Models can also be produced procedurally or via physical simulation. Basically, a 3D model is formed from points called *vertices* (or *vertexes*) that define the shape and form *polygons*. A polygon is an area formed from at least three vertexes (a triangle). A four-point polygon is a *quad*, and a polygon of more than four points is an *n-gon*. The overall integrity of the model and its suitability to use in animation depend on the structure of the polygons.

Before rendering into an image, objects must be placed (laid out) in a scene. This defines spatial relationships between objects, including location and size. Animation refers to the *temporal* description of an object, i.e., how it moves and deforms over time. Popular methods include keyframing, inverse kinematics, and motion capture. These techniques are often used in combination. As with modeling, physical simulation also specifies motion.

Rendering converts a model into an image either by simulating light transport to get photo-realistic images, or by applying some kind of style as in non-photorealistic rendering. The two basic operations in realistic rendering are transport (how much light gets from one place to another) and scattering (how surfaces interact with light). This step is usually performed using 3D computer graphics software or a 3D graphics API. Altering the scene into a suitable form for rendering also involves 3D projection, which displays a three-dimensional image in two dimensions.

There are a multitude of websites designed to help educate and support 3D graphic artists. Some are managed by software developers and content providers, but there are standalone sites as well. These communities allow for members to seek advice, post tutorials, provide product reviews or post examples of their own work.

Not all computer graphics that appear 3D are based on a wireframe model. 2D computer graphics with 3D photorealistic effects are often achieved without wireframe modeling and are sometimes indistinguishable in the final form. Some graphic art software includes filters that can be applied to 2D vector graphics or 2D raster graphics on transparent layers. Visual artists may also copy or visualize 3D effects and manually render photorealistic effects without the use of filters.

Exercise 1. Read and memorize using a dictionary:

dimension, software, transparent, indistinguishable, multitude, triangle, raster, blur, rely on, standalone, spatial, temporal, capture, render, suitability, layout, scatter, purpose, manual, achieve, seek, alter

Exercise 2. Answer the questions:

1. What do 3D computer graphics rely on?
2. What are the two most common sources of 3D models?
3. What are the two basic operations in realistic rendering?
4. What do the overall integrity of the model and its suitability to use in animation depend on?

Exercise 3. Complete the sentences with the suggested words: **sources, via, tool, shape, from.**

The model describes the process of forming the _____ of an object. The two most common _____ of 3D models are those that an artist or engineer originates on the computer with some kind of 3D modeling _____ and models scanned into a computer _____ real-world objects. Models can also be produced procedurally or _____ physical simulation.

Exercise 4. Ask questions to the given answers**:**

1. Question: ____?
   Answer: Before rendering into an image, objects must be placed (laid out) in a scene.
2. Question: ____?
   Answer: *Rendering* converts a model into an image either by simulating light transport to get photo-realistic images, or by applying some kind of style as in non-photorealistic rendering.
3. Question: ____?
   Answer: A model can be displayed visually as a two-dimensional image through a process called *3D rendering,* or used in non-graphical computer simulations and calculations.

Exercise 5. Match the left part with the right:

1. Models can also be produced procedurally	a) of any three-dimensional object.
2.A 3D model is the mathematical representation	b) including location and size.
3. Altering the scene into a suitable form for rendering also involves 3D projection,	c) or via physical simulation.
4. This defines spatial relationships between objects,	d) which displays a three-dimensional image in two dimensions.

Exercise 6. Learn the following definitions**:**

3D computer graphics are graphics that use a three-dimensional representation of geometric data (often Cartesian) that is stored in the computer for the purposes of performing calculations and rendering 2D images.

A polygon is an area formed from at least three vertexes (a triangle).

Keyframing is the process of assigning a specific parameter value to an object at a specific point in time.

A website **wireframe** , also known as a page schematic or screen blueprint, is a visual guide that represents the skeletal framework of a website.

A **quad** is a quadrilateral, a four sided polygon. It is similar to a rectangle, but the angles between its edges are not constrained to ninety degrees.

Exercise 7. Compose a story on one of the topics (up to 100 words):
"3D models "
"3D rendering "
"3D computer graphics"

Lesson 10

Read the text: Online CAD Solutions Improve Engineering Productivity, Reduce Errors

As engineers and their supplier partners are challenged to work faster and to reduce mistakes, it's no wonder that the market for CAD software is booming, topping $5 billion*. Manufacturers of electronic components, and the engineers who work with them, are using this software to change the way they share CAD drawings over the Internet, increasing efficiency in the process. For instance, it used to be that an engineer might talk with a supplier about his need for a surface mount connector—from what he would use it for to the exact dimensions that he required. The supplier would then provide a drawing by fax or email, and 30 minutes or more of conversations would follow, along with additional drawings until both sides agreed on the "perfect fit."

Today's and tomorrow's newer technological capabilities enable engineers to find and "build" the part they need online, download a 2-D or 3-D drawing, insert it into their design, and immediately assess its fit. The direct insert also reduces risks of "$10,000 mistakes," which can easily occur when one wrong spec gets picked up by an individual engineer, who copies it into several colleagues' systems.

Thomas Industrial Network, for instance, has developed WebCAD Publishing technology to make the collaboration between engineers and their suppliers more efficient. The technology is CAD software agnostic; it will work with any brand, including SolidWorks, AutoCAD, Inventor, and many others. It also includes a CAD viewer, plus the ability to configure drawings to create customized parts – literally, millions of design variations are possible.

Engineers use the technology in just a few steps. For example, if your design calls for an AC inverter, you can quickly:

1. Search manufacturers for the parts you need. Those companies that offer these CAD drawings through their websites are all searchable on ThomasNet.com, a free destination for engineers, purchasing professionals and others looking for suppliers.

2. Once you have identified suppliers that offer CAD drawings, you can conduct a parametric search to narrow down results by your detailed specifications.

3. Then you can compare parts side by side, and download the closest matches. You can also search the sites of those suppliers of interest for related information (pricing, related products, certifications, etc.) to help with decision making.

Once you specify a part, you select the CAD system you're working in and hit a "GO" button to automatically download and insert the desired part directly into your design. Engineers can choose a variety of views—front or back, top or bottom, or right or left side.

The technology also generates and delivers the bill of materials for the part inserted, including the manufacturer's name, the specific part number and all of the detailed specifications. This makes it easy for everyone involved in the buying process and virtually eliminates the possibility for error during specifying and purchasing.

Online CAD solutions have transformed the industrial buying process and offer a precise way to easily do business today. For design engineers working with suppliers, online CAD solutions are all about exchanging information and tools needed to specify and buy. Online CAD solutions save time, encourage productivity and generate greater ROI (return on investment) for everyone.

Exercise 1. Read and memorize using a dictionary:

precise, dimension, supplier, solution, insert, involve, share, encourage, eliminate, increase, return, destination, collaboration, require, narrow, literally, customized, occur, bottom, additional, offer

Exercise 2. Answer the questions:

1. Why is the market for CAD software booming?
2. What technology has Thomas Industrial Network developed to make the collaboration between engineers and their suppliers more efficient?
3. When can mistakes easily occur?
4. What eliminates the possibility for error during specifying and purchasing?

Exercise 3 Complete the sentences with the suggested words: **choose, bottom, desired, download, select.**

Once you specify a part, you _____ the CAD system you're working in and hit a "GO" button to automatically _____ and insert the _____part directly into your design. Engineers can _____ a variety of views—front or back, top or _____, or right or left side.

Exercise 4 Ask questions to the given answers:

1. Question: ___________________________________?

Answer: Engineers can choose a variety of views—front or back, top or bottom, or right or left.side.

2. Question: ___________________________________?

Answer: Those companies that offer these CAD drawings through their websites are all searchable on ThomasNet.com, a free destination for engineers, purchasing professionals and others looking for suppliers.

3. Question: ___________________________________?

Answer: Today's and tomorrow's newer technological capabilities enable engineers to find and "build" the part they need online, download a 2-D or 3-D drawing, insert it into their design, and immediately assess its fit.

Exercise 5 Match the left part with the right:

1. Manufacturers of electronic components, and the engineers who work with them, are using this software	a) virtually eliminates the possibility for error during specifying and purchasing.
2. This makes it easy for everyone involved in the buying process and	b) you can conduct a parametric search to narrow down results by your detailed specifications.
3. Once you have identified suppliers that offer CAD drawings,	c) – literally, millions of design variations are possible.
4. It also includes a CAD viewer, plus the ability to configure drawings to create customized parts	d) to change the way they share CAD drawings over the Internet, increasing efficiency in the process.

Exercises 6: Learn the following definitions**:**

Capability is the ability to perform or achieve certain actions or outcomes through a set of controllable and measurable faculties, features, functions, processes, or services.

Customize - to make or alter to individual or personal specifications.

Productivity is the ratio of output to inputs in production; it is an average measure of the efficiency of production.

Dimension is a measure of spatial extent, especially width, height, or length.

Specification is the exact statement of the particular needs to be satisfied, or essential characteristics that a customer requires (in a good, material, method, process, service, system or work) and which a vendor must deliver.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"WebCAD Publishing technology"

"Online CAD solutions"

Lesson 11

Read the text: Modelling and Simulation Innovation: Just Do the Math

Modelling and simulation tools are increasingly using powerful maths and physics computations to engineer a wider range of products faster and more accurately.

The latest generation of modelling and simulation (M&S) software is being used to supplement or supersede more traditional computer-aided design (CAD) and manufacturing (CAM) applications, enabling engineers across a range of industries to more rapidly design new projects, ranging from smart vehicles to fashion accessories. The more advanced systems are also increasingly able to conduct virtual prototyping and performance testing, and see where the proposed model has unintended or undesirable effects before the final product gets anywhere near the physical manufacturing process.

More powerful high-performance computing (HPC) platforms are helping to facilitate the advances. High-end workstations, servers, and supercomputers are being tasked with number-crunching complex maths and engineering calculations. These use a much broader range, and higher volume, of data sets to meet the initial requirements of design processes when developers are concerned less about the details of the final composition than the constraints and rough dimensioning of the model under development.

Another important factor is M&S software's ability to repurpose elements that were initially developed for previous projects. "We pick up where standard CAD/CAM software stops, primarily looking at system dynamics rather than physical appearance, and addressing structure rather than the form of metal or plastic," says Jos Martin, principal software engineer at technical computing software developer MathWorks. "We import from that list of bodies or parts - and how they connect together - [then] model how they move, add motors, hydraulics, different physical domains and simulate those to describe how they would move, how much power they would require."

If you have failures in the prototypes and tooling issues, you can "get the right product out of the door much quicker", adds Jonah Normand, product specialist in design, lifecycle and simulation at 3D design software firm Autodesk. "There is a lot of research around fibre- and carbon-filled materials in, for instance, making vehicles more lightweight. The manufacturer can experiment with different materials and have the confidence to input different figures to analyse the stresses on material and fibre orientation, and take that stress analysis to get a much more accurate result."

One of the reasons behind the improved feature sets and accuracy of modelling software lies in the wider range and increased volume of information which can be input into individual simulations, ranging from energy consumption to climate statistics, in an attempt to gain a better idea of how models 'behave' using different materials in varied 'scenarios'. The data sets are a mixture of information used in similar scenarios, or new numbers which are adapted for specific applications - a new manufacturing facility based overseas, say, might have a different climate, but will re-use site measurement and temperature data, for example, while new cars based on traditional petrol engines will use existing data sets.

Being able to input and process so much information to obtain the best results is due in no small part to the increase in hardware compute capacity now available to engineers and developers. On-premise servers and supercomputers with much larger complements of CPU power, memory and storage allow for more compute-intensive modelling and simulation batch jobs to be run in shorter timescales.

Exercise 1. Read and memorize using a dictionary:

computation, accuracy, obtain, supersede, supplement, facilitate, requirement, constraint, consumption, lifecycle, application, appearance, rough, intend

Exercise 2. Answer the questions:

1. What are modelling and simulation tools increasingly using maths and physics computations for?
2. What are high-end workstations, servers, and supercomputers being tasked with?
3. What can the manufacturer experiment with?
4. What is one of the reasons which lies behind the improved feature sets and accuracy of modelling software?

Exercise 3. Complete the sentences with the suggested words: **conduct, manufacturing, undesirable, advanced, proposed.**

The more _____ systems are also increasingly able to _____ virtual prototyping and performance testing, and see where the _____ model has unintended or _____ effects before the final product gets anywhere near the physical _____ process.

Exercise 4. Ask questions to the given answers:

1. Question: ____ ?

Answer: The latest generation of modelling and simulation (M&S) software is being used to supplement or supersede more traditional computer-aided design (CAD) and manufacturing (CAM) applications

2. Question: ____ ?

Answer: Another important factor is M&S software's ability to repurpose elements that were initially developed for previous projects

3. Question: ____ ?

Answer: Being able to input and process so much information to obtain the best results is due in no small part to the increase in hardware compute capacity now available to engineers and developers.

Exercise 5. Match the left part with the right:

1. High-end workstations, servers, and supercomputers are being tasked	a) and see where the proposed model has unintended or undesirable effects.
2. There is a lot of research around fibre- and carbon-filled materials in,	b) with number-crunching complex maths and engineering calculations.
3. The data sets are a mixture of information used in similar scenarios,	c) for instance, making vehicles more lightweight.
4. The more advanced systems are also increasingly able to conduct virtual prototyping and performance testing,	d) or new numbers which are adapted for specific applications.

Exercise 6. Learn the following definitions:

Performance is the accomplishment of a given task measured against preset known standards of accuracy, completeness, cost, and speed.

A **server** is a computer program that provides services to other computer programs (and their users) in the same or other computers.

Simulation is the imitation of the operation of a real-world process or system over time.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"The latest generation of modelling and simulation"

"M&S software's abilities"

Lesson 12

Read the text: **A Domain Specific Software Model for Interior Architectural Education and Practice**

Computer aided architectural design (CAAD) software packages are mostly developed for general-purpose use and then they are customized to serve for specific needs. Most software packages used in interior architecture are such general-purpose software, which are originally developed for architecture. Often, customization of these packages to meet fundamental requirements of interior architectural design process is left to the user. Most of the interior architectural companies utilize bespoke or general CAAD software by integrating plug-ins. Similar to many other professions, today interior architectural companies are becoming more dependent upon digital technologies and software packages for their daily operations, thus the number of individual software packages used in interior architectural practice increases. However, a domain specific interior architectural software package, which is widely accepted and used, is not existent.

Interior architecture is a distinct design field which specializes in interior space's detailed design requirements related to color, texture, lighting, heating, acoustics, furniture and all details of human use and actually, it owes its independent existence as a field to these details. These details put forth a special characteristic for interior architecture and express its “otherness”. However, interior architecture still struggles to manifest its existence; deprived of connotations of decoration and sublimed from the subduing effects of architecture. Often, interior architecture is merely taken as decorating the space that could even be done by those who are interested and tasty, with no formal education, and/or it is overlooked as already being taken care of within the architectural agenda.

This dilemma has already obstructed interior architecture from benefiting from the medium of computer fully. Currently, the available software for interior architecture reflects the quandary about interior architecture. On the one hand, there are how-to-do-it-yourself packages that reduce the process to selecting from a bundle; totally reducing the process of design to a series of selections. On the other, there are general-purpose packages that encompass architectural shell making, comprising all the details of the shell and its making. Using the latter packages is like taking a plane to go to the grocery store, in other words, it is employing an over-equipped a tool for an otherwise too random a function for interior architecture.

In fact, given the right tools, the digital opportunities could enable interior architecture to assert itself by putting forth its differences and potentials in terms of creating and assessing spaces with color, light, materials and sounds, which could eventually alter the way how the profession is perceived. Interior architecture is concerned with the changing effects of light on different colors and materials, the manipulation of sound within a space and the quality of the interior space in terms of issues pertaining to sustainability, like heat distribution in a space or ventilation. These issues can be displayed through digital opportunities better than in any other medium, largely because real-time animations are possible.

Surprisingly, with the advancements of the technology interior architecture looses the grip of its design field, instead of having the upper hand. Not only contractors are producing optimized interiors based on cliché visions, which are nonetheless professional looking thanks to the computer aid; even clients are becoming capable of creating their own images of the interiors through the do-it-yourself packages.

Exercise 1. Read and memorize using a dictionary:

advancement, deprive, random, opportunity, nonetheless, existent, pertain, obstruct, subdue, encompass, issue, similar, comprise, grip, perceive, dependant, customization, contractor, quandary, agenda

Exercise 2. Answer the questions:

1. What are computer aided architectural design software packages mostly developed for?
2. How do most of the interior architectural companies utilize bespoke or general CAAD software?
3. What does the available software for interior architecture reflect currently?
4. What is interior architecture concerned with?

Exercise 3. Complete the sentences with the suggested words: **heating, use, distinct, owes, requirements**

Interior architecture is a _____ design field which specializes in interior space's detailed design _____ related to color, texture, lighting, _____, acoustics, furniture and all details of human ____ and actually, it _____ its independent existence as a field to these details.

Exercise 4. Ask questions to the given answers:

1. Question: ____ ?

Answer: Often, customization of these packages to meet fundamental requirements of interior architectural design process is left to the user.

2. Question: ____ ?

Answer: Interior architecture is a distinct design field which specializes in interior space's detailed design requirements.

3. Question: ____ ?

Answer: There are general-purpose packages that encompass architectural shell making, comprising all the details of the shell and its making.

Exercise 5. Match the left part with the right:

1. Computer aided architectural design software packages are mostly developed for	a) which is widely accepted and used, is not existent.
2. However, a domain specific interior architectural software package,	b) better than in any other medium, largely because real-time animations are possible.
3. This dilemma has already obstructed interior architecture	c)general-purpose use and then they are customized to serve for specific needs.
4. These issues can be displayed through digital opportunities	d) from benefiting from the medium of computer fully.

Exercise 6. Learn the following definitions:

Customization is the process of delivering wide-market goods and services that are modified to satisfy a specific customer need.

A **dilemma** is a situation requiring a choice between equally undesirable alternatives or any difficult or perplexing situation or problem.

A **plug-in** is a hardware or software module that adds a specific feature or service to a larger system.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"Computer aided architectural design software packages"

"Modern interior architecture"

Lesson 13

Read the text: **3D Printing** (part 1)

Imagine a future in which a device connected to a computer can print a solid object. A future in which we can have tangible goods as well as intangible services delivered to our desktops or highstreet shops over the Internet. And a future in which the everyday "atomization" of virtual objects into hard reality has turned the mass pre-production and stock-holding of a wide range of goods and spare parts into no more than an historical legacy.

Such a future may sound like it is being plucked from the worlds of Star Trek. However, while transporter devices that can instantaneously deliver us to remote locations may remain a fantasy, 3D printers capable of outputting physical objects have been in both development and application for over three decades, and are now starting to present a whole host of new digital manufacturing capabilities. 3D printing may therefore soon do for manufacturing what computers and the Internet have already done for the creation, processing and storage of information. Such a possibility has also started to capture mainstream media attention.

3D printing is an additive technology in which objects are built up in a great many very thin layers. The first commercial 3D printer was based on a technique called **stereolithography**. This was invented by Charles Hull in 1984. Stereolithographic 3D printers (known as SLAs or **s**tereolithography apparatus) position a perforated platform just below the surface of a vat of liquid photopolymer. A UV laser beam then traces the first slice of an object on the surface of this liquid, causing a very thin layer of photopolymer to harden. The perforated platform is then lowered very slightly and another slice is traced out and hardened by the laser. Another slice is then created, and then another, until a complete object has been printed and can be removed from the vat of photopolymer, drained of excess liquid, and cured. Stereolithographic printers remain one of the most accurate types of hardware for fabricating 3D output, with a minimum build layer thickness of only 0.06mm (0.0025 of an inch).

Another 3D printing technology based on the selective solidification of a tank of liquid -- or 'vat polymerization' -- is **DLP projection**. This uses a projector to solidify object layers one complete cross-section at a time, rather than using a laser to trace them out. One of the leading manufactuters of this kind of printer is envision TEC with its Perfactory range of 3D printer hardware.

A final 3D printing technology that creates objects by using a light source to solidify a liquid photopolymer is known generically as '**material jetting**', or commercially as '**polyjet matrix**'. This was pioneered by a company called Objet and forms object layers by emitting liquid photopolymer from an inkjet-style, multi-nozzel print head. After each layer is printed a powerful UV light is then used to set it solid before the next layer is printed. The really clever thing is that the Connecx range of 3D printers created by Objet can jet several different materials from their print head, and in varying combination. This allows up to 14 of 120 potential materials to be printed at the same time. This means that objects can be printed with, for example, both hard plastic and rubber-like parts.

Exercise 1. Read and memorize using a dictionary:

solid, spare parts, pluck legacy, remote, capability, mainstream, additive, layer, thickness, harden, drain, hardware, source, rubber, liquid, tangible, emit, jetting, emit

Exercise 2. Answer the questions:

1. What can 3D printing do for manufacturing ?
2. How are objects built up in 3D printing?
3. What printers are the most accurate types of hardware for fabricating 3D output?
4. What started to capture mainstream media attention?

Exercise 3. Complete the sentences with the suggested words: **solid, tangible, desktops, connected, intangible**

Imagine a future in which a device _____ to a computer can print a _____object. A future in which we can have _____ goods as well as _____services delivered to our _____ or highstreet shops over the Internet.

Exercise 4. Ask questions to the given answers:

1. Question ______________________________?

Answer: The first commercial 3D printer was based on a technique called stereolithography.

2. Question: ______________________________?

Answer: Another 3D printing technology based on the selective solidification of a tank of liquid is DLP projection.

3. Question: ______________________________?

Answer: Stereolithographic 3D printers position a perforated platform just below the surface of a vat of liquid photopolymer.

Exercise 5. Match the left part with the right:

1. Imagine a future in which a device connected	a) rather than using a laser to trace them out.
2. This uses a projector to solidify object layers one complete cross-section at a time,	b) then used to set it solid before the next layer is printed.
3. This means that objects can be printed with,	c) to a computer can print a solid object.
4. After each layer is printed a powerful UV light is	d) for example, both hard plastic and rubber-like parts.

Exercise 6. Learn the following definitions:

Solid is one of the four fundamental states of matter (the others being liquid, gas, and plasma). It is characterized by structural rigidity and resistance to changes of shape or volume.

Stereolithography is an additive manufacturing or 3D printing technology used for producing models, prototypes, patterns, and production parts up one layer at a time by curing a photo-reactive resin with a UV laser or another similar power source.

A photopolymer is a polymer that changes its properties when exposed to light, often in the ultraviolet or visible region of the electromagnetic spectrum.

A **laser** is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"A future with 3D printing"

"Stereolithography "

"Material jetting"

Lesson 14

Read the text: **3D Printing** (part 2)

Rather than solidifying a photopolymer, another category of 3D printer hardware is based on **material extrusion**. Here a semi-liquid material -- and most usually a hot thermoplastic -- is deposited from a computer-controlled print head. This process was invented by Scott Crump in 1988. Crump chose to name the technology '**fused deposition modelling**' or '**FDM**', and patented and trademarked these terms. Some manufacturers refer to the same process as '**thermoplastic extrusion**', '**plastic jet printing**' (PJP), the '**fused filament method**' (FFM) or '**fused filament fabrication**' (FFF).

One of the key benefits of FDM ('**fused deposition modelling**') is that objects can be made of out of exactly the same thermoplastics used in traditional injection moulding. Most FMD 3D printers can print with both ABS (acrylonitrile butadiene styrene), as well as a biodegradable bioplastic called PLA (polylactic acid) that is produced from organic alternatives to oil. Within a decade developments in synthetic biology are likely to make the direct production of PLA from a range of biomass materials quite common, hence allowing 3D printing supplies to be grown in many a back yard.

In addition to being used to output plastic objects, material extrusion printers have also been developed that can output other semi-liquid materials. The applications are already quite diverse, and range from 3D printers that can print in cheese or chocolate, to concrete printers that may in future allow entire buildings (or large parts thereof) to be 3D printed. D-Shape have even created an enormous 3D printer that can build objects in a form of synthetic stone.

A third broad category of 3D printer hardware creates object layers by selectively sticking together successive layers of a powdered build material. This can also be achieved in two ways. Firstly, there are printers based on **binder jetting** (also sometimes known as 'inkjet powder printing'). Here a glue or 'binder' is jetted from an inkjet style print head to stick together successive powder layers. Most commonly the powder used is gypsum-based composite that needs to have its surface coated after printout if a robust object is required. Some binder jetting printers -- such as the ZP printer 850 from 3D Systems -- jet both a binder and coloured inks from five print heads, so allowing full-colour 3D objects to be created at up to 600x540dpi.

Other binder jetting printers can build objects by sticking together plastic powders, sand or even metals. Where a binder is sprayed onto sand, the final object is used as a mould in '**3D sandcasting**', with molten liquid metal poured into it. Once the metal has cooled solid, the sand is then broken away.

Binder jetting metal printing has been developed by a company called ExOne (who also make 3D sandcasting printers). Here a layer of bronze or stainless steel metal powder is laid down and a print head moves across it to selectively spray on a binder solution. A heating lamp then dries the layer, and a fresh layer of powder is rolled over it, and the process repeats. Once all layers have been output, the object is then placed in an oven to fully cure the binder. At this stage the object is still very fragile, but is put in a kiln where it is infused with additional bronze powder. The final result is a very solid object that is a least 99.9 per cent solid metal.

Rather than spraying on a binder, an alternative method to stick powder granules together is to apply heat. A well established 3D printing technology that works in this manner is **selective laser sintering** (SLS). This builds objects by laying down a fine layer of powder and then using a laser to selectively fuse some of its granules together. At present, SLS 3D printers can output objects using a wide range of powdered materials. These include wax, polystyrene, nylon, glass, ceramics, stainless steel, titanium, aluminium and various alloys including cobalt chrome. During printing, non-bonded powder granules support the object as it is constructed. Once printing is complete, almost all excess power is able to be recycled.

When SLS is used to directly produce metal objects the process is also called **direct metal laser sintering** (DMLS). Metal objects created by a DMLS 3D printer are about 99.99 per cent dense, and hence can be used in place of traditional metal parts in the vast majority of applications.

Exercise 1. Read and memorize using a dictionary:

filament, layer, powder, sintering, alloy, stainless, binder, infuse, recycle, fragile, solidify, extrusion, diverse, fuse, sand, additional, cure, glue, ink, dense, vast, majority, robust, application, moulding

Exercise 2. Answer the questions:

1.What process was invented by Scott Crump in 1988 ?
2.What is the key benefit of 'fused deposition modelling' ?
3. How does the third broad category of 3D printer hardware create object layers?
4. What company developed binder jetting metal printing?

Exercise 3. Complete the sentences with the suggested words: **binder, powder, spray, layer, output**

Here a _____ of bronze or stainless steel metal powder is laid down and a print head moves across it to selectively _____ on a binder solution. A heating lamp then dries the layer, and a fresh layer of _____powder is rolled over it, and the process repeats. Once all layers have been _____, the object is then placed in an oven to fully cure the _____.

Exercise 4. Ask questions to the given answers:

1. Question: ____?
Answer: During printing, non-bonded powder granules support the object as it is constructed.
2. Question: ____?
Answer: Once the metal has cooled solid, the sand is then broken away.
3. Question: ____?
Answer: At this stage the object is still very fragile, but is put in a kiln where it is infused with additional bronze powder.

Exercise 5. Match the left part with the right:

1. Here a layer of bronze or stainless steel metal powder is	a) PLA that is produced from organic alternatives to oil.
2. This builds objects by laying down a fine layer of powder and	b) laid down and a print head moves across it to selectively spray on a binder solution.
3. Other binder jetting printers can build objects	c) then using a laser to selectively fuse some of its granules together.
4.Most FMD 3D printers can print with both ABS, as well as a biodegradable bioplastic called	d) by sticking together plastic powders, sand or even metals.

Exercise 6. Learn the following definitions**:**

Sintering is a method for creating objects from powders, including metal and ceramic powders. It is based on atomic diffusion.

Binder is a material that is used to hold things together.

alloy is a substance composed of two or more metals or of a metal and a nonmetal intimately united usually by being fused together and dissolving in each other when molten; *also* **:** the state of union of the components

Extrusion is manufacturing process in which a softened blank of a metal or plastic material is forced through a shaped metal piece or die to produce a continuous ribbon of the formed product.

Jet - a high-velocity fluid stream forced under pressure out of a small-diameter opening or nozzle.

A **kiln** is a thermally insulated chamber, a type of *oven,* that produces temperatures sufficient to complete some process, such as hardening, drying, or chemical changes.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"Binder jetting metal printing "
"Selective laser sintering "
"Fused deposition modelling**"**

Lesson 15

Read the text: 3D Printing - Concept Modeling Solutions - Marketing and Design

Marketing is the process of communicating messages and advertising your product or ideas to your target audience. Marketing your business, your product and service is an extremely important function to attract your customers. Having a visual and tangible product or prototype to showcase to a customer is a very helpful tool once you try to explain a concept. 3D printed models are great marketing tools since they are a visual representation of your ideas and designs. Having prototypes during a presentation can be used as samples for people to see, hold and examine from every angle.

Whether you have an idea in mind, a sketch on paper, a 3D design, or even physical prototype, there is always a step forward to take with Proto3000. An idea or a sketch can be developed, and optimized using a CAD (Computer Aided Design) file, which is sent to a Polyjet or an FDM 3D printer.

Single material or multiple materials can be used to create the parts or model. Once the project is 3D printed, it will go through finishing touches based on the preference. It is possible to paint it, bond/glue it, dye the parts or simply leave the prototype as it is.

Our industry leading systems can print 3D Prototypes and models that are as close to an exact replica of the end use parts. We offer a wide variety of materials and combinations of materials to choose from, allowing a prototype to be made to complete perfection.

Having a Stratasys 3D printer can give you high–quality product models in just hours or a few days, without having to send your design offsite. The time from 3D CAD design to fully functioning 3D prototype (with moving parts) will be minimal. Not only will you be saving time, effort and money but your product development lifecycle will be greatly enhanced when you have a 3D Printer in-house.

PolyJet 3D printed marketing models are created using several materials including rubberlike, rigid and clear. This can be useful for not just the product development but also for the packaging development. This usability will allow you to get consumer feedback and to be creative with the packaging and the design without having to create expensive pre-series production molds. PolyJet creates exceptionally accurate 3D product models that have fine details and smooth surfaces. Acrylic-based materials can be post-processed to create painted and metallic finishes that make the models truly indistinguishable from the end product. Use accurate models in photos for marketing collateral that highlights product details and features, and to design effective packaging and displays. Reduce time to market by enabling graphic designers to integrate product images in collateral and ensure that packaging and displays work seamlessly with end products, well before it goes into actual production. Models built with Fused Deposition Modeling (FDM) Technology can be sanded, painted and even chrome–plated to match the finished appearance of a new product. Since FDM uses production-grade thermoplastics, you will be able to create a model with the durability and feel of a final product.

Using Fused Deposition Modeling (FDM) technology allows affordability and durability by printing concept models with production-grade thermoplastics. FDM 3D Printers are office friendly and they produce small models in hours and large models in days. The FDM printed models can be drilled, sanded and painted according to your preference to create a perfect finishing of your prototype.

As a 3D printing process, the PolyJet 3D Printing technology produces amazingly realistic models. The printing technology builds accurate models by incorporating multiple materials into one automated part to create prototypes that look and feel like finished products. With fine details, smooth surfaces, rigid housings, soft-touch buttons, lettering, rubberlike seals and even clear components, your models can look the part at a trade show, a presentation or even during a sales pitch.

Exercise 1. Read and memorize using a dictionary:

accurate, smooth, rigid, durability, rubber, soft, drill, seal, indistinguishable, collateral, lifecycle, bond, glue, target, tangible, amazing, sand, highlight, feature, fuse, seamless, effort, enhance

Exercise 2. Answer the questions:

1. What is marketing?
2. How can an idea or a sketch be developed?
3. How are PolyJet 3D printed marketing models created?
4. What makes the models truly indistinguishable from the end product.?

Exercise 3. Complete the sentences with the suggested words: **indistinguishable, smooth, accurate, create, make.**

PolyJet creates exceptionally _____ 3D product models that have fine details and _____ surfaces. Acrylic-based materials can be post-processed to _____ painted and metallic finishes that _____ the models truly _____ from the end product.

Exercise 4. Ask questions to the given answers:

1. Question: ____ ?

Answer: Having a visual and tangible product or prototype is a very helpful tool once you try to explain a concept.

2. Question: ____ ?

Answer: Using Fused Deposition Modeling (FDM) technology allows affordability and durability by printing concept models with production-grade thermoplastics.

3. Question: ____ ?

Answer: The printing technology builds accurate models by incorporating multiple materials into one automated part to create prototypes that look and feel like finished products.

Exercise 5. Match the left part with the right:

1. 3D printed models are great marketing tools since they are	a) to create prototypes that look and feel like finished products.
2. The time from 3D CAD design to fully functioning 3D prototype (with moving parts)	b) they produce small models in hours and large models in days.
3. FDM 3D Printers are office friendly and	c) will be minimal.
4. The printing technology builds accurate models by incorporating multiple materials into one automated part	d) a visual representation of your ideas and designs.

Exercise 6. Learn the following definitions:

A sample is a small part of anything or one of a number, intended to show the quality, style, or nature of the whole; specimen.

Durability is assurance or probability that an equipment, machine, or material will have a relatively long continuous useful life, without requiring an inordinate degree of maintenance.

A **prototype** is an early sample, model or release of a product built to test a concept or process or to act as a thing to be replicated or learned from.

Exercise 7. Compose a story on one of the topics (up to 100 words):

"3D printing and marketing"
"Fused Deposition Modeling (FDM) Technology"

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Keys

Lesson 1
Exercise 2.

1. The term "algorithmic language" usually refers to a problem-oriented language, as opposed to machine code.

2. The lowest level elements, formed by chains of basic symbols, are called lexemes, or lexical units.

3. The further levels of elements of an algorithmic language are formed by notions, or non-terminals.

4. Finding the attributes of lexemes begins with the analysis of their defining occurrences.

Exercise 3. A tree whose root is the initial notion, whose terminal vertices (leafs) are lexemes and basic symbols, whose internal vertices are concepts and whose branches are constituent relations, is called a production or syntax tree of a program.

Exercise 4.

1. What does the transitive closure of the constituent relation uniquely assign to each notion?

2. What is called semantic analysis?

3. What are the rules of syntactic analysis laid down by?

Exercise 5 - 1b, 2c, 3d, 4a

Lesson 2

Exercise 2

1.Object-oriented programming is an approach to designing modular, reusable software systems.

2. One of the most common sources of errors in programs is when one part of the system accidentally interferes with another part

3. The goals of object-oriented programming are: increased understanding, ease of maintenance and ease of evolution.

4. Object orientation eases maintenance by the use of encapsulation and information hiding.

Exercise 3.

Object orientation eases maintenance by the use of encapsulation and information hiding. One of the most common sources of errors in programs is when one part of the system accidentally interferes with another part.

Exercise 4.

1. What is the object-oriented approach in reality?

2. What is an object?

3. What sections off responsibility for individual blocks to implement separate functionality?

Exercise 5 -1c, 2a, 3d, 4b

Lesson 3

Exercise 2

1. The subject System Analysis and Design (SAD), mainly deals with the software development activities.
2. The objective of the system demands that some output is produced as a result of processing the suitable inputs.
3. The phase of system designing is the most crucial phase in the developments of a system.
4. The system design needs to be implemented to make it a workable system.

Exercise 3

The objective of the system demands that some output is produced as a result of processing the suitable inputs. A well-designed system also includes an additional element referred to as ‘control’ that provides a feedback to achieve desired objectives of the system.

Exercise 4

1. What are three major components in every system?
2. What specifications are drawn up in detail?
3. What coordinates the data movements and control the entire process in a system?

Exercise 5 – 1d**,** 2c, 3b, 4a

Lesson 4

Exercise 2

1. Many, if not most, management decisions concerning the environment affect and are affected by the landscape.

2. The U.S. Environmental Protection Agency moved away from their traditional “media-based” approach to environmental management and toward a more “place-based” approach.

3. Landscape modeling studies at local, regional, and global scales integrate natural and social sciences and develop a common framework for understanding linked ecological economic systems.

4. The spatially explicit landscape simulation models deal with a range of ecological and socio-economic variables.

Exercise 3

Among landscape models there is a large variation in complexity and capabilities. Often, it is this variation that makes one model more suitable for certain applications than others. Landscape models are, by definition, spatially explicit.

Exercise 4

1. Who makes decisions about land use and infrastructure that directly affect the landscape?
2. What are the spatially explicit landscape simulation models?
3. What is the least complex interaction between horizontal and vertical fluxes?

Exercise 5 – 1b, 2a, 3d, 4c.

Lesson 5

Exercise 2.

1. The product designer's role is to combine art, science, and technology to create new products that other people can use.

2. Product design is sometimes confused with (and certainly overlaps with) industrial design, and has recently become a broad term inclusive of service, software, and physical product design.

3. New consumer-friendly 3D printers can produce dimensional objects and print upwards with a plastic like substance opposed to traditional printers that spread ink across a page.

4. Synthesis encompasses four stages: ideate, select, implement, evaluate.

Exercise 3.

The product design process has experienced huge leaps in evolution over the last few years with the rise and adoption of 3D printing. New consumer-friendly 3D printers can produce dimensional objects and print upwards with a plastic like substance opposed to traditional printers that spread ink across a page

Exercise 4

1. What has the product designer's role been facilitated by?
2. What is industrial design concerned with?
3. What are the main sections of the design process?

Exercise 5 – 1c, 2d, 3b, 4a.

Lesson 6

Exercise 2

1. Ergonomics derives from two Greek words: ergon, meaning work, and nomoi, meaning natural laws, to create a word that means the science of work and a person's relationship to that work.

2. Ergonomics is the scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance.

3. Ergonomics helps define how it is used, how it meets you needs, and most importantly if you like it. It makes things comfy and efficient.

4. The mental aspect of comfort in the human-machine interface is found in feedback.

Exercise 3

The utility of an item is the only true measure of the quality of its design. The job of any designer is to find innovative ways to increase the utility of a product. Making an item intuitive and comfortable to use will ensure its success in the marketplace.

Exercise 4

1. What does ergonomics literally mean?
2. Where is the mental aspect of comfort in the human-machine interface found?
3. What should a quality product feel like?

Exercise 5 – 1b, 2c, 3d, 4a.

Lesson 7

Exercise 2

1. CAD systems enable designers to view objects under a wide variety of representations and to test these objects by simulating real-world conditions.

2. The development of CAD and CAM and particularly the linkage between the two overcame traditional NC shortcomings in expense, ease of use, and speed by enabling the design and manufacture of a part to be undertaken using the same system of encoding geometrical data. This innovation greatly shortened the period between design and manufacture.

3. The third source of CAD development resulted from efforts to facilitate the flow from the design process to the manufacturing process using numerical control (NC) technologies.

4. Since both CAD and CAM use computer-based methods for encoding geometrical data, it is possible for the processes of design and manufacture to be highly integrated.

Exercise 3

The development of CAD and CAM and particularly the linkage between the two overcame traditional NC shortcomings in expense, ease of use, and speed by enabling the design and manufacture of a part to be undertaken using the same system of encoding geometrical data.

Exercise 4

1. What do CAD systems enable designers?
2. What was pioneered by high-tech industries like aerospace and semiconductors?
3. What are computers also used for?

Exercise 5 – 1d, 2c, 3a, 4b.

Lesson 8

Exercuse 2

1. Designs can be altered without erasing and redrawing. CAD systems also offer "zoom" features analogous to a camera lens, whereby a designer can magnify certain elements of a model to facilitate inspection.

2. CAD systems function by their capacity to codify geometrical concepts.

3. Among the most common types of simulation are testing for response to stress and modeling the process by which a part might be manufactured or the dynamic relationships among a system of parts.

4. In stress tests, model surfaces are shown by a grid or mesh, that distort as the part comes under simulated physical or thermal stress

Exercise 3

The system could then mimic the engineer's thought pattern and actually "create" more of the design. Expert systems might involve the implementation of more abstract principles, such as the nature of gravity and friction, or the function and relation of commonly used parts, such as levers or nuts and bolts.

Exercise 4

1. What could the system mimic?
2. How do dynamics tests function?
3. Where is simulation used?

Exercise 5 – 1b, 2c, 3d, 4b.

Lesson 9

Exercise 2

1. 3D computer graphics rely on many of the same algorithms as 2D computer vector graphics in the wire-frame model and 2D computer raster graphics in the final rendered display.
2. The two most common sources of 3D models are those that an artist or engineer originates on the computer with some kind of 3D modeling tool, and models scanned into a computer from real-world objects.
3. The two basic operations in realistic rendering are transport (how much light gets from one place to another) and scattering (how surfaces interact with light).
4. The overall integrity of the model and its suitability to use in animation depend on the structure of the polygons.

Exercise 3

The model describes the process of forming the shape of an object. The two most common sources of 3D models are those that an artist or engineer originates on the computer with some kind of 3D modeling tool, and models scanned into a computer from real-world objects. Models can also be produced procedurally or via physical simulation.

Exercise 4

1. Where must objects be placed before rendering into an image?
2. How does rendering convert a model into an image?
3. How can a model be displayed?

Exercise 5 – 1c, 2a, 3d, 4b.

Lesson 10

Exercise2

1. As engineers and their supplier partners are challenged to work faster and to reduce mistakes, it’s no wonder that the market for CAD software is booming, topping $5 billion*.
2. Thomas Industrial Network, for instance, has developed WebCAD Publishing technology to make the collaboration between engineers and their suppliers more efficient.
3. Mistakes can easily occur when one wrong spec gets picked up by an individual engineer, who copies it into several colleagues’ systems.
4. The technology also generates and delivers the bill of materials for the part inserted, including the manufacturer’s name, the specific part number and all of the detailed specifications. This makes it easy for everyone involved in the buying process and virtually eliminates the possibility for error during specifying and purchasing.

Exrcise 3

Once you specify a part, you select the CAD system you're working in and hit a "GO" button to automatically download and insert the desired part directly into your design. Engineers can choose a variety of views—front or back, top or bottom, or right or left side.

Exercise 4

1. What views can engineers choose?
2. What companies are searchable on ThomasNet.com?
3. What do today's and tomorrow's newer technological capabilities enable engineers?

Exercise 10 – 1d, 2a, 3b, 4c.

Lesson 11

Exercise 2

1. Modelling and simulation tools are increasingly using powerful maths and physics computations to engineer a wider range of products faster and more accurately.
2. High-end workstations, servers, and supercomputers are being tasked with number-crunching complex maths and engineering calculations.
3. The manufacturer can experiment with different materials.
4. One of the reasons behind the improved feature sets and **accuracy** of modelling software lies in the wider range and increased volume of information which can be input into individual simulations.

Exercise 3

The more advanced systems are also increasingly able to conduct virtual prototyping and performance testing, and see where the proposed model has unintended or undesirable effects before the final product gets anywhere near the physical manufacturing process.

Exercise 4

1. What is being used to supplement or supersede more traditional computer-aided design (CAD) and manufacturing (CAM) applications?
2. What is another important factor of M&S software?
3. What does the increase in hardware compute capacity now available to engineers and developers result in?

Exercise 5 – 1b, 2c, 3d, 4a.

Lesson 12

Exercise 2

1. Computer aided architectural design (CAAD) software packages are mostly developed for general-purpose use and then they are customized to serve for specific needs.
2. Most of the interior architectural companies utilize bespoke or general CAAD software by integrating plug-ins.
3. The available software for interior architecture reflects the quandary about interior architecture.
4. Interior architecture is concerned with the changing effects of light on different colors and materials, the manipulation of sound within a space and the quality of the interior space.

Exercise 3

Interior architecture is a distinct design field which specializes in interior space's detailed design requirements related to color, texture, lighting, heating, acoustics, furniture and all details of human use and actually, it owes its independent existence as a field to these details.

Exercise 4

1. What operation is often left to the user?
2. What is interior architecture?
3. What do general-purpose packages encompass?

Exercise 5 – 1c, 2a, 3d, 4b.

Lesson 13

Exercise 2

1. 3D printing may therefore soon do for manufacturing what computers and the Internet have already done for the creation, processing and storage of information.

2. 3D printing is an additive technology in which objects are built up in a great many very thin layers.

3. Stereolithographic printers remain one of the most accurate types of hardware for fabricating 3D output, with a minimum build layer thickness of only 0.06mm

4. 3D printing has also started to capture mainstream media attention.

Exercise 3

Imagine a future in which a device connected to a computer can print a solid object. A future in which we can have tangible goods as well as intangible services delivered to our desktops or highstreet shops over the Internet.

Exercise 4

1. What was the first commercial 3D printer based on?

2. What is DLP projection?

3. How do Stereolithographic 3D printers position a perforated platform?

Exercise 5 – 1c, 2a, 3d, 4b.

Lesson 14

Exercise 2

1. Here a semi-liquid material -- and most usually a hot thermoplastic -- is deposited from a computer-controlled print head. This process was invented by Scott Crump in 1988.

2. One of the key benefits of FDM ('fused deposition modelling') is that objects can be made of out of exactly the same thermoplastics used in traditional injection moulding.

3. A third broad category of 3D printer hardware creates object layers by selectively sticking together successive layers of a powdered build material.

4. Binder jetting metal printing has been developed by a company called ExOne.

Exercise 3

Here a layer of bronze or stainless steel metal powder is laid down and a print head moves across it to selectively spray on a binder solution. A heating lamp then dries the layer, and a fresh layer of powder is rolled over it, and the process repeats.

Exercise 4

1. What supports the object as it is constructed during printing?

2. When is the sand broken away?.

3. Where is the object infused with additional bronze powder?

Exercise 5 – 1b, 2c, 3d, 4a.

Lesson 15

Exercise 2

1. Marketing is the process of communicating messages and advertising your product or ideas to your target audience.

2. An idea or a sketch can be developed, and optimized using a CAD (Computer Aided Design) file, which is sent to a Polyjet or an FDM 3D printer.

3. PolyJet 3D printed marketing models are created using several materials including rubberlike, rigid and clear.

4. Acrylic-based materials can be post-processed to create painted and metallic finishes that make the models truly indistinguishable from the end product.

Exercise 3.

PolyJet creates exceptionally accurate 3D product models that have fine details and smooth surfaces. Acrylic-based materials can be post-processed to create painted and metallic finishes that make the models truly indistinguishable from the end product.

Exercise 4.

1. What is a very helpful tool once you try to explain a concept?
2. How does FDM technology allow affordability and durability?
3. How does the printing technology build accurate models?

Exercise 5 – 1d, 2c, 3b, 4a.