Engineering

I. Reading.

Engineering is the discipline, art and profession of acquiring and applying technical, scientific, and mathematical knowledge to design and implement materials, structures, machines, devices, systems, and processes that safely realize a desired objective or invention.

History

The concept of engineering has existed since ancient times as humans devised fundamental inventions such as the pulley, lever, and wheel. Each of these inventions is consistent with the modern definition of engineering, exploiting basic mechanical principles to develop useful tools and objects.

Ancient era

The Pharos of Alexandria, the pyramids in Egypt, the Hanging Gardens of Babylon, the Acropolis and the Parthenon in Greece, the roman aqueducts and cities and pyramids of the Mayan, Inca and Aztec Empires, the Great Wall of China, among many others, stand as a testament to the ingenuity and skill of the ancient civil and military engineers.
Chinese, Greek and Roman armies employed complex military machines and inventions such as artillery which was developed by the Greeks around the 4th century B.C., the trireme, the ballista and the catapult. In the Middle Ages, the Trebuchet was developed.

Aqueduct of Segovia, Spain.

Trebuchet at Chateau de Baux, France.

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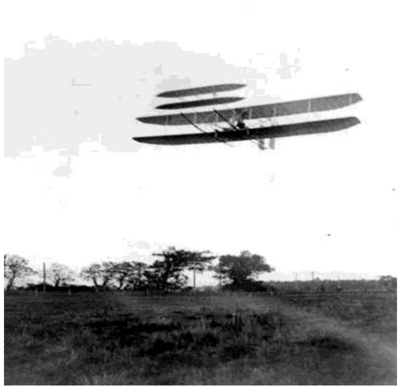
Renaissance era

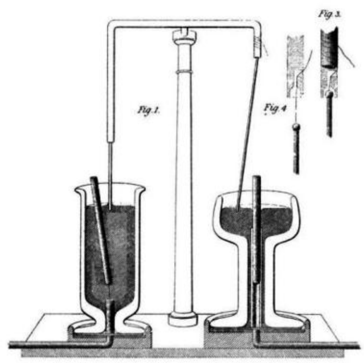
The first electrical engineer is considered to be William Gilbert, with his 1600 publication of De Magnete, who was the originator of the term ”electricity”. The first steam engine was built in 1698 by mechanical engineer Thomas Savery. The development of this device gave rise to the industrial revolution in the coming decades, allowing for the beginnings of mass production. With the rise of engineering as a profession in the 18th century, the term became more narrowly applied to fields in which mathematics and science were applied to these ends. Similarly, in addiction to military and civil engineering the fields then known as the mechanic arts became incorporated into engineering.

Modern era

Electrical engineering can trace its origin in the experiments of Alessandro Volta, the experiments of Michael Faraday, George Ohm and others and the invention of the electric motor in 1872. The work of James Maxwell and Heinrich Hertz gave rise to the field of electronics The inventions of Thomas Savery and the Scottish engineer James Watt gave rise to modern Mechanical Engineering. It developed in the 19^{th} century during Industrial Revolution. Industrial scale manufacturing demanded new materials and new processes and by 1880 the need for large scale production of chemicals was such that a new industry was created, dedicated to the development and large scale manufacturing of chemicals in new industrial plants. Aeronautical engineering deals with aircraft design while Aerospace Engineering is a more modern term that expands the reach envelope of the discipline by including spacecraft design. Early knowledge of aeronautical engineering was largely empirical with some concepts and skills imported from other branches of engineering. Only a decade after the successful flights by the Wright brothers, the 1920s saw extensive development of aero nautical engineering through development of World War I military aircraft. Meanwhile, research to provide fundamental background science continued by combining theoretical physics with experiments. In 1990, with rise of computer technology, the first search engine was built by computer engineer Alan Emtage.



Wright flyer III. Piloted by Orwille Wright, 1905.



Faraday's electromagnetic experiment, 1821.

Main Branches of Engineering

Engineering, much like other science, is a broad discipline which is often broken down into several sub-disciplines. These disciplines concern themselves with differing areas of engineering work. Although initially an engineer will be trained in a specific discipline, throughout an engineer's career the engineer may become multi-disciplined, having worked in several of the outlined areas. Historically the main Branches of Engineering are categorized as follows:

- Chemical engineering
- Civil engineering
- Electrical engineering
- Mechanical engineering

With the rapid advancement of technology many new fields are gaining prominence and new branches are developing such as materials engineering, computer, software, robotics, nanotechnology, food process, molecular engineering, etc. For each of these fields there exists considerable overlap, especially in the areas of the application of sciences to their disciplines such as physics, chemistry and mathematics.

Methodology

Engineers apply the sciences of physics and mathematics to find suitable solutions to problems or to make improvements to the status quo. More than ever, engineers are now required to have knowledge of relevant sciences for their design projects, as a result, they keep on learning new material throughout their career.

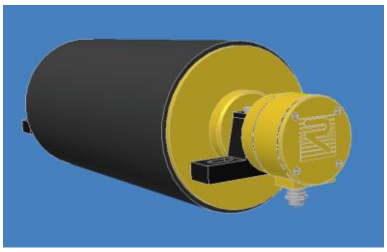
If multiple options exist, engineers weigh different design choices on their merits and choose the solution that best matches the requirement. The crucial and unique task of the engineer is to identify, understand, and interpret the constraints on a design in order to produce a successful result. It is usually not enough to build a technically successful product; it must also meet further requirements.

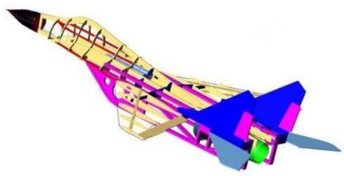
Computer Use

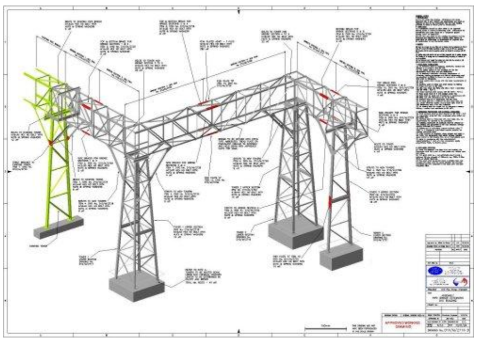
As with all modern scientific and technological efforts, computers and software play an increasingly important role. As well as the typical business application software there are a number of computer aided applications. One of the most widely used tools in the profession is computer-aided design (CAD) software which enables engineers to create 3D models, 2D drawings, and schematics of their designs. CAD together with Digital mock-up (DMU) and CAE software such as finite element method analysis or analytic element method allows engineers to create models of designs that can be analyzed without having to make expensive and time-consuming physical prototypes.

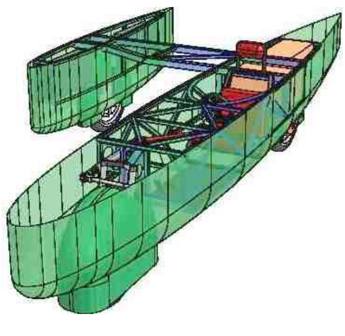
There are also many tools to support specific engineering tasks such as Computer-aided manufacture (CAM) software to generate CNC machining instructions; Manufacturing Process Management software for production engineering; EDA for printed circuit board (PCB) and circuit schematics for electronic engineers; MRO applications for maintenance management; and AEC software for civil engineering.

The examples of CAD drawings









II. Vocabulary.

acquire	získat	**broad**	obsáhlý
implement	realizovat	**initially**	původně
device	zařízení	**considerable**	významný
desired	požadovaný	**overlap**	přesah
invention	vynález	**status quo** *(lat.)*	současný stav
pulley	kladka	**multiple**	rozmanitý
lever	páka	**option**	volba
wheel	kolo	**merit**	výhodnost
consistent	shodný	**requirement**	požadavek
exploiting	využívající	**crucial**	rozhodující
develop	vyvinout	**constraint**	omezení
ingenuity	vynalézavost	**effort**	úsilí
incorporated	začleněný	**mock-up**	model
demanded	požadovaný	**finite**	ohraničený
dedicate	věnovat	**circuit board**	el. vodící deska
scale	škála	**maintenance**	udržování
expand	rozvinout		

Glossary:
Trimere – triméra, těžká bojová loď, která se používala ve starověkém Řecku a Římě.
Trebuchet – obléhací zbraň pracující na principu vahadla, velký dalekonosný katapult dřevěné konstrukce, užívaný k likvidaci budov a hradeb, v 15.století je nahrazen obléhacím dělem.

III. Exercises.

1. Look at the title of the text. Do you think the materials are clever, fashionable, or formal? Read the text and check.

SMART MATERIALS

Smart – or shape memory – materials are an invention that has changed the world of engineering. There are two types: metal alloys and plastic polymers. The metal alloys were made first and they are usually an expensive mixture of titanium and nickel.

Shape memory materials are called smart because they react to changes in their environment, for example:

- Plastics that return to their original shape when the temperature changes. One use is in surgery where plastic threads 'remember' the shape of a knot, react to the patient's body temperature and make themselves into stitches.
- Metal alloys that have a 'memory' and can return to their original shape. They are used in medical implants that are compressed so they can be put inside the patients body through a small cut. The implant then expands back to its original shape. More everyday uses are for flexible spectacle frames and teeth braces.
- Solids that darken in sunlight, like the lenses in some sunglasses.
- Liquid crystals that change shape and colour. These have been used in climbing ropes that change colour if there is too much strain and weight on them.

The future of these materials and their possible uses is limited only by human imagination. One clever idea is that if cars were made of smart metal, a minor accident could be repaired by leaving the car in the sun!

2. Read the text again and choose the correct answers for questions 1 – 4 below.

1. Smart materials change when

   a) the weather changes.
   b) something affects them.
   c) the light is switched on.

2. Plastic threads are used for

   a) sewing.
   b) stitching.
   c) knitting.

3. Medical implants made from shape memory alloys are good because

   a) they save lives.
   b) they change colour.
   c) they are easy to put in.

4. Climbing ropes with liquid crystals change colour to

   a) warm you.
   b) amuse you.
   c) make you heavy.

3. Complete the definitions below with the highlighted words in the text.

1. An …………… is something medical put inside the body, e.g. a heart valve.
2. You need a good …………… to think of new and interesting ideas.
3. The …………… is the first or earliest.
4. …………… are materials made from mixing two metals.
5. To …………… means to become bigger.
6. To …………… is to change because something else happens..
7. The …………… is every thing around a person or thing.
8. To be …………… means to be made smaller.

4. Text *Robot*. Read the text quickly and choose the correct answers to the questions below.

1. Are the paragraphs about
   a. lots of topics?
   b. one topic?
2. Which is the best title?
   a. Imaginary robots in film and fiction
   b. Robot: the fantasy and the facts

We can thank the world of literature for the words *robot* and *robotics.* The world robot was first was first used by the Czech playwright Karel Capek in his 1921 play, RUR *(Rossum's Universal Robots).*
(1) …………… . Asimov used it in a short story in 1941.

Robots often star in films too, for example dangerous machines like *Terminator* or cute ones like R2D2 in *Star Wars*. (2) …………… Industrial robots don't have personalities and they don't think like people. Most real robots are designed to save people from dangerous jobs (3) …………… or boring, routine work (4) ………. .

A simple robot is made of:

- A mechanical device (5) …………… that can react to its environment.
- Sensors that (6) …………… give information to the device.
- Systems or computer programs that (7) …………… give the device instructions.

5. Read the text again and put the sentences and phrases (a – g) below in the correct places (1 – 7).

a. in factories, laboratories, or ware houses
b. In this play machines behave like people
c. like an arm
d. can 'see' the environment and
e. like handling nuclear or radioactive materials
f. The reality is less exciting.
g. understand the messages from the sensors and

6. Find words in the text that mean:

a. always done in the same way
b. respond to a change
c. a piece of equipment designed to do a particular job
d. part of a machine that can sense heat, light, etc.

7. Speaking.

Find examples from your own country of robots in a story, a film, and in real life. Tell your class about them. Who the most interesting or technologically advanced robots?

Work in pairs. You have one minute. How many different dams or tunnels can you think of? Compare your answers with the rest of the class.

8. Read the text quickly and decide which structure it describes.

- The Hoover Dam
- The Arlberg Tunnel
- The Channel Tunnel
- The Golden Gate Bridge

The …………… is between Britain and France. It's more than 20 kilometres long. It was built by British and French engineers. They started on opposite sides and met in the middle under the sea. They used specially-designed tunnel boring machines (TBMs) to dig the tunnels through the rock under the seabed. TBMs are enormous machines for digging tunnels. The machines used to dig the main tunnels were about 8.5 metres in diameter and 250 metres long. Work started in 1987 and teams met under the seabed in 1991. It is a rail tunnel. The first passenger train went through in 1994.

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9. Speaking.

Find out about a major new engineering project. Where is it? What will it do? What problems do the engineers have to solve to build it?

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