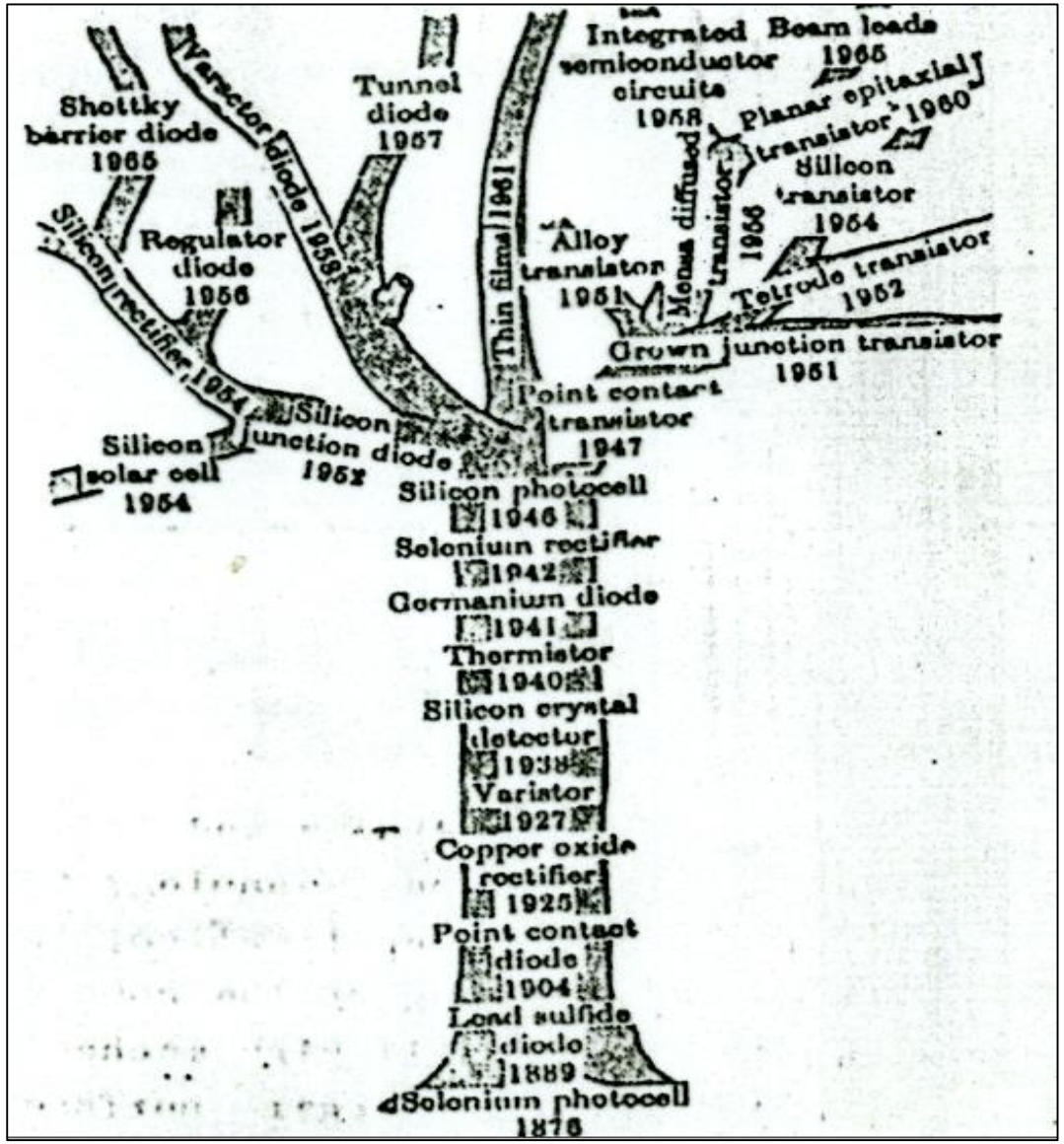
# Introduction to Semiconductor Electronics

**Electronics, includes a wide range of specialized fields, including, but not limited to, sound systems, wireless communication systems, digital and optical electronics, power electronics engineering, optical instrumentation, medical electronics, automatic control, computer science and many others. Each of these areas in turn includes more fine specialization, yet they all used Semiconductor components that have one roots governed by mainly Electronics Semiconductors as some would like to call them, are the basic elements of science of electronics (diodes and transistors Integrated circuits).**

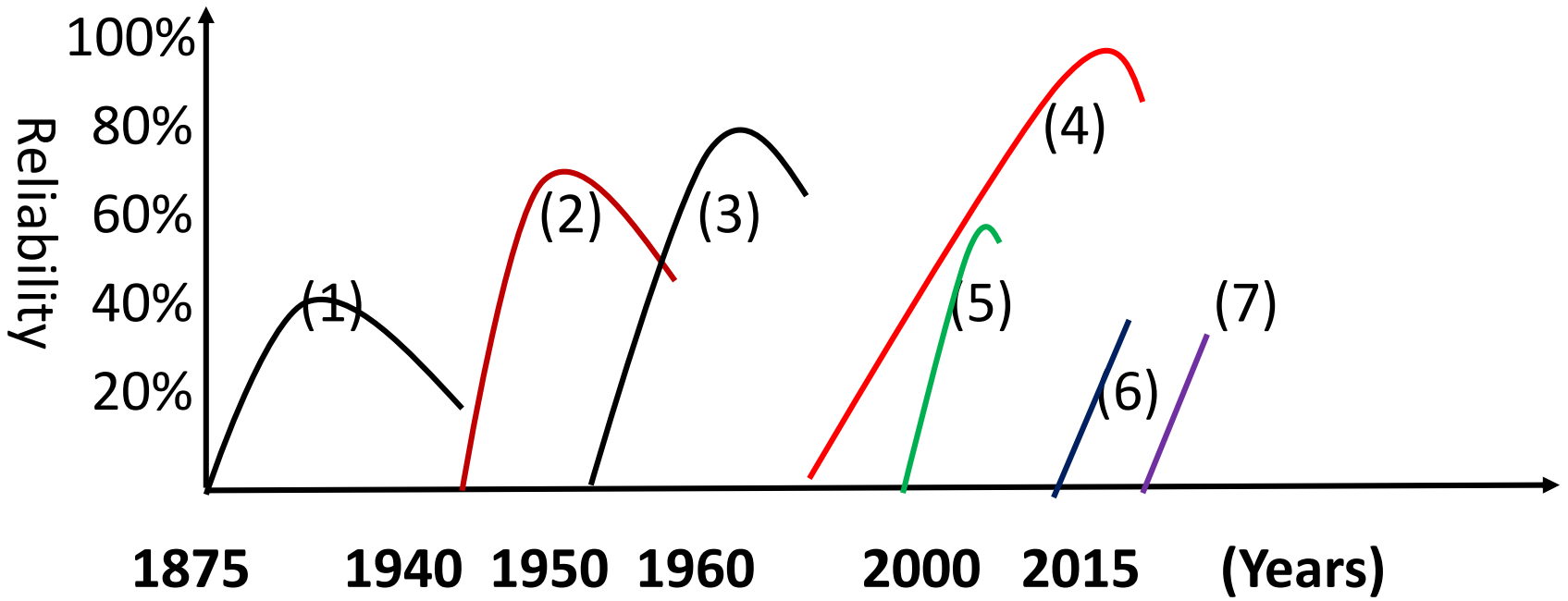
**Basic electronics study based the understanding of physics of semiconductors, theories, materials, structure, and composition. also individual characteristics of each of the basic electronic elements of the concept of electronics and thorough understanding of how the composition and electrical properties of these elements, making it easy to build electronic circuits techniques in many applications that previous subject areas refer to its real history begins. Electronics technology to the emergence of photovoltaic cells made from Silicon (semiconductor) in 1876 , and continued the emergence and development of semiconductor elements intervals spaced until the 1940s of the previous century began using vacuum tube (Figure I-1).**


**It spread in several applications to achieve the aspirations of the modern man during this period , and there is no dispute that the emergence of vacuum tube technology has had the greatest impact on human life change since the 1940s. It considered the first invention in the history of electronics. Within the forties of the 19$^{th}$ century, exploration rediscovered again for semiconductor materials and their use in electronic engineering applications. Seventy-five years, after discovery the first semiconductor element. It may be the real reason in the rapid spread of semiconductor technology in the fifties of the 19th century is the sensitive measurement instruments commensurate with the small electric units used which were not available during the period following the emergence of the first semiconductor in 1876.**

**The figure (I -2) shows the roots and the history and development of all technologies in electronics since 1890 until the early twentieth century.**



**Curves in figure (I - 3) shows, electronics technology as a function with the reliability of components manufactured to realize the aspirations of modern man that even today.**




**1- Silicon Photo cells (Semiconductor Materials)**

**2- Vacuum Tube Technology**

**3- Semiconductor Technology**

**4- Integrated circuits (Small – Medium – Large – Super large)**

**5- Optical Electronic (LASER) Technology**

**6- Superconductor Technology**

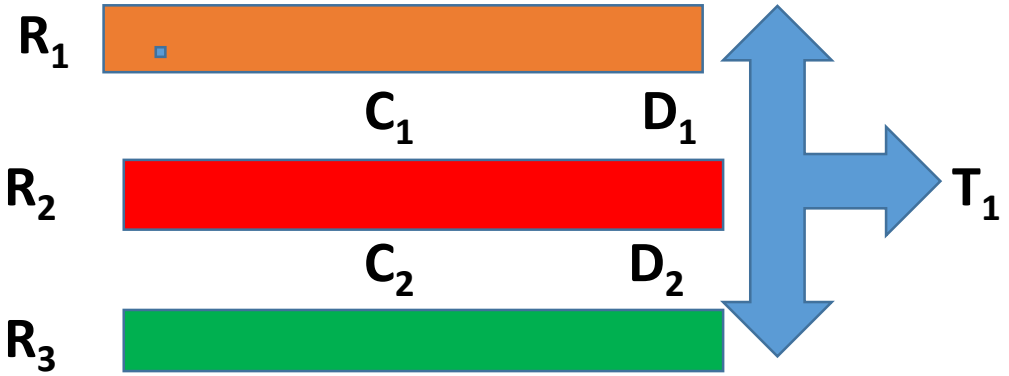
**7- Nano technology**

It is clear that in the fifty years since the emergence of vacuum tube technology human achieved many technological systems and control what considered dreams to previous generations. The development and introduction of advanced technologies for electronics science and engineering are natural extension of semiconductor technology, including different types of transistors that appeared in 1951 and integrated circuit technology for small and medium-sized and very large and super large in1960 and still evolving stand-up.

Now it is performing basic microprocessor pattern on a small slice of silicon, and skip the stages where recently announced that it has access to the high density of elements with more than 500 thousand devices per one $cm^2$. and thus might develop services in multiple areas and did not stand when it also announced a few years back to vacuum tube technology where through this technology can reach some difficult applications implemented with semiconductor technology and integrated circuits where it is possible to implement 100 valve in one $cm^3$. No wonder we are actually in the third electronics technology generation, recently announced the emergence of technologies as, optoelectronics, and superconductive materials technology. In 50 years only began the true history of electronics. Not forget the Nano-electronics. it is clear that the future promise for achieving dreams. we are unable to implement modern technology thus it requires the concept of contemporary technology and control them , so that we can receive future technology without fear and God only knows.

Electronics technology is experiencing an abundance of various devices and systems used to achieve the prosperity of systems for radio and visual communications , replaces the human acts of the robot can carry out and implement the actions required to accurately and even exceeded it to contribute effectively in disease diagnosis and determine the necessary medication doses – and out of planet Earth to other worlds and many others which result from the technological development of electronics technologies which call the need to understand and engage in a struggle to catch up and don't forget we are in the midst of this conflict to know that there is the will of God bestowed on man. For more recognition of the importance of the electronics science has exceeded by contributing effectively to identify the fraction of complex systems on Earth is that, it is announced that, the human nervous system contains 14,000 million cell and neural cell size 0.001 $mm^3$. Of these cells as a television camera as announced. The ability of human vision needs three million cell to represent a model and even to understand the relevance of this information and find her perception through the art electronics technology. Is there anything we can imagine this? Could be simpler to say that slice of silicon, has resistance to measure. As example, R1 (is one of the electronic elements). If we used two slices placed one over the other to form two layers – so we have two resistances R1 and R2 – between the two layers, can be free air however were attached (filled with air or any electrical insulation material) so it can be represented with a capacitance C1 and also another element called a binary or diode (D1).

This means that we have through the semiconductor segments one over the other to get number of four electronic elements R1, R2, C1, and D1. Apply third slice on previous. it means R1, R2, R3, C1, C2, D1, D2 and also get a new component a transistor T1, became number of three resistances, two capacitors, two diodes, and one transistor which means eight electronic elements. Each element depends on the rest of the Group and this is the basis of the concept of integrated elements. In addition, even understand the idea – imagine the configuration as shown in figure (I -4).




If our flag and thank God that, we were able to develop large capacity integrated circuit. That has more than half-million devices in one square centimeter. Figurative sense it is absorbing 500 X $10^3$ cells on a $cm^2$. The nervous system of the human body includes 14,000 million cells. Metaphorically imposition that, nerve cell whereas one element in integrated circuit. It made practically 500 X $10^3$cells in area one $cm^2$. That means we need to estimate space for work model of the nervous system is estimated by dividing the 14000 x $10^6$ by 0.5 x $10^6$ equals to 28000 $cm^2$ , is equal to about 280 $m^2$ only for modeling the nervous system.

So we need integrated circuits technology capacity currently unperceptive or other technologies, meaning that much needed technology to reach an area commensurate with the modeling of the nervous system. For example – with a simple calculation it required the further development of the integrated circuit with half a million devices per square centimeter to other component technology achieves 5 to 10 billion devices in the $cm^2$ - only for modeling your nerve without the rest of the human body. But this truth reminds us, may be glorified and exalted in the name of God the merciful (In yourself would they see) the great truth of God – do you imagine that? What about volume required for the heart, liver, kidneys, human brain and the rest of the body too? When we talking about the high complex engineering system (the human), we do not possess only increase Thanks giving to the creator of the universe, and do not forget to bid farewell to the creator of the universe. The human body has many other senses, such, as innovation – values – reflexes – awareness – motion – Speech – taste – balance and many other systems are known and many others is still unknown, as there are in many other senses like reading reflections – danger remote sensing – predicting the future – deal with unseen – some of these senses is access to technologies to achieve for example hearing – sense of touch – olfactory –sense of separation colors has been achieved – I want to access to give the reader, the importance of science in our electronics . Here you will find some arguments to more think about and try to imagine the technology required in future.

# How many atoms are in the human body?

The number of atoms in one person is almost too big to write out. However, fortunately there is a short hand system, called scientific notation that we use instead for writing BIG or SMALL numbers. Since huge numbers are generally just estimates anyway, we just use the first few numbers, followed by a code that tells you how many zeros would follow if you wrote it all out. Ok, here it goes. Hydrogen, oxygen and carbon make up about 99% of the average human. We leave out the other 1%, which is made up of trace elements (that is, stuff there is only a trace of in the body). Then, let us assume an average adult weighs 70 kilograms. Be sure to keep in mind that the following numbers are based on the number of atoms, not percent of body weight (by weight we are mostly oxygen). A 70 kg body would have approximately $7*10^{27}$ atoms. That is, 7 followed by 27 zeros: 7,000,000,000,000,000,000,000,000,000 Of that, $4.7*10^{27}$ would be hydrogen atoms, which have one proton and one electron each. Another $1.8*10^{27}$ would be oxygen, which has 8 protons, 8 neutrons and 8 electrons. There are $7.0*10^{26}$ carbon atoms, which have 6 protons, 6 neutrons and 6 electrons. Now, let us add that all up:

| | Protons | Neutrons | Electrons |
|---|---|---|---|
| Hydrogen | $4.7*10^{27}$ | 0 | $4.7*10^{27}$ |
| Oxygen | $1.4*10^{28}$ | $1.4*10^{28}$ | $1.4*10^{28}$ |
| Carbon | $4.2*10^{27}$ | $4.2*10^{27}$ | $4.2*10^{27}$ |
| Total | $2.3*10^{28}$ | $1.8*10^{28}$ | $2.3*10^{28}$ |

In summary, for a typical human of 70 kg, there are almost $7*10^{27}$ atoms (that's a 7 followed by 27 zeros!) Another way of saying this is "seven billion billion billion." Of this, almost 2/3 is hydrogen, 1/4 is oxygen, and about 1/10 is carbon. These three atoms add up to 99% of the total! This arguments is an introduction to a very new area of medical research named Nano electronics and Nano medicine which can be defined as "the monitoring, repair, construction and control of human biological systems at the molecular level, using engineered nano devices and nanostructures."

# *How many atoms are in the human head?*

Can you calculate the number of atoms in your head if we know the density and a constant called Avogadro's number. This is really just an estimate, but it is going to be a good one. The equation is simple. The number of atoms of ANY substance in a volume is:

# of atoms = N * (density) * volume / (Molecular Weight).

N is a constant called Avogadro's number and it's equal to $6.022*10^{23}$ atoms/mole. It can also be molecules per mole. In the above formula density times volume is just the mass. If you know how heavy, something is or what its volume and density are you can easily do this. Let's start with a simple problem. A liter of water is 1000 cubic centimeters. Water is easy because each cubic centimeter has 1 gram of mass. Water is made up of 2 hydrogen atoms and one oxygen atom. Hydrogen has an atomic weight of 1 and oxygen has an atomic weight of 16. The water has a molecular weight of 18. The liter of water has 1000 grams. The number of moles is 1000/18 = 55.556 moles. The number of molecules is therefore $6.022*10^{23} * 55.556 = 3.346*10^{25}$ molecules. The number of atoms is 3 times larger because each molecule has three atoms, so there are $1.0038*10^{26}$ atoms in a liter of water. Now we know enough to answer the question. A typical human head weighs about 4 Kgr. It mostly made up of water. When you go swimming you probably noticed that almost everybody floats with just part of his or her head out of water. This observation will lead you to conclude that our density is very close to the density of water. Armed with all this we can estimate the number of atoms in your head. If we assume that we are mostly water on the average because our average density is approximately that of water then we can use the above information on water to get the answer.

Moles per head = (4,540 grams) / (18 grams/mole) = 252.22 moles
Molecules per mole = $6.022*10^{23} * 252.22$ moles = $1.519*10^{26}$ molecules
Atoms per head = 3 * molecules = $4.56*10^{26}$

This is 456 trillion trillion atoms!