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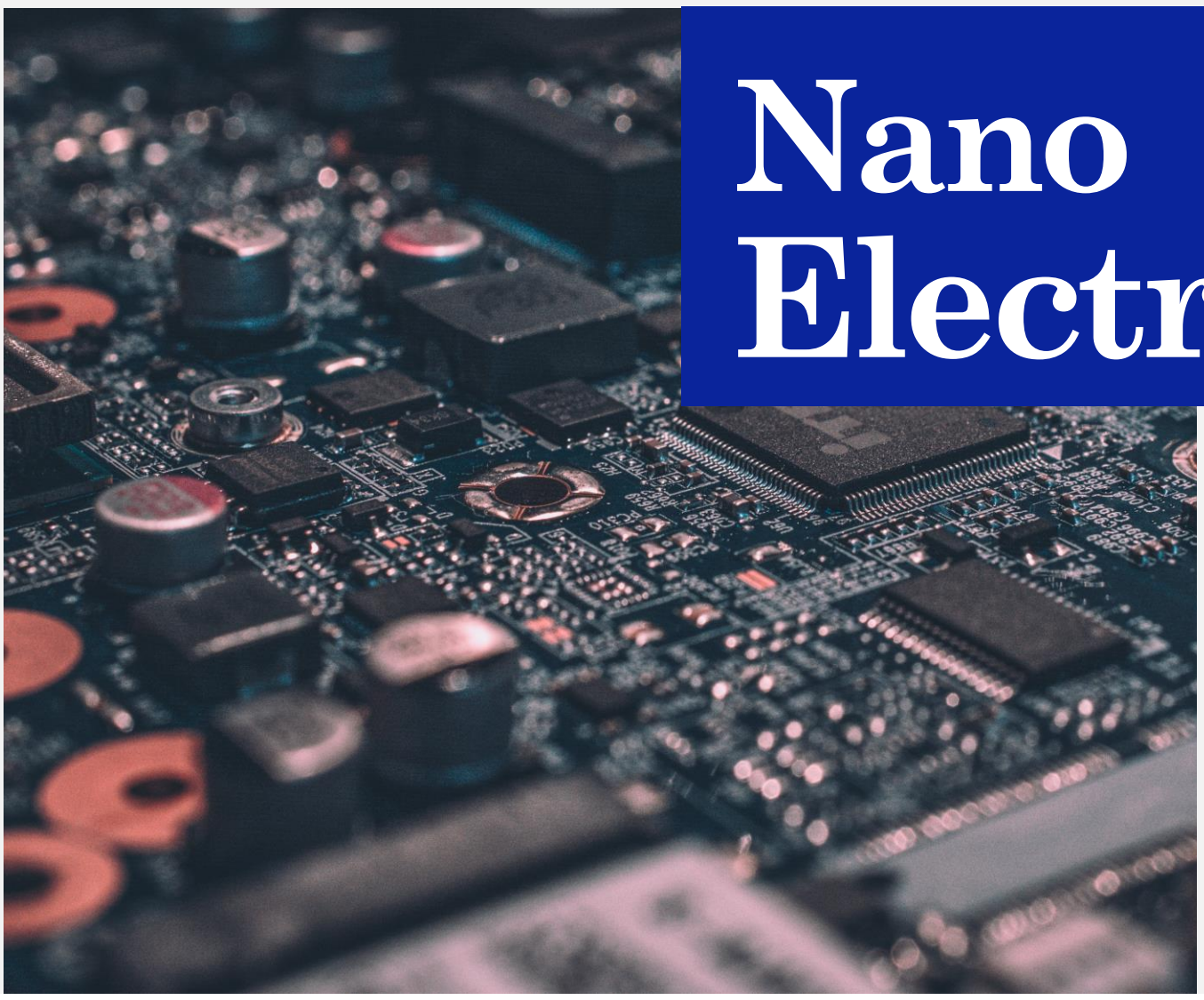


Nano Electronics

"Nano Electronics is about manufacturing with atoms which most people don't believe until they see it in action!"

Ref: https://www.online-sciences.com/technology/benefits-and-uses-of-nanotechnology-in-electronics/

Electronic devices, and the components within them, are becoming smaller year by year. This has been driven by consumer demand for smaller devices that have an equivalent capabilities and performance, if not better, than pre-existing 'bulkier' technology. By these enhancement in detail, Nano Electronics reduces the size of electronic devices and provide same or enhanced performance.

Ref: https://www.nanowerk.com/nanoelectronics.php

The term Nano Electronics refers to the utilization of nanotechnology in electronic components and research on improvements of electronics like display, size, and power consumption of the device for the sensible use. These components are often measure a few nanometres in size. However, the tinier electronic components become, the complexity to manufacture the components increases.

Nano Electronics focuses at improving the capabilities of electronic devices and displays while shrinking them and also reducing their weight and power consumption.

Nanoelectronics includes quantum mechanical properties of the hybrid material and also semiconductor, single dimensional nanotubes, nanowires, etc.

Ref: https://www.sciencedirect.com/topics/materials-science/nanoelectronics

How valuable is Nano Electronics?

Compiled by Kushal & Riddhi

Nano Electronics consist of a sets of devices and materials, having common characteristic that the components are too compact so that physical effects alter the materials properties on a nanoscale, interatomic interactions and quantum mechanical properties play an enormous role within the workings of these devices. At the nanoscale, new phenomena take priorities over those that hold sway and control within the macro world. Quantum effects dominate the properties of these nanoscale devices. Well-developed Nano electronics are often applied in several fields as well for wide purposes.

Future of Nano electronics:

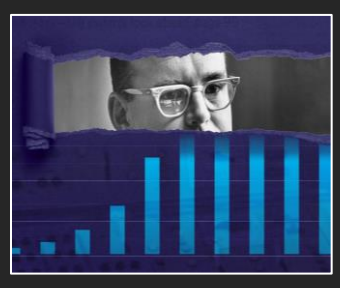
1. Future of mobile lies in stretchable or few flexible electronics.

2. The potential usage may consist of couple of new wearable electronic device and biomedical uses, compact portable devices and robotic devices.

3. Graphene, an allotrope of carbon, is probably going to be dominant material in flexible electronics in future. It is because of its superb electrical conductivity, flexibility as well as high strength it'll replace other carbon products amongst the Nano field.

Nanoelectronics holds important promise for expanding the skills of electronics devices while reducing their size, weight and power needs. It is improved by cutting power requirements and lowering the burden and density. Nanoscale chip capable of holding 1TB+ of data per square measure.

Is Moore's Law the limitation?



Moore's Law refers to Moore's perception that the quantity of transistors on a microchip doubles every two years, though the price of computers is halved.

Moore's prediction proves that he is a unique technological giant and visionary who quietly led the silicon revolution with his own law yet holding true.

Read more on Pg. 2

Nano Electronics not only examines the electronic but also the magnetic properties of systems at the nanoscale.

Is Moore's law the limitation?

Compiled by Shamini & Sneha

Moore's Law refers to Moore's perception that the quantity of transistors on a microchip doubles every two years, though the price of computers is halved.

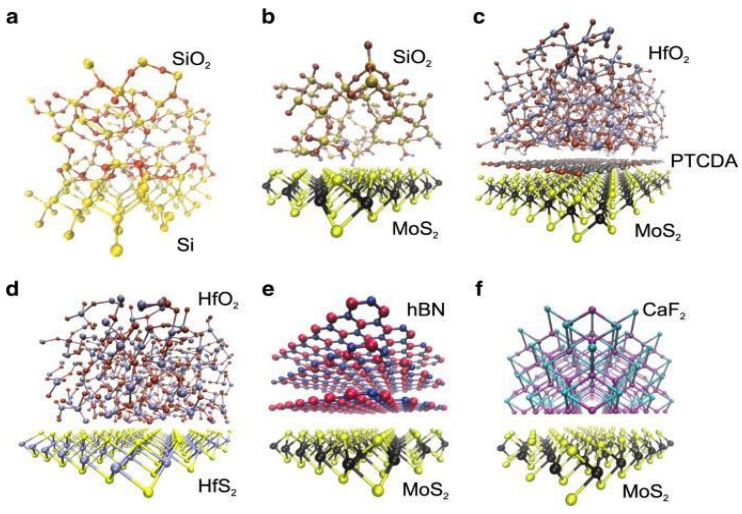
Moore's Law states that we can expect the speed and capability of our computers to increase every couple of years, and we will pay less for them. The insight, mentioned as Moore's Law, became the golden rule for the industry , and a Springboard for innovation.

Whether there is an ultimate limit to Moore's Law is an open debate dependent upon future electronic innovations and physics. Moore s prediction proves that he is a unique technological giant and visionary who quietly led the silicon revolution with his own law. We evaluate that the potential future Nanotechnologies are against the current known barriers for Moore's Law. While, some say that is coming to an end!

Schematic channel/insulator interfaces in different device technologies.

The crystalline insulators like layered 2D insulators such as hexagonal boron nitride (hBN) or ionic crystals like calcium fluoride CaF2 have been used. The surfaces of those materials are chemically inert and freed from dangling bonds. This leads to well-defined van der Waals interfaces with 2D materials, which is a considerable advantage of crystalline insulators over 3D oxides. In contrast to hBN, fluorides have good dielectric properties and thus exhibit low gate leakage currents. This talk will address the current state of the art and summarize the main problems together with potential solutions and all others.

2D INSULATORS



Among the above mention insulators, the foremost promising are those which can be scalable right down to equivalent oxide thicknesses (EOT, i.e. the thickness of SiO2 which might produce an equivalent capacitance because the insulator in use) i.e. below 1 nm, as required for channel lengths below 10 nm, and also the insulators which can manufacture by typical semiconductor process technology.

The figure below discusses some commonly measured effects in 2D devices which can be attributed to defects in the channel, in the insulator and at their interface.

Ref: https://www.nature.com/articles/s41467-020-16640-8

Quantum Devices!

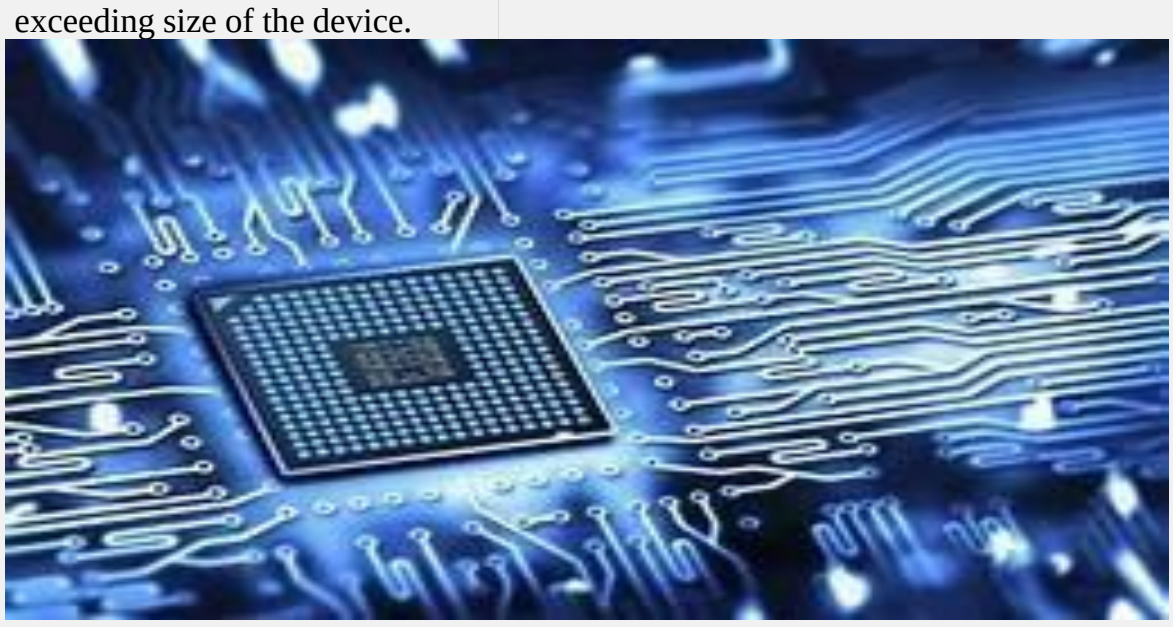
-Compiled by Sanskruti & Prachi

Electrons flowing through semiconductor devices are of immense importance in modern life. When devices are made sufficiently small, in the dimensions of nanometers, the quantum nature of the electron plays a major role. Working at lower temperatures reduces the mutual electron-electron scattering resulting in the wave nature of electron transport becoming observable over distances exceeding size of the device.

"Quantum Computer" has certain advantages over conventional computers.

This is based on quantum principles, thus if two electrons are in a quantum state then their total spin wave function reflects the range of possible states that can be present. It is superposition of states (the basis) quantum computer. It is a purely quantum phenomenon and has given rise to concepts such as "Schrodinger's Cat" exemplifying non-intuitive nature of quantum mechanics. Pure quantum effect results in two electrons being in the same quantum state and "knowing" about each other's existence, consequently if the spin of one is rotated then the spin of the other is affected despite there being a considerable distance between them.

Major theory on Quantum dots (QDs) states that they are semiconductor particles a few nanometers in size, having optical and electronic properties that differ from larger particles due to quantum mechanics. They are a central topic in nanotechnology. When quantum dots illuminated by UV light, an electron in the quantum dot is excited to higher state of energy. In this case of semiconducting quantum dot, the process corresponds to the transition of an electron from the valence band to the conductance band. The excited electron drops back in valence band releasing its energy by the emission of light.

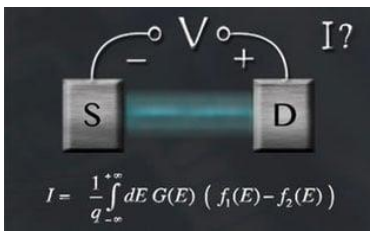


Ref : https://3wnews.org/wp-content/uploads/2020/07/Nanoelectronics.jpeg

Facts on Nanotechnology

- Nanotechnology in electronics increases the density of memory chips and it reduces the size of transistors that used in integrated circuits.
- Nanotechnology is used for magnetic random access memory (MRAM) enabled by nanometer-scale magnetic tunnel junctions that can quickly and effectively save even encrypted data during a system shutdown or crash.
- Nano Electronics provide organic light-emitting diodes or OLED screens which offer brighterconsumption and longer lifetimes.

Fundamentals of Nanoelectronics



The use of nanotechnology in electronic components is called as nanoelectronics. In nanoelectronics material is the fundamental feature that we should consider. The inter-atomic interaction and quantum mechanical properties of various combination of devices and materials which comes under nanoelectronics. Some of these examples include: hybrid molecular/semiconductor electronics, one-dimensional nanotubes/nanowires (e.g. silicon nanowires or carbon nanotubes) or advanced molecular electronics.

Recent silicon MOSFET (metal- oxide-semiconductor field-effect transistor, or MOS transistor) technology generations are already within this arrangement. Multi-gate MOSFETs enabled scaling below 20 nm gate length, starting with the FinFET.

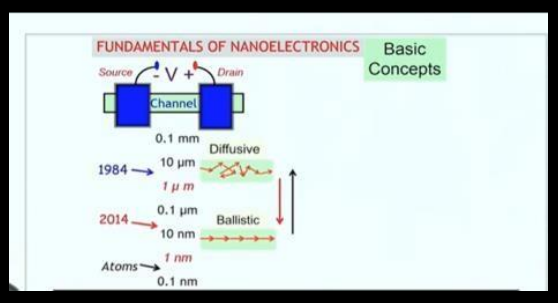
Nanotransistors:

Nano Transistors is the foremost widely used product within the Electronic industries and host of others.

Nanoelectronics are sometimes considered as innovative technology because present devices are remarkably different from traditional transistors. The first transistors built in 1947 were over 1 centimeter in size; the smallest working transistor today is 7 nanometers long-over 1.4 million times smaller.

Including 22 nanometer CMOS (complementary MOS) nodes and succeeding 14 nm, 10 nm and 7 nm Fin FET (fin field- effect transistor) generations, increases the capabilities of electronics devices while reducing their weight and power consumption

A transistor could also be a semiconductor device used to amplify or switch electronic signals and also electrical power. Nanoelectronics examines the electronic properties of systems at the nanoscale.



In 1965, Gordon Moore noticed that silicon transistors were undergoing a continual process of scaling downward, an observation which waslater classified as Moore's law. By following this law the field of nanoelectronics aims to use new methods and materials to manufacture electronic devices with feature sizes on the nanoscale. Nanoelectronics devices are small and allows more transistors to means faster frequency, and a symmetrical electron/hole characteristics are due to the uniform and symmetrical structure of nanotubes or nanowires.

Nanoelectronics are sometimes considered as disruptive technology because present candidates are significantly different from traditional transistors.

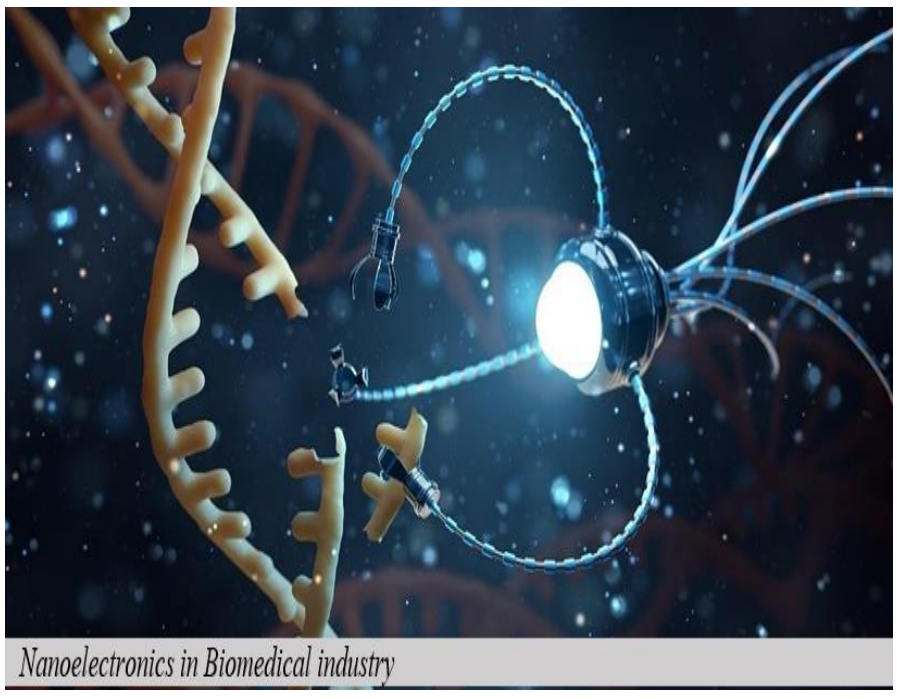
-compiled by Nilesh & Prachi

The dimensions of nanoelectronics are critical with the size range between 1 nm and 100 nm.

Application of Nano Electronics:

1)Optoelectronics:

Electronic devices that source, detect and control light. Highly energy-efficient optical communications are increasingly important because they have the potential to solve one of the biggest problems of our information age: energy consumption. Optoelectronics are electronic devices that generate, recognize and manipulate light. Nanoscale optoelectronics are increasingly being seen as how to deal with one among the best problem with modern technology: energy usage. Including silicon Nano photonics elements in complementary metal–oxide–semiconductor (CMOS) circuits are one method used to supply greater speed of data transmission between circuits.



Nanoelectronics in Biomedical industry

2)Wearable and versatile Devices:

The age of wearable electronics is here as seen within the fast-developing range of smartwatches and next-generation personal health devices. Wearable nanoelectronics will go way beyond digital watches and armbands. For instance, wearable, flexible nanoelectronics could be embedded in textiles, enabling 'smart clothing' of all shapes, sizes, and uses. If current research is an indicator, wearable electronics will go far beyond just very small electronic devices or wearable, flexible computers. Not only will these devices be embedded in textile substrates but an electronics device or system could ultimately become the fabric itself. Electronic textiles (e-textiles) will allow the design and production of a new generation of garments with distributed sensors and electronic functions.

3)Energy Technology:

Nanoelectronics are expected to play a serious role in energy technology, with application in photovoltaics and supercapacitors currently looking the foremost promising. Nanotechnologies also are expected to reinforce the capacity and safety of lithium-ion batteries. Solar cells and supercapacitors are examples of areas where nanoelectronics is playing a major role in energy generation and storage. To learn more read our detailed sections on Nanotechnology in Energy and Graphene Nanotechnology in Energy.

4)Display Technology:

Electrodes created from nanowires could make it possible for flat panel displays to be flexible additionally to thinner than existing flat panel displays. Quantum dots are a nanomaterial that would replace the fluorescent dots found in current display technology. Quantum dot displays also will likely be easier to fabricate and require less power. Display technologies can be grouped into three broad technology areas; Organic LEDs, electronic paper and other devices intended to show still images, and Field Emission Displays. For more, read our special section on Nanotechnology in Displays.

ALUMNI TALK

Mrudula Manjrekar

Batch-2014

Principal Infra Developer, Cognizant
Worked on an architect level in terms of solution design and on technology solution designing.

Describe a typical day in your current position?

My typical workday would start with sorting out emails and prioritizing them according to urgency and delivery timelines, heading scrum calls and assigning tasks to teams, assisting my team with any technical queries, reviewing solution architecture

How is your work profile and responsibilities as a Sr. Infra Specialist at Cognizant? How have you prepared yourself for this position?

My work profile is a technical architect position and would mainly revolve around solution designing and feasibility analysis. As one problem can have multiple solutions, and neither one can be deemed incorrect, my job is to sort out the possibilities and analyse the best possible solution for the client network with minimal impact of the current infrastructure of client.

What are the most valuable lessons/skills that you have learned in your work experience so far?

I have learnt quite a few things over years, but most importantly, I stand by work ethics irrespective of designations. As you mature over your career and grow up in the ladder, we should always be humble towards colleagues. Everybody is a employee in an organization, and we can always try to assist each other.
One another thing which I've learnt over the years is knowledge is meant for sharing and not keeping to oneself. In line with this, I train freshers who join Cognizant in ServiceNow technology when time permits, I am also involved in mentorship programmer for ServiceNow Cognizant and try to extend my knowledge to maximum.

If someone wants to get into a similar line as you, what courses will you suggest?

I joined the IT industry without much background or any knowledge of advanced coding languages. But over the course of 3 months, we were trained in almost 5 different languages including C++, HTML, CSS, JavaScript etc. However, I would suggest if anybody wants to join in the IT industry, they should work on improving their logical skills. Syntax and languages can change, but logic for problem solving still remains same.

How was your experience during the initial years?

It was tedious in the beginning. However, one has to adapt and change according to the situation. It's a self-learning process in corporate where each individual is responsible for extra effort to get things done. Additionally, for the majority of you, you will be living all alone in a new city during this time. In each city, there are many positive aspects to be gained, and one should explore these aspects as well.

What is the demand for the position? Is there job security?

Recent COVID times have shown us that there is no security for any job, but as long as you have wish you work and you have willingness to learn, you can always find a place to work. Job security, according to me is very person specific. If we're delivering the quality in line with what the company needs, we should be able to survive anywhere.

What would you suggest to a budding engineer who wants to get into the same field as you?

I'd suggest you all to have an open attitude when you're starting off in any career field. If you want to survive in this industry, you'll have to love learning and keeping up with the trends.

What is your most cherished moment as a student at VCET?

Every day was a good day in VCET. I met a few amazing teachers, still like to stay in touch with them, I made some amazing friends whom I'll cherish for lifetime. I have absolutely the best memories of college including Brahman, Anveshan, Zeal and various college cultural festivals.

What has been your most challenging or rewarding academic experience so far?

I was a college topper for straight 3 years of my Diploma in Anna Saheb Bhausaheb Vartak college. Along with this, I was on 8th rank in overall Maharashtra in my final graduating year of Diploma. That has and will always be the most rewarding experience of my academic journey.

Did you feel the college prepared you for the workforce and the real world?

Since I chose a different field than my education in EXTC, I had to struggle more than others to grasp the concepts. But college experience of 9-5 has definitely helped me be open to the long working hours and basic 8085/8086 coding programs have built my basic logic understanding capacity which immensely helped code in various other languages.

What is your valuable suggestion for the young engineers?

My suggestion would be, as I mentioned before, be open to learning guys. In these trying times, opportunities are rare, so when you get one, grab it and make good use of it.

-interviewed by Sneha Jaiswal

Toppers of Academic year 2020-2021

10	9.85	9.77
Kushal Raut Dipak	Patil Shraddha Ashok	Pitodia Abdulmateen
SE - 2021	TE - 2021	BE - 2021

Staff In-charge: Mrs. Ashwini Katkar Secretary: Kushal Raut Edited by: Kushal Raut, Prachi Purohit, Sneha Jaiswal