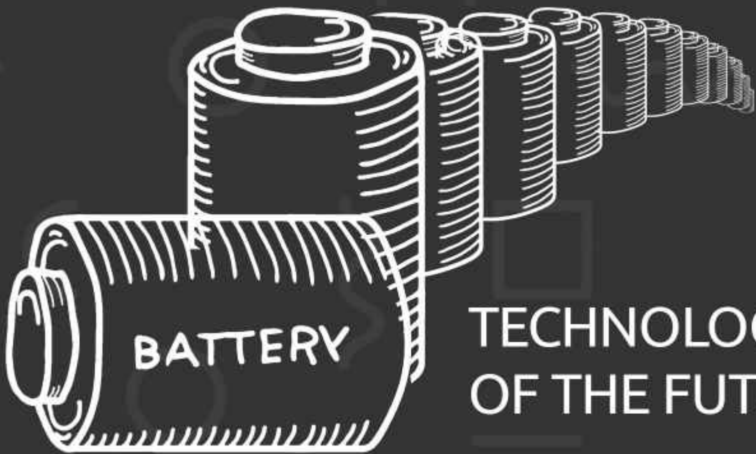
COVER STORY :



TECHNOLOGIES
OF THE FUTURE

TRONICALS

VOLUME 5 | ISSUE 1

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING,
NATIONAL INSTITUTE OF TECHNOLOGY, TRICHY

CONTENTS

MESSAGE FROM THE HOD

The Department of Electrical & Electronics Engineering has consistently maintained an exemplary academic record. The greatest asset of the department is its highly motivated and learned faculty. The available diversity of expertise of the faculty with the support of the staff prepares the students to work in global multicultural environment.

The journey of Electrical and Electronics Engineering Association started in the year of 1990 and over the decades it has reached new heights. The association activities include workshops on state-of-art techniques, technical contests, quiz programs and symposia in the core Electrical and Electronics Engineering. The primary focus of the magazine is to expose the students to the research contributions, achievements, techno events of our faculty and students. Students are encouraged to present the details of their fellowships, internships and projects undergone both in India and outside India. This motivates students to carry out projects in their area of interest and also help them to undergo training through fellowships.

It is rightly said that "A dream becomes a goal when action is taken towards its achievement" and we are committed in taking constructive and purposeful actions to produce optimistic, independent, compassionate, life-long learners and leaders who will bring glory to the Department, Institute and the Nation.

Dr. S Sudha,
Head of Department

MESSAGE FROM THE FACULTY ADVISOR

On behalf of EEE Association and TRONICALS, I extend my warm welcome to the first year students to the EEE family of NITT. I am glad to be a part of this family and work with the young, energetic and innovative team members. The association is not only instrumental in conducting various science and technical knowledge sharing workshops, for the School and Engineering student's inspiration but also engaged in various humanitarian activities for the society. The TRONICALS is a medium to showcase the activities and achievements accomplished by the tremendous efforts of the team members in EEE Association. Keeping in view of the potentials of the members and office bearer of the EEE Association, I aspire that they will elevate it to a newer height and create a bench mark for the Indian Society. I congratulate the editorial team for their excellence in publishing this magazine to bring out a smile for the association and inspire the newly joined first year students.

Dr. Manoranjan Sahoo,
Faculty Advisor

EDITORIAL

Technology, as we know it, has seen a multifold leap in the past few years. We are so accustomed to seeing futuristic technology that sometimes we grow numb to the sheer dedication and efforts of the engineers and scientists working behind it. Being students of a premier technical institute, the onus is on us to delve into nuances of this fast-paced development and try to appreciate the process.

In this edition of Tronicals, we aim to shed light on the intricacies of battery technology through the cover story. Along with that, we present the readers with an assortment of articles that span a variety of topics pertaining to the field of Electrical and Electronics Engineering. In a bid to help out the internship aspirants, we have dedicated a section to the various corporate and research internship experiences that our batchmates and juniors underwent.

We hope the readers find this edition of Tronicals to be insightful, and look forward to continue delivering relevant and quality content.

Kiran Krishnan and Nandita Sreekumar

Editors-in-Chief, Tronicals

TRONICALS TEAM

VISION AND MISSION OF THE DEPARTMENT

ABOUT:

The Department of Electrical and Electronics Engineering, NIT, Tiruchirappalli was started in the year 1964. It offers one Under-Graduate programme (B.Tech), two Post-Graduate programmes (M.Tech. in Power Systems and Power Electronics) and also research programmes (M.S. and Ph.D.) in the various fields of Electrical and Electronics Engineering. After the institute became NIT, the department has grown not only in terms of student and faculty strength, but also in improving the laboratory facilities for teaching and research purposes. Thus, the department has dedicated and state of the art teaching / research laboratories. The department is recognized for excellence in research (First Department in NIT-T to be accorded QIP status for Ph.D. programme), teaching and service to the profession.

The faculty members have a strong sense of responsibility to provide the finest possible education for both graduate and undergraduate students. The academic strength of the faculty is reflected by the alumni, many of whom are in the top echelons of industry and academia both in India and abroad.

VISION:

To be a centre of excellence in Electrical Energy Systems.

MISSION:

- Empowering students and professionals with state-of-art knowledge and Technological skills.
- Enabling Industries to adopt effective solutions in Energy areas through research and consultancy.
- Evolving appropriate sustainable technologies for rural needs

B.TECH PROGRAMME

Programme Educational Objectives (PEOs):

The major objectives of the B.Tech. programme in Electrical and Electronics Engineering are to prepare students:

1. for graduate study in engineering
2. to work in research and development organizations
3. for employment in electrical power industries
4. to acquire job in electronic circuit design and fabrication industries
5. to work in IT and ITES industries

Programme Outcomes (POs):

The students who have undergone the B.Tech. programme in Electrical and Electronics Engineering (EEE):

1. will have an ability to apply knowledge of mathematics and science in EEE systems.
2. will have an ability to provide solutions for EEE problems by designing and conducting experiments, interpreting and analysing data, and reporting the results.
3. will have comprehensive understanding of the entire range of electronic devices, analog and digital circuits with added state-of art knowledge on advanced electronic systems.
4. will have knowledge and exposure on different power electronic circuits and drives for industrial applications.
5. will have in-depth knowledge in transmission and distribution systems, power system analysis and protection systems to pursue a career in the power sector.
6. will have a good knowledge in microprocessors/microcontrollers, data structures, computer programming and simulation software.
7. will be able to develop mathematical modelling, analysis and design of control systems and associated instrumentation for EEE.
8. will be able to systematically carry out projects related to EEE.
9. will have an ability to participate as members in various professional bodies as well as multidisciplinary design teams.
10. will demonstrate the ability to choose and apply appropriate resource management techniques so as to optimally utilize the available resources.
11. will be proficient in English language in both verbal and written forms which will enable them to compete globally.
12. will have confidence to apply engineering solutions with professional, ethical and social responsibilities.
13. will be able to excel in their professional endeavours through self-education.
14. will be able to design and build renewable energy systems for developing clean energy and sustainable technologies.

M.TECH IN POWER SYSTEMS

Programme Educational Objectives (PEOs):

The major objectives of the M.Tech. programme in Power Systems are to equip the students with adequate knowledge and skills in Power Systems Engineering and to prepare them for the following career options:

1. Research programmes in Power Systems Engineering
2. Employment in power research and development organisations
3. To work in electric power industries and energy sectors
4. Faculty positions in reputed institutions

Programme Outcomes (POs):

A student who has undergone M.Tech. programme in Power Systems(PS) will

1. have an ability to evaluate and analyse problems related to Power Systems and be able to synthesise the domain knowledge and incorporate the principles in the state of art systems for further enrichment
2. be able to critically investigate the prevailing complex PS scenarios and arrive at possible solutions independently, by applying the acquired theoretical and practical knowledge
3. be able to solve PS problems such as load flows, state estimation, fault analysis and stability studies
4. be able to develop broad-based economically viable solutions for unit commitment and scheduling
5. be able to identify optimal solutions for improvising power transfer capability, enhancing power quality and reliability
6. be able to evolve new schemes based on literature survey, and propose solutions through appropriate research methodologies, techniques and tools, and also by designing and conducting experiments
7. be able to interpret power system data and work on well-defined projects with well defined goals to provide real time solutions pertaining to PS
8. be able to develop, choose, learn and apply appropriate techniques, various resources including hardware and IT tools for modern power engineering, including prediction and modelling with an understanding of the limitations
9. be able to develop dedicated software for analysing and evaluating specific power system problems

M.TECH IN POWER ELECTRONICS

Programme Educational Objectives (PEOs):

The major objectives of the M.Tech. programme in Power Electronics are to equip the students with adequate knowledge and skills in Power Electronics and to prepare them for the following career options:

1. Research programmes in Power Electronics and related areas
2. Employment in R & D organisations related to sustainable technologies
3. To work in power electronic circuit design and fabrication industries
4. Faculty positions in reputed institutions

Programme Outcomes (POs):

A student who has undergone M.Tech. programme in Power Electronics (PE) will

1. have an ability to evaluate and analyse problems related to Power Electronic Systems and incorporate the principles in the state of art systems for further improvement
2. be able to investigate critical PE problems and to arrive at possible solutions independently, by applying theoretical and practical considerations
3. be able to solve PE problems such as switching control, converter design, analysis and control of solid state drives and stability studies
4. be able to develop appropriate power converters for sustainable energy technologies
5. be able to identify optimal solutions for improvising power conversion and transfer capability, enhancing power quality and reliability through PE based solutions
6. be able to evolve new power electronic topologies and control schemes based on literature survey and propose solutions through appropriate research methodologies, techniques and tools, and also by designing and conducting experiments
7. be able to work on small, well-defined projects with particular goals to provide real time solutions pertaining to power electronics
8. be able to develop, choose, learn and apply appropriate techniques, various resources including sophisticated digital controllers and IT tools for modern power electronic system simulation, including prediction and modelling with existing constraints
9. be able to develop dedicated software for analysing and evaluating specific power electronics and control problems
10. be able to participate in collaborative-multidisciplinary engineering / research tasks and work as a team member in such tasks related to PE domain, giving due consideration to ecological and economical intricacies, and lead the team in specific areas
11. be able to confidently interact with the industrial experts for providing consultancy
12. be able to pursue challenging professional endeavours based on acquired competence and knowledge
13. be a responsible professional with intellectual integrity, code of conduct and ethics of research, being aware of the research outcomes and serve towards the sustainable development of the society

JOURNALS AND CONFERENCE PUBLICATIONS

JOURNAL PUBLICATIONS

B Malakondareddy, SS Kumar, NA Gounden, I Anand, "An adaptive PI control scheme to balance the neutral-point voltage in a solar PV fed grid connected neutral point clamped inverter" , International Journal of Electrical Power & Energy Systems 110, 318-331

J Thiyagarajan, B Murugan, AGN Gounden,"A Chaotic Image Encryption Scheme with Complex Diffusion Matrix for Plain Image Sensitivity". , Serbian Journal of Electrical Engineering 16 (2), 247-265

MJ Charles, A Nanjappagounder ,Bbenjd betnam "Power electronic controller with time sharing switching strategy for grid connected PV systems",Turkish Journal of Electrical Engineering & Computer Sciences 27 (1), 243-257

Diptak Pal, B. Mallikarjuna, M. Jaya Bharata Reddy and D.K.Mohanta,"Analysis and Modelling of Protection System Hidden Failures and its impact on Power System Cascading Events",Journal of Control Automation and Electrical Systems (Springer publication), Vol. 30, no. 2, pp 277-291

S Aditya, S Moorthi,"Digitally tunable active inductor for RF-DCO applications", International Journal of Electronics Letters

R Ramya, S Moorthi,"Performance Evaluation of Wordlength Reduction Based Area and Power Efficient Approximate Multiplier for Mobile Multimedia Applications", Circuits, Systems, and Signal Processing

V Ramachandran, R Pitchaimuthu, MP Selvan,"Systematized Active Power Control of PMSG-Based Wind-Driven Generators ",IEEE Systems Journal

A Dheepanchakkravarthy, MP Selvan, S Moorthi,"Alleviation of Power Quality Issues Caused by Electric Arc Furnace Load in Power Distribution System Using 3-Phase Four-Leg DSTATCOM ",Journal of The Institution of Engineers (India): Series B 100 (1), 9-22

I Anand, Diksha Agarwal, S Senthilkumar, B Malakondareddy,"A Dynamic Load Controller for a Standalone Solar PV System Employing a Dual Input/Output Biphase dc–dc Converter",Journal of Control, Automation and Electrical Systems

RR Eapen, SP Simon,"Performance analysis of combined similar day and day ahead short term electrical load forecasting using sequential hybrid neural networks", IETE Journal of Research 65 (2), 216-226

CONFERENCE PUBLICATIONS

K Sundareswaran,"A Learner's Guide to Fuzzy Logic Systems",CRC Press

K Sundareswaran, CH Ram Jethmalani, SP Simon,"A Novel Technique for Sensor Less Speed Estimation of Variable Voltage Induction Motor Drive via Neural Networks", Elementary Concepts of Power Electronic Drives 13 (4), v-v

K Sundareswaran,"Elementary Concepts of Power Electronic Drives", CRC Press

R Kuttappan, S Durgaprasanth, N Chilakapati, SI Ganesan,"A Simple Voltage Modulator Scheme for Torque Ripple Minimization in a Permanent Magnet Brushless DC Motor", IEEE Transactions on Power Electronics

M Meenalochani, S Sudha,"Jammed Node Detection and Routing in a Multihop Wireless Sensor Network Using Hybrid Techniques", Wireless Personal Communications 104 (2), 663-67

M Manickam, S Selvaraj,"Range-based localisation of a wireless sensor network using Jaya algorithm ",IET Science, Measurement & Technology

DU Maheswari, S Sudha,"Node Degree Based Energy Efficient Two-Level Clustering for Wireless Sensor Networks" ,Wireless Personal Communications 104 (3), 1209-1225

B. Bijukumar,A. G. Kaushik Raam,G. Saravana Ilango,C. Nagamani, M. Jaya Bharata Reddy ,"MPPT Algorithm for Thermoelectric Generators Based on Parabolic Extrapolation", IET Generation Transmission & Distribution, Vol. 13, no. 6, pp 821-828\

P Padmagirisan, R Sowmya, V Sankaranarayanan,"Power-assist control of a human–electric hybrid bicycle with energy regeneration and cruise control", Proceedings of the Institution of Mechanical Engineers

P Padmagirisan, V Sankaranarayanan,"Powertrain control of a solar photovoltaic-battery powered hybrid electric vehicle",Frontiers in Energy 13 (2), 296-306

S Murugesan, MV Kirthiga,"Disturbance Injection based Decentralised Identification of Accidental Islanding",IEEE Transactions on Industrial Electronics

S Gangolu, P Raja, MP Selvan, VK Murali,"An Effective Algorithm for Fault Discrimination and Estimation of Fault Location in Transmission Lines",IET Generation, Transmission & Distribution

A Dheepanchakkravarthy, MR Jawahar, K Venkatraman, MP Selvan,"Performance Evaluation of FPGA Based Predictive Current Controller for Four-leg DSTATCOM in Electric Distribution System",IET Generation, Transmission & Distribution

CONFERENCE PUBLICATIONS

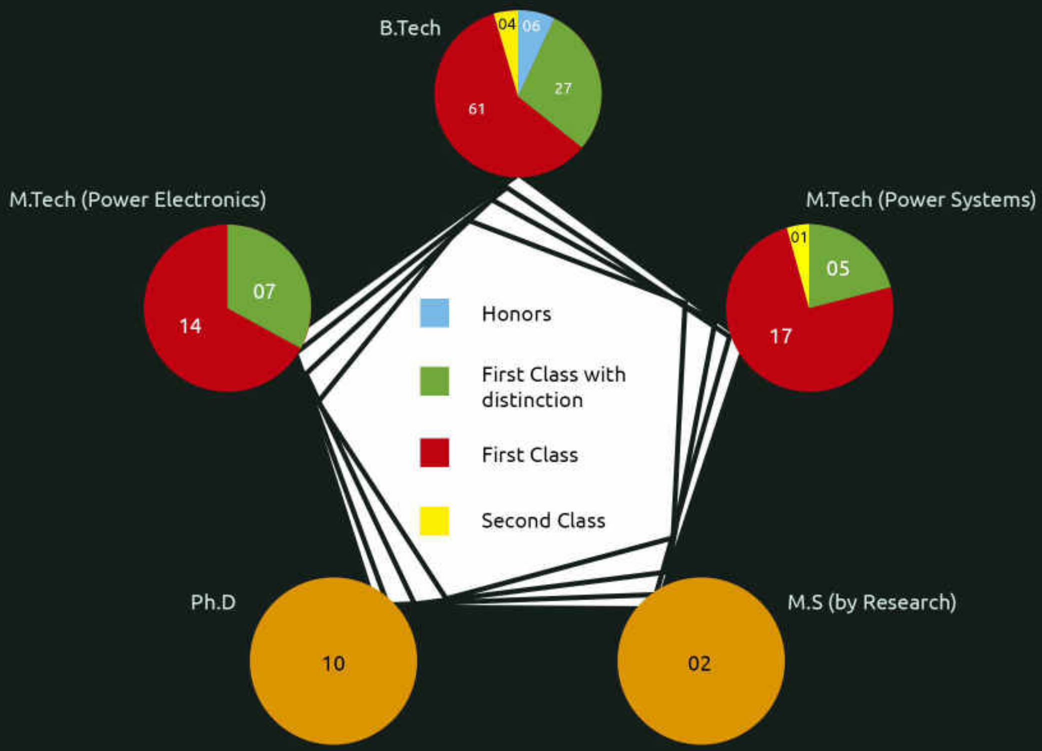
S Singh, A Namboodiri, MP Selvan,"Simplified Algorithm for Dynamic Demand Response in Smart Homes Under Smart Grid Environment",2019 IEEE PES GTD Grand International Conference and Exposition Asia

K Thirumala, S Pal, T Jain, AC Umarikar,"A classification method for multiple power quality disturbances using EWT based adaptive filtering and multiclass SVM",Neurocomputing 334, 265-274

K Thirumala, AC Umarikar, T Jain,"An improved adaptive filtering approach for power quality analysis of time-varying waveforms",Measurement 131, 677-685

CONVOCATION '19

The 15th convocation of NIT, Trichy was held on 27th July, 2019. The chief guest was Prof. Subra Suresh, President and Distinguished University Professor at Nanyang Technological University, Singapore.



Medal Winners - 2019

The institute medal is awarded to the person with the highest overall CGPA in their respective programme.

Roll Number	Name	CGPA	Programme
107115010	ARNAB BHATTERJEE	9.84	B.Tech
207117028	KOLLI JNANESWAR	9.11	Power Systems
207217010	KADAM VISWAJIT SUDAKAR	8.97	Power Electronics

Doctor of Philosophy (Ph.D)

Guide	Roll Number	Name	Thesis
Dr. P.Raja	407113005 20th September 2018	VIJAYA PRIYA R	Design of Enhanced Power Control Schemes for the Grid Integrated PMSG Based Wind Energy Conversion Systems
Dr. M.P Selvan	407113004 30th November 2018	ARUN S L	Investigations on Various Demand Response Frameworks for Smart Residential Buildings
Dr. P. Srinivasa Rao Nayak	407114056 18th December 2018	DHARAVATH KISHAN	Design, Implementation and Analysis of Resonant Inductive Power Transfer System for Electric Vehicle Battery Charging Application
Dr. Venkata Kiruthiga	407114005 11th February 2019	SUMAN M	Investigations on Unintentional Islanding Detection Techniques for Inverter Based Distributed Generators
Dr. S. Moorthi Co - Guide: Dr. M.P. Selvan	407912051 1st March 2019	DHEEPANCHAKK RAVARTHY A	FPGA Controlled Four-Leg DSTATCOM for Multifarious Load Compensation in Power Distribution System
Dr. V. Sankaranarayanan Co - Guide: Dr. K. Sundareswaran	407113002 14th June 2019	SUNILA M S	Optimized Sliding Mode Control of Uncertain Nonlinear Systems
Dr. C. Nagamani	407114007 4th July 2019	PRIYAVARTHINI S	Realization of Multi-agent System for Residential Demand Response under Smart Grid Paradigm
Dr. N. Kumaresan	407114006 10th July 2019	ARTHISHRI K	Analysis and Control of Wind –Driven 3-Phase SEIGs and Associated Power Converters Feeding 1 – Phase Utility Grid
Dr. N. Ammasai Gounden	407114007 15th July 2019	MARIA JENISHA C	Certain Investigations on the Development of Power Electronic Controllers for Solar and Wind Energy Applications
Dr. Sishaj P Simon Co-Guide: Dr. K. Sundareswaran	407912003 15th July 2019	J SATHIYA-NARAYANAN	Development and Analysis of Enhanced Schemes in Traction Network of Railway Workshop

Master of Science (by Research)

Guide	Roll Number	Name	Thesis
Dr. Srinivasa Rao Nayak	307115002 26th November 2018	RUFZAL T A	Design and Analysis of Feedback Controller for Induction Motor Soft-starting using a few recently developed biologically-inspired optimization algorithms
Dr. M.P Selvan	307116001 15th July 2019	SHASHANK SINGH	Realization of Multi-agent System for Residential Demand Response under Smart Grid Paradigm

CURRENTS 2019

The 29th edition of Currents was held from 15th to 17th February, 2019. With a host of intriguing workshops and scintillating events, this edition ascended Currents to a new level

EUREKA, a district level exhibition, was conducted at the Barn Hall. Multiple schools from the district of Tiruchirappalli took part in this event. Students from grades 8 and 9 showcased their ideas in various domains ranging from conservation of biodiversity to improvements in transport technology, and much more

The participants pitched their solutions to better their domains, to highly esteemed faculty members from NIT Trichy as well as the general public. The use of Arduino boards and robotics principles, was a common theme across most of the exhibits. From a robot to help the struggling farmers, to innovative solutions that speed up ambulance response times, there was something for everyone at EUREKA

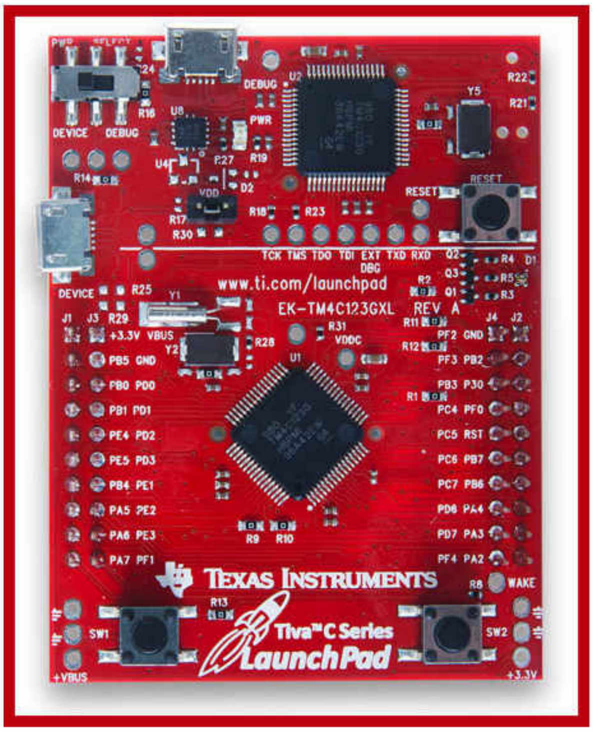
Currents '19 also saw a trio of Guest Lectures given by experts from leaders in the electrical and electronics industries. The first among the three lectures was delivered by Mr. Veera Manikandan Raju, CTO, Texas Instruments (TI), Bangalore. The crux of the talk revolved around the future of developments and transformation of technology as a whole. He laid emphasis on a total of ten trends that are projected to disrupt multiple industries, ranging from technology, to agro-tech and even healthcare. He also spoke about TI, as a company, is helping us rapidly advance to this connected future. This lecture was attended by an audience of nearly 150, comprising of students and faculty members alike

The second lecture was given by Dr. M. Ganesan, a senior expert at Alstom Transport, Bangalore. Addressing a crowd of nearly a 100 students and a few distinguished faculty members, he helped shine light onto the future of transport and mobility, whilst keeping in mind the safety aspects

Drawing the curtains on the fantastic trio of industrial lectures, an expert on SoCs from Intel, Mr. Shankar Ganesh, gave the audience with a glimpse into the world of SoCs, as it is today, and as it will be in the future. As is visible these days, SoCs have become a part and parcel of modern technology. The lecture, too, dealt with the basics of SoC design, along with some real-world applications

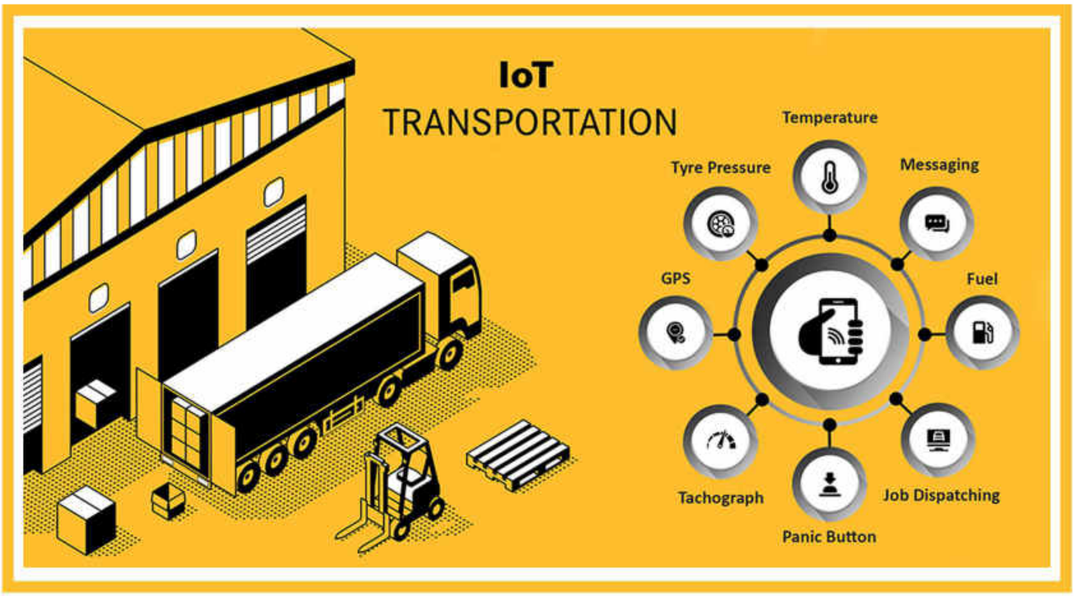
Overall, it was an excellent experience that bridged the gap between the knowledge gained within the four walls of the classroom, and the current trend in the industry

LECTURE 1



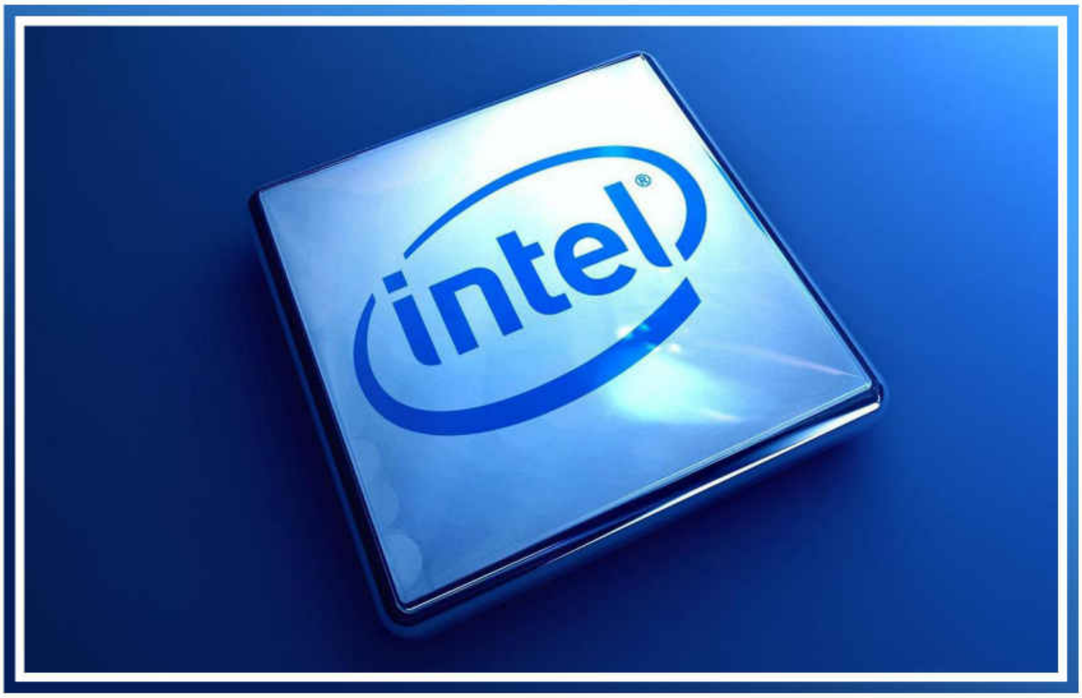
Currents '19 also saw a trio of Guest Lectures given by experts from leaders in the electrical and electronics industries. The first among the three lectures was delivered by Mr. Veera Manikandan Raju, CTO, Texas Instruments (TI), Bangalore. The crux of the talk revolved around the future of developments and transformation of technology as a whole. He laid emphasis on a total of ten trends that are projected to disrupt multiple industries, ranging from technology, to agro-tech and even healthcare. He also spoke about TI, as a company, is helping us rapidly advance to this connected future. This lecture was attended by an audience of nearly 150, comprising of students and faculty members alike.

LECTURE 2

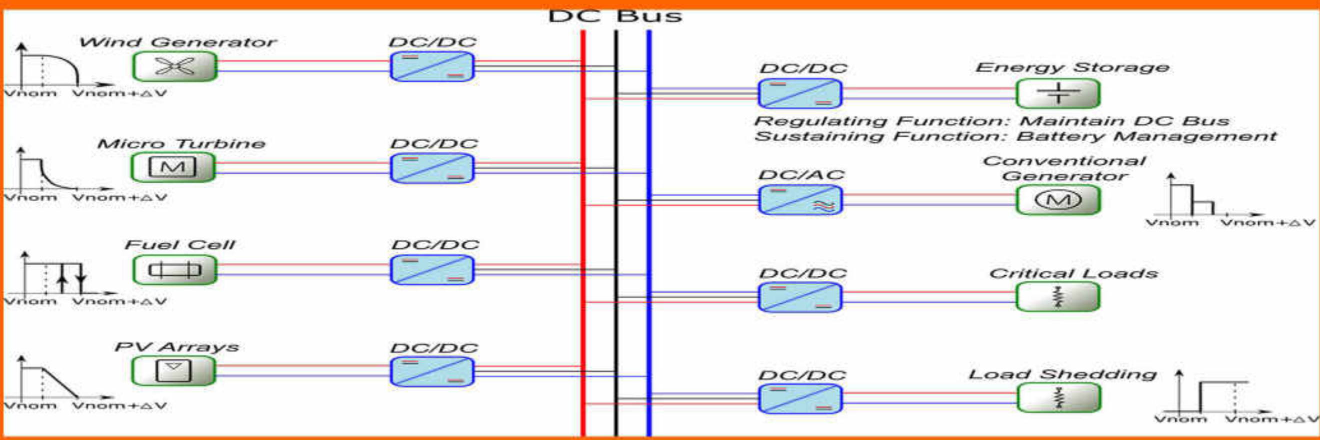


The second lecture was given by Dr. M. Ganesan, a senior expert at Alstom Transport, Bangalore. Addressing a crowd of nearly a 100 students and a few distinguished faculty members, he helped shine light onto the future of transport and mobility, whilst keeping in mind the safety aspects. The talk started with a discussion on how the safety features of trains have seen improvements over the course of the past few years. He then went into the future of railway transport, which involved GSM-based communication and IoT implementations. While railway transport was the key focus of his talk, emphasis was placed on diversifying the means of available transport, and how the key to progress is to unite them together. Taxi services like Ola and Uber, food delivery services like Zomato, Swiggy, etc., and goods delivery services like Amazon and BigBasket need to work in unison with the public transport-system and the authorities, to ensure seamlessness at every stage. The lecture concluded with an insight on a data-analytics-driven approach for better planning and resource management.

LECTURE 3



Drawing the curtains on the fantastic trio of industrial lectures, an expert on SoCs from Intel, Mr. Shankar Ganesh, gave the audience with a glimpse into the world of SoCs, as it is today, and as it will be in the future. As is visible these days, SoCs have become a part and parcel of modern technology. The lecture, too, dealt with the basics of SoC design, along with some real-world applications. An example of a "smart meter" was given, wherein the subsystems that constitute the SoC were dealt with. Following this, he eased the audience into the concept of Layers of Abstraction and other important terminologies that are crucial for any aspiring SoC engineer. After touching up on some critical timing constraints that are vital in SoC design, he ended the lecture with an interactive round of Q&A. Overall, it was an excellent experience that bridged the gap between the knowledge gained within the four walls of the classroom, and the current trend in the industry.



The 'War of Currents' is not a recent one. AC-DC rivalry has a very long history of its own. It all started when Nikola Tesla had some disagreements with Edison and started working on AC, as opposed to the then-popular DC. Soon AC overpowered DC because of its ability to be transmitted over long distances with less power loss and operated over varying range of amplitudes. But now we can see the resurrection of DC power. What happened in the meantime that lead to this drastic change?

Up until a few decades back, people used electric appliances which needed AC supply. But in the late 1950's the usage of electronics increased, which needed DC supply and it became a hassle to always use adapters. The whole idea of DC supply at the switch boards seemed like an option that we should be moving towards. Also the idea of microgrids was born from the idea of distributed generation which meant we could make use of renewable sources of energy in a much better manner.

So, what is a MICROGRID?

A microgrid is a group of interconnected loads and distributed energy resources within clearly defined electrical boundaries that acts as a single controllable entity with respect to the grid. This works in a coordinated way either while connected to the main power network or while islanded.

Distributed energy resources consists distributed generators and storage devices. Generators cover all possible sources within the context of a microgrid, like small wind turbines, photovoltaic cells etc. And storage devices can store the excess power produced by the generators and can be used in situations where we are unable to use generators to produce electricity. The DC bus, is the common power line, which is responsible for all the power exchange. The distributed energy resources and loads are interconnected using the DC bus. In DC microgrid structure, sources with DC output are connected to DC bus directly, whereas sources with AC output are interfaced to DC bus through AC/DC converter.

Now, what is the advantage of using a microgrid? Let's say that we have only one power station for generation of energy and also for transmission of energy to a large area. And let us assume that due to an unforeseen calamity this station stops functioning. Then the whole area will experience a widespread loss of power. But if we have multiple microgrids in that area, even if the main grid stops functioning, the other microgrids can still sustain the energy requirements of that area.We can also use microgrids as private and personal power stations. In case of a p ower outage you can supply power to the main grid and the cost will be deducted from your electric bill.

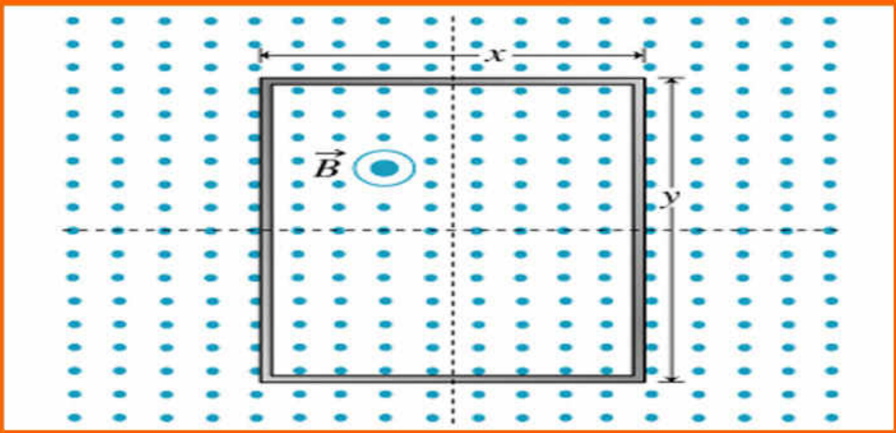
We also have AC microgrids. Then why do we still prefer DC microgrids over AC microgrids? DC microgrid has advantage over AC microgrid in terms of system efficiency, cost, and system size. Because lesser number of power electronic converters are required, the overall efficiency improves. Additionally, AC-DC converters do not require a transformer, which reduces the size of DC microgrid significantly. Similar to AC microgrid, an energy management system is required with DC microgrid as well. However, only voltage stabilisation is needed. Compared to AC microgrid, a support for frequency stabilization is not required in case of DC microgrid.

With increasing dependency on renewable resources, microgrids provide an excellent way to harness energy from multiple renewable sources like solar, wind etc. Since, these resources are weather dependent and provide highly varying supply. Hence microgrids can be used to store this energy from various sources and provide it to consumers. In conclusion, we can say that DC microgrids provide numerous benefits over other ways and will become an integral part of the way we produce, transmit and distribute energy.

.

-Rakesh Varma Rayapalli, 2nd year

THE QUEER NATURE OF INDUCED EMF



The conclusions drawn from the experiments conducted by Faraday in 1831 has given direction to experts and enthusiasts related to the field of electrical engineering. It opened several new topics to ponder, which led to more topics and it has brought us to where we are now. Such a scientific breakthrough also has some intriguing things that have put people into deep thought.

The concept of induced emf came as a complete surprise to people, as it paved the way to an entirely new means to generate electricity, which was easier and more efficient than the older methods by leaps and bounds. On the contrary, there are a few properties of this concept which were not quite as expected. For example, the non-conservative nature of induced emf is an anomaly that obscures people's understanding of the concept.

Induced emf is an emf induced within a magnetic circuit, which in most cases is a coil or an inductor. It is induced by varying the magnetic flux linked with a conductor by moving a conductor placed in a magnetic field, which is known as dynamically induced emf. The flux can also be varied by varying the current flowing through the circuit producing the flux, which is called statically induced emf.

Lenz law proves that the direction of the induced emf is in accordance to the law of conservation of energy. Thus, it is a common assumption that the force caused by the emf should also be a conservative force. But, when a conductor placed in a magnetic field is rotated to complete one full circle, the magnitude of the induced emf is a non-zero value, unlike the expected zero emf.

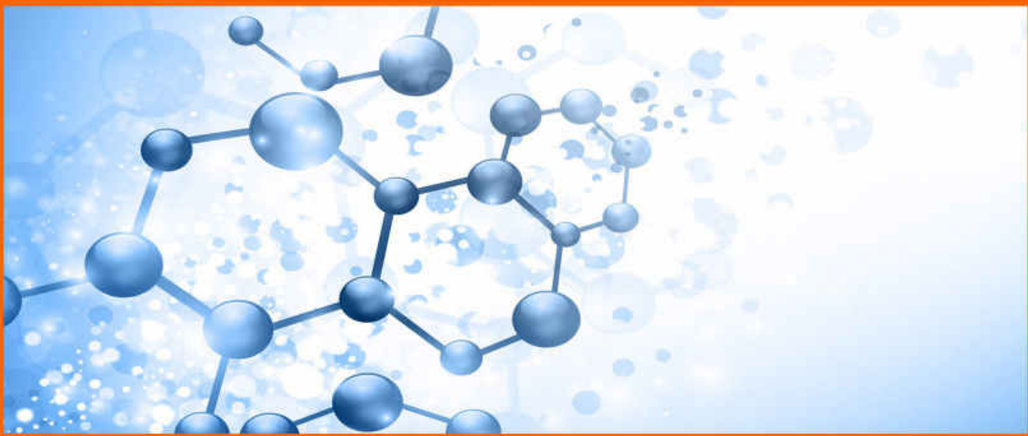
The fact that the work done when the conductor is rotated for one full circle is not zero, brought about a lot of confusion and provided a topic for discussion. But the reason for induced emf being non-conservative was soon given. If the induced electric field is in an opposing direction to the flow of positive charges, it will cause the charges to lose energy. As a result, work is lost by the device pushing these charges. On the other hand, if the charge moves along the induced field carrying a load, energy is absorbed by the device pushing the charges.

The power supply that homes receive on an everyday basis is also a consequence of induced emf in more than one way. It is not just being applied during power generation using generators, but also in transformers. Transformers are where induced emf is helping us to vary the voltage of the generated electrical energy. If the induced emf in the secondary coil was consersative, there would be no concept of eddy current. The very fact that work is either lost or gained by a machine which is operated by a non conservative force is important to understand that eddy current is a consequence of the non conservative nature of induced emf. The applications of eddy currents are widely used in several fields, from a simple galvanometer to a huge brake for a train.

The non-conservative nature of induced emf has not stopped us from utilizing it for endless applications. Generators, motors, and transformers; which are devices that have become a necessity in daily human life, would not be a thing if not for induced emf. It is surprising that something which opposes its own cause could be so important that it is so commonly used albeit its non-conservative nature.

-Vishnu Dhinakaran, 2nd year

USAGE OF POLYMERS IN THERMOELECTRIC GENERATORS



Conversion of energy from various forms into electrical energy has been at the core of engineering for nearly 150 years. We have created various mechanisms for doing the same by driving turbines using fluids that would travel through conduits by absorbing energy from whatever source we are utilising. While a turbine lies at the core of all these mechanisms, Thermoelectric Generators, or TEGs, follow a very different principle. A TEG is a solid state device that uses temperature differences into electrical energy through a phenomenon called the Seebeck Effect. Unlike heat engines, it has no moving parts, making it a very attractive option for long term power generation.

The use of TEGs for active power generation was never a solid idea since it could never generate power for large scale usage in an efficient manner. A more interesting application is the use of thermoelectric modules by themselves to produce electricity from waste heat, basically the energy spectrum which cannot be used in photovoltaic applications in the infrared spectral region (IR). It is used for the same, in some home appliances such as air coolers, refrigerators and certain types of ovens. The restrictions imposed on its usage in more places for power saving can be blamed on the choice of materials we had earlier. Thermoelectric generators require materials with low thermal conductivity to make sure that one end of the TEG heated up more than the other end to have the maximum temperature difference, and with high electrical conductivity to maximise its efficiency of electricity production.

The quality of the material for use in TEGs is given by something known as its "figure of merit". Since the prediction of the improvement of the figure of merit by means of electronic confinement in 1993, it has been improved by a factor of 3–4. However, organic materials, in particular intrinsically conducting polymers, have improved their figure of merit by orders of magnitude during the last few years. Moreover, their small thermal conductivity makes them more attractive than inorganic compounds. The thermal conductivity of most polymers is at least a factor of 10 smaller than that of inorganic compounds. There are several more advantages in the use of conducting polymers instead of inorganic materials: the non scarcity of raw materials, the non toxicity, the possibility of using them in large area applications, etc.

From the phenomenological point of view, there are mainly two theoretical approaches to the transport properties of conducting polymers. The approaches depend on the strength of the electron-phonon interaction. If the electron-phonon interaction is strong, the electrons can be completely localized and hopping between the polymer chains dominates the transport. On the other side, if the electron-phonon interaction is weak, a band model can be used to describe the electronics, and the electron-phonon interaction can be introduced by means of perturbation theory.

In between, we have the polaron model. A polaron is an electron dressed with phonons; electrons move with a larger effective mass or a renormalized mass due to the coupling with phonons and, consequently, a smaller mobility. Polyaniline was discovered 150 years ago, but until the 80's its high electrical conductivity was not measured. Polyaniline is the first intrinsically conducting polymer discovered. Most of the models explaining the conducting properties of the models developed at this time were devoted to the analysis of the behaviour of σ (dc and ac) and α as a function of temperature, electric field, level of localization, etc. Basically, all the models are based on those previously developed to study electric transport in disordered semiconductors (amorphous semiconductors mainly). By finally considering polymer conduction into the picture, we can broaden our perspective of TEGs using new materials.

One of the broad applications that can be achieved using conducting polymers like graphene, is the creation of flexible TEGs for efficient temperature difference generation. It may be the more logical way of power generation for a Dyson Sphere, a futuristic idea of covering the Sun with solar panels for harnessing nearly 100% of the energy generated by it. While this idea may be unimaginably far into he future, most of our technologies seemed impossible even in the recent past. Looking for avenues for development where we never saw one before is what science is at its heart.

.

- Sabharinathan J, 2nd year

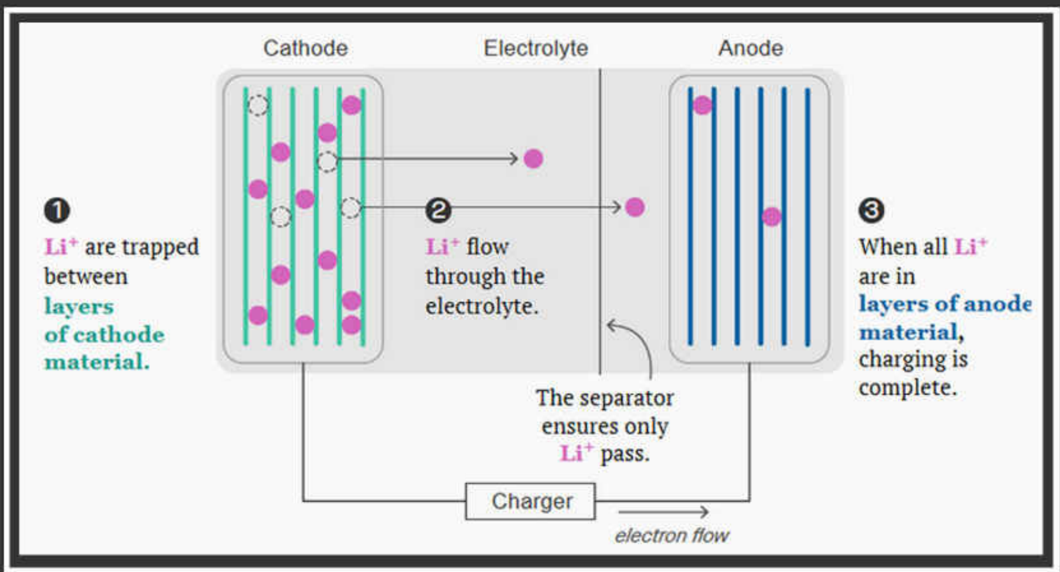
BATTERY TECHNOLOGIES

OF THE FUTURE

Firstly, the Traditional Battery. How does it work?

Electricity is the flow of electrons through a conductive path. However unlike conventional means of power delivery to our homes, a battery slowly converts chemicals packed inside it into electrical energy, typically released over a period of days, weeks, months, or even years.

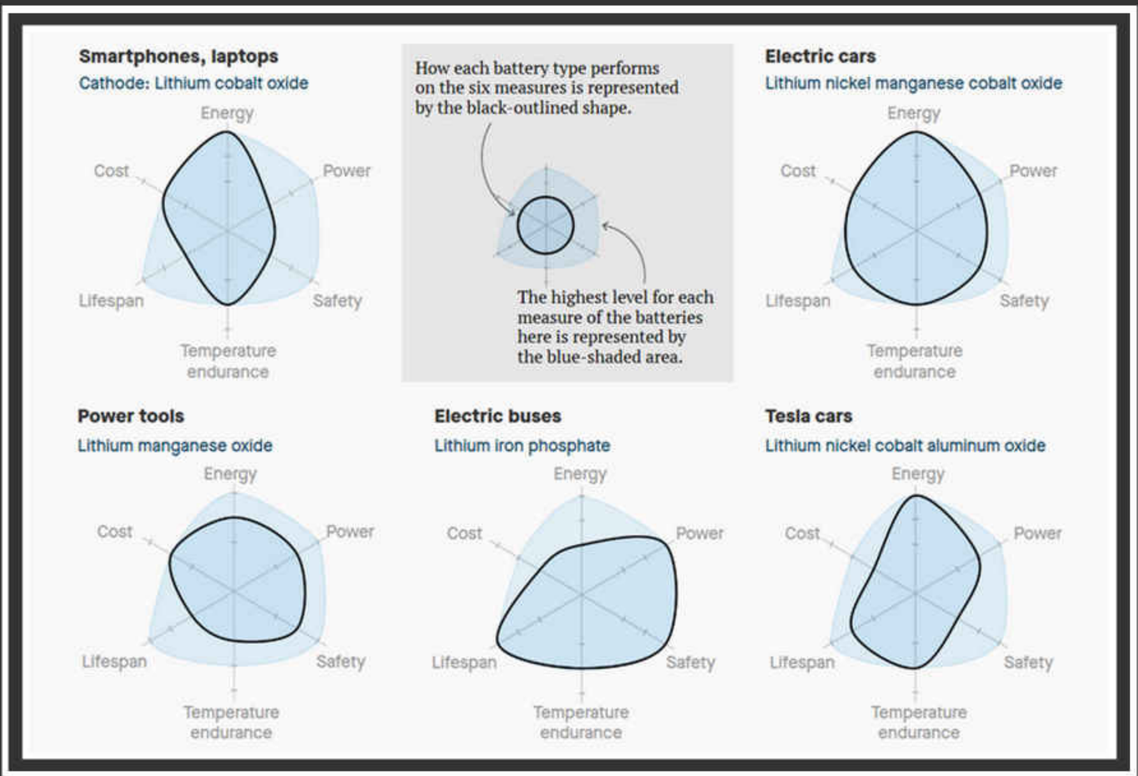
The most cutting-edge battery technology we currently have is lithium-ion which most experts agree is going to be the industry standard for at least another decade. A lithium-ion battery has two electrodes (cathode and anode) with a separator (conducts ions but not electrons) in the middle and an electrolyte to enable the flow of lithium ions back and forth between the electrodes. When a battery is charging, the ions travel from the cathode to the anode and vice-versa when it is being used.



The dreaded descent into the state of being underpowered (pictured to the left). The uphill battle that is being waged against draining batteries is one of our biggest plights, and will revolutionise every other tech industry dependant on power.

What are the main areas in which the battery faces a disadvantage?

Every battery has two electrodes. However, while the anodes of lithium-ion batteries are made of graphite, the cathodes are made of various materials, depending on what the battery will be used for. The picture below shows how cathode materials change the way battery types perform on six metrics.



THE POWER CHALLENGE

A battery not only needs to have a lot of energy stored but also have the ability to extract that energy very quickly. The battery's power capacity is determined by how fast this process happens. However, it is not so simple to turn up that speed. Drawing lithium-ions out of the cathode layer too quickly can cause the carbon layers to develop flaws and eventually break down. It is one reason why the longer we use our smartphones and laptops the worse their battery life gets.

Various companies are working on solutions to the problem. One idea is to replace layered electrodes with something structurally stronger. For example, a Swiss battery company Leclanché, is working on a technology that uses lithium iron phosphate (LFP) and lithium titanate oxide (LTO) to replace the cathode and anode respectively. These structures are better at handling the flow of lithium ions in and out of the material.

THE ENERGY CHALLENGE

The Tesla Model 3, the company's most affordable model, starts at $35,000. It runs on a 50 kWh battery, which costs approximately $8,750, or 25% of the total price of the car. That is still amazingly affordable compared to not that long ago. According to Bloomberg New Energy Finance, the average global cost for lithium-ion batteries in 2018 was about $175 per kWh—down from nearly $1,200 per kWh in 2010. The US Department of Energy calculates that once battery costs fall below $125 per kWh, owning and operating an electric car will be cheaper than a gas-powered car in most parts of the world.

One way to get there is to increase the energy density of batteries—to cram more kWh into a battery pack without lowering its price. Battery chemists can do that, in theory, by increasing the energy density of either the cathode or the anode, or both.

The most energy-dense cathode on the way to commercial availability is NMC 811. However, currently it can only withstand a relatively small number of charge-discharge cycles before it stops working. Nevertheless, experts predict that industry R&D should solve the problems of the NMC 811 within the next five years, hence improving energy density by 10% or more. For batteries though, a 10% increase isn't much. Anodes are where the biggest energy-density opportunities lie.

Graphite has been and remains far and away the dominant anode material. It is cheap, reliable, and relatively energy dense, especially compared to current cathode materials. But it is fairly weak when stacked up against other potential anode materials, like silicon and lithium.

Silicon, for example, is theoretically much better at absorbing lithium ions as graphite. That is why a number of battery companies are trying to pepper some silicon in with the graphite in their anode designs; Tesla CEO Elon Musk has said his company is already doing this in its lithium-ion batteries. A bigger step would be to develop a commercially viable anode made completely from silicon. But the element has traits that make this difficult. When graphite absorbs lithium ions, its volume does not change much. A silicon anode, however, swells to four times its original volume in the same scenario.

This expansion breaks apart what's called the "solid electrolyte interphase," or SEI, of the silicon anode. The SEI is a sort of protective layer that the anode creates for itself, similar to the way that iron forms rust. At the end of a battery's first charge, the SEI stops additional chemical reactions from consuming the electrode, ensuring that lithium ions can flow as smoothly as possible. But with a silicon anode, the SEI breaks apart every time the battery is used to power something up, and reforms every time the battery is charged. And during each charge cycle, a little bit of silicon is consumed. Eventually, the silicon dissipates to the point where the battery no longer works.

Over the last decade, a few Silicon Valley startups have been working to solve this problem. For example, Sila Nano's approach is to encase silicon atoms inside a nano-sized shell with lots of empty room inside. That way, the SEI is formed on the outside of the shell and the expansion of silicon atoms happens inside it without shattering the SEI after each charge-discharge cycle. Enovix, on the other hand, applies a special manufacturing technique to put a 100% silicon anode under enormous physical pressure, forcing it to absorb fewer lithium ion and thus restricting the expansion of the anode and preventing the SEI from breaking. While these compromises mean the silicon anode can't reach its theoretical high energy density, their anodes perform better than a graphite anode.

THE SAFETY CHALLENGE

All the molecular tinkering done to pack more energy in batteries can come at the cost of safety. Ever since its invention, the lithium-ion battery has caused headaches because of how often it catches fire. For example, Samsung's Galaxy Note 7 smartphones, which were made with modern lithium-ion batteries, started exploding in people's pockets. The resulting 2016 product recall, cost the South Korean giant a whopping $5.3 billion.

Today's lithium-ion batteries still have inherent risks, because they almost always use flammable liquids as the electrolyte. It is one of nature's unfortunate quirks that liquids able to easily transport ions also tend to have a lower threshold to catching fire. One solution is to use solid electrolytes. But that means other compromises. A battery design can easily include a liquid electrolyte that's in contact with every bit of the electrodes—making it able to efficiently transfer ions but it is much harder with solids.

So far, the commercial use of lithium-ion batteries with solid electrolytes has been limited to low-power applications, such as for internet-connected sensors. The efforts to scale up solid-state batteries can be broadly classified into two categories: solid polymers at high temperatures and ceramics at room temperature.

Solid polymers at high temperatures:

When some types of polymers are heated, they behave like liquids, but without the flammability of the liquid electrolytes used in most batteries. However, they have limitations. They can only operate at temperatures above 105°C (220°F), which means they aren't practical options for, say, smartphones. But they can be used for storing energy from the grid in home batteries.

Ceramics at room temperature:

Over the last decade, two classes of ceramics have proven almost as good at conducting ions at room temperature as liquids. Toyota, as well as the Silicon Valley startup QuantumScape, are both working on deploying ceramics in lithium-ion batteries.

So far battery chemists have found that, when they try to improve one trait (say energy density), they have to compromise on some other trait (say safety). That kind of balancing act has meant the progress on each front has been slow and fraught with problems.

CURRENT AND FUTURE TECHNOLOGIES IN BATTERIES - the traditional and the unconventional

The use of rechargeable lithium ion batteries is gaining prevalence in the modern technological world - but as explained above, they have a lot of limitations in their capacity, durability and safety issues.
A few alternative types of batteries have been researched over the years to replace the lithium ion technology in the future.

Sand batteries

Lithium-ion batteries are taken a step further with the use of silicon in the anodes, instead of graphite. This change in the element used can lead to an improvement in the battery life, with silicon batteries needing up to three times more discharge time.
However, the major drawback of these batteries is that pure or nano-silicon is quite tough to obtain. The sand must be crushed, powdered and ground with magnesium and salt, before heating at high temperatures to remove the oxygen. The resultant porous and three-dimensional nature of silicon makes the batteries long lasting.
These batteries are being researched in California, with scientists promising a 20 to 40 percent longer battery life by the time the technology is commercialized.

Sodium-ion batteries

Scientists in Japan are working on new types of batteries that don't need lithium like today's smartphone batteries. These new batteries will use sodium, one of the most common materials on the planet rather than rare lithium – and they'll be up to seven times more efficient than conventional batteries.Research into sodium-ion batteries has been going on since the eighties in an attempt to find a cheaper alternative to lithium. By using salt, the sixth most common element on the planet, batteries can be made much cheaper. Commercialising the batteries is expected to begin for smartphones, cars and more in the next five to ten years.

Metal air batteries

Metal air batteries consist of a pure metal anode and a cathode of air, with a water soluble or aprotic electrolyte. The oxygen in the air is reduced, while an oxidation reaction forms the oxidation half cell reaction. The reaction processes slowly and makes the battery more long lasting, making metal air batteries perfect for use in electric vehicles. However, limitations arise with the catalysts used to get the oxygen in the air to the metal membrane.
That being said, metal air batteries remain one of the most feasible alternatives to the traditional Li-ion batteries for the future.

Carbon-ion batteries

A carbon-ion battery combines the superfast charging capabilities of a supercapacitor, with the performance of a Lithium-ion battery, all while being completely recyclable.
Currently, there exists a prototype of a power bank charger that can be fully charged in five minutes, and will then charge a smartphone up to full in two hours.

Batteries made using biological semiconductors

The StoreDot charger works with current smartphones and uses biological semiconductors made from naturally occurring organic compounds known as peptides – short chains of amino acids - which are the building blocks of proteins.
The result is a charger that can recharge smartphones in 60 seconds. The battery comprises non-flammable organic compounds encased in a multi-layer safety-protection structure that prevents over-voltage and heating.

PROJECTED TECHNOLOGIES IN THE FUTURE OF BATTERIES

Wearable battery technology

A very interesting concept we come across when looking into the projected advancements in batteries in the future is the concept of deriving energy from friction, i.e., deriving energy from the device user himself. TENG, or triboelectric nanogenerator, is a power harvesting technology. The concept is simple - it derives energy from the contact of two materials. This technology is expanded into the fascinating field of wearable battery-powered gadgets.
Researchers at the University of California in San Diego have developed a stretchable biofuel cell that can generate electricity from sweat. The energy generated is said to be enough to power LEDs and Bluetooth radios.
Similarly, the potential of wearable technology is taken a step even further with the introduction of the Jenax J. Flex Battery, which makes the use of bendable gadgets possible. The paper-like battery can fold and is waterproof - making it perfect to integrate into clothing and wearable items. It has already been developed as well as tested, both for safety and performance. The tough yet flexible battery has been folded as many as 200,000 times without even a slight drop in performance!

Projected advancements in the safety of batteries

Built-in fire extinguishers:
Lithium ion batteries can overheat and catch on fire with prolonged use. This is a safety hazard for people, and can also lead to the damage of the powered device. To combat this problem, researchers at Stanford University developed a type of Li-ion battery with a built-in fire extinguisher. The primary component of this flame resistant technology is the addition of triphenyl phosphate to the plastic fibres, to keep the anode and cathode apart. It can extinguish fire in as little as 0.4 seconds - when the temperature rises above 120 degrees Celsius, the plastic fibres melt and the anti-inflammatory chemical leaks out.

Non explosive:
Lithium-ion batteries have a rather volatile liquid electrolyte porous material layer sandwiched between the anode and cathode layers. Mike Zimmerman, a researcher in Massachusetts, has developed a battery that has double the capacity of lithium-ion ones, but without the inherent dangers. Zimmerman's battery is incredibly thin, being slightly thicker than two credit cards, and swaps out the electrolyte liquid with a plastic film that has similar properties. It can withstand being pierced, shredded, and can be exposed to heat as it is not flammable.

Free of flammable electrolyte
A foam-like material has been developed by a company called Prieto using a copper substrate. The resultant battery is much safer to use, as the presence of a flammable electrolyte has been eliminated. This copper foam battery also has a longer life and a faster charging speed, and is cheaper to manufacture.

Battery Power derived from unconventional sources

Using ambient sound
Researchers in the UK have built a phone that is able to charge using ambient sound in the atmosphere around it.The smartphone was built using a principle called the piezoelectric effect. Nanogenerators were created that harvest ambient noise and convert it into electric current. The nanorods even respond to the human voice, meaning chatty mobile users could actually power their own phone while they talk.

Using pedestrian footsteps
The TENG technology used in wearable devices can be applied to more than just clothing - it can be integrated into the pavement, so when people constantly walk over it, it can store electricity which can then be used to power street lamps.

Using Wi-Fi
While wireless inductive charging is common, being able to capture energy from Wi-Fi or other electromagnetic waves remains a challenge. The idea is that devices can incorporate a rectenna (radio wave harvesting antenna) that is only several atoms thick, making it incredibly flexible. This molybdenum disulphide-based rectenna is employed so that AC power can be harvested from Wi-Fi in the air and converted to DC, either to recharge a battery or power a device directly.

All in all, the future of batteries plays a major role in determining the technological advancements of the century. With the research and experimentation taking place in the field, the technology of batteries and power supply is sure to advance greatly in the next few years. The limitations of lithium-ion batteries can be overcome in a variety of ways.

Step by step, with the growth and advancements in technology, we can improve our efficiency to sustain the ever-increasing demand for automation...until the next big advancement comes up.

Rohinee Phatak, 2nd year EEE
Thomas Mathew, 3rd year EEE

I did my two-month-long summer internship at Fidelity Investments, Chennai, which is one of the top financial services companies. My work involved developing a video conferencing web application for a specific business case. During the term of the project, I learnt a lot of industry practices and general workflow of working on a project from ideation to planning to the execution stage.

Also, we also got access to the resources at hand and were treated at par with their full-time counterparts, in terms of work as well as outside the office. The company has a proper technology setup and people are very approachable. They offer an excellent work-life balance, with zero work pressure, as we work with the competitive spirit, at flexible durations. The company also facilitates learning in both technological as well as managerial fields with access to renowned journals, magazines and free access to MOOCs and certifications. We also had a few sessions teaching us about the financial industry in general.

Other than that, we had few engaging activities like innovation challenge, coding challenge, and volunteering events. Aiming for the global reach of the company, we get opportunities to interact and collaborate with senior professionals from various back-grounds. Fidelity stayed rooted to their ethics and security which gives an edge in the financial services domain. Overall, the experience was fun and fulfilling.

The selection process consists of a software OT with questions from diverse fields like DBMS, DS, algorithms, networks, and aptitude. Following the OT, there were two rounds of interviews, one technical and one HR. The technical interview was based on my previous major projects and general technical questions. Based on the OT and interview, we would be allotted a project in one of the various domains that Fidelity recruits for.

Shubham P
Year IV

This summer I had the opportunity to intern at P&G as a product supply intern. I worked in the production end of the supply chain, at the Fabric Care plant in Hyderabad. P&G believes in assigning responsibilities from Day1 and giving real life problems for the interns to tackle. I was given complete liberty to ideate and implement solutions that I believed were relevant to my problem statement. The problem statements were challenging and I had the opportunity to learn from a lot of different avenues. The interns were provided with tremendous support by everyone at the company and their ideas are heavily valued.

I worked specifically to design and propose a new operating strategy for the fabric care unit while integrating it with the throughput increment. This required me to understand the technical aspects of the production process along with patterns of recruitment, expenditure for plant functioning and profit margins. The internship enabled me to get an overall view of how supply chains work, how cost saving projects are actually implemented on a production line and how attention to detail is extremely crucial when dealing with complex solutions integrated with technology.

Personally, the internship has given me the opportunity to deliver massive cost saving projects and work on projects with a real time impact, something that I did not expect an intern to be entrusted with. The company does truly offer a unique internship experience for students interested in techno managerial roles irrespective of their branch of engineering.

CH Esha
Year IV

I was given an opportunity to do a 60 day internship at Western Digital's Bangalore office in the Retail Diversification Engine team. The small team works together to innovate in retail flash memory products. In the beginning, there was a 3 day orientation which gave us an insight into major activities of the company, how to utilise various facilities like IT, Security, etc and also a few guidelines the ins and outs of corporate life.

After that, all the interns joined their allotted teams- mostly in the Sandisk office and few in Tegile (both are companies acquired by western Digital). Before I go into specifics of my project, I would like to mention here that the company took very good care of its interns, talking in terms of a week's hotel stay initially, daily cab rides and shuttles to those who requested and meal passes to the cafeteria.

On joining my team, I was initially asked to familiarise myself with the latest product which was in its testing phase. I had to go through the design and other documents pertaining to the upcoming project. After which my co-intern and I were given a list of tasks to choose from according to our interest. Owing to my personal interest in power management and monitoring, I worked on it for 2 weeks to make a concrete deliverable before taking up the next task. The second task was based on memory architecture modification for cost reduction on which I worked for the rest of the summer. These tasks gave me practical understanding of both the hardware and software sides of complex embedded systems (very different from the hobbyist-level projects we all try). My teammates and project in-charge were extremely supportive and approachable which eventually lead to a not-so-steep learning curve.

Bhavya K
Year IV

MITACS Summer Internship Program

This summer I had the privilege to do a 10 week internship in the field of Approximate Computing at the University of Saskatchewan, Saskatoon, Canada, through the Mitacs Summer Internship program, 2019. My major work scope was implementing and innovating novel Approximate Computing techniques in the field of electronics, and extend its application to other domains.

In simple terms, Approximate Computing involves the creation of tradeoff between accuracy and complexity of a convoluted system. In the process I was able to leverage my skills in the field of Deep Learning and implement computational approximation in applications like Licence Plate Recognition, and Medical Imaging among several other facets.

Apart from the work, this internship offered me an amazing opportunity to meet and work with new people coming from diverse backgrounds who brought unique skill sets to the table. The working environment was completely different from my prior experiences in India. The work ambience was so conducive and encouraging that, I relentlessly drove myself out of my comfort zone to seize the best out of myself. At the same time I was given the liberty to work and grow at a pace which was comfortable to me.

One of the greatest takeaways from my internship was the attitude to be blunt. Everyone in Canada, in and around you, are extremely honest about their opinions. If they think something won't work, they'll say it unaltered and unprompted. This was the sole aspect which I deeply appreciate and wish to imbibe the same in myself. Just like any other intern outside of India, I made sure to explore Canada during weekends and holidays where I visited different cities and attended several festivals! Exploring the culture in and around Canada was one of the greatest experiences of my internship. I would suggest and recommend all students to give foreign internships a chance as there are ample skills you get to learn, both professionally and personally. Such an experience always pushes your boundaries and expands one's horizons which I believe would aid one immensely in their forthcoming ventures!

Aaryan S
Year IV

CalTech Internship Experience

I was awarded Summer Undergraduate Research Fellowship (SURF) by California Institute of Technology (Caltech), the United States of America to undergo an eleven week summer research project to explore challenges in Cryogenic High-Q Mechanical Resonators. In a nutshell, the project involved detailed finite element modeling of the resonator, checking the system parameters near cryogenic temperatures with temperature modulations and developing a new non-contact temperature probe.

The application process was highly structured and extensive. It consisted of a global online application on the Caltech portal, followed by rounds of resume shortlist and telephonic Skype interviews. As US funding agencies fund most of the research at Caltech, they were highly selective in choosing a non-US citizen for internship, hence strong recommendation letters, previous research projects and publications in high index journals gave an edge.

Every SURF Awardee is required to submit a project proposal, a project abstract, two interim reports, a final presentation, and a research paper. Caltech, ranked as one of the world's top-five universities, is widely known for its strength in natural science and engineering. Owing to it, I got an opportunity to share the same workplace and frequently interact with notable scientists like Kip Thorne (Noble Prize 2017; author of the book 'The Science of Interstellar' on which the oscar-winning movie 'Interstellar' is based), Katie Bouman (the woman behind the
first black hole image), Takaaki Kajita (Nobel Prize 2015) and many more.

I had the perfect balance between work and fun. Being in very close proximity to Downtown Los Angeles and star-studded Hollywood, day trips were always on the cards. To make things better, Caltech administration organized trips every week to major attractions in and around Los Angeles. Overall, it was an exhilarating and enriching experience to indulge in frontier scientific research after the completion of my fourth semester. I would strongly recommend sophomores and juniors, interested in pursuing research, to apply for Caltech SURF program.
All the best!

Shubhabroto M
Year III

SFRP Internship Experiences

I:

I did my intern of Summer 2019 in Advanced Multi-core systems Laboratory at the Department of Electronics and Communication Engineering, IIIT Delhi under the guidance of Dr. Sujay Deb. I got the opportunity through the Indian Academy of Sciences Summer Research Fellowship programme.

I worked on implementing an ARM Cortex-M0 based SoC platform on a Field Programmable gate array (FPGA). The licensed processor logic was deployed and the hardware interfaces and the peripheral blocks were coded in Verilog. The application program was initially coded in assembly, followed by C and eventually on CMSIS.

Finally, a basic SoC platform with simple interfaces was built. The researchers in the laboratory were very supportive and they made sure they made me understand concepts and help me whenever I got stuck with a problem. The freedom they provided and the flexibility in lab timings were conducive to my research work. Altogether, it was an amazing learning experience.

Charulatha N
Year IV

II:

I got an opportunity to work as a Summer Research Fellow, at IIT Delhi under Prof. Sukumar Mishra through Summer Research Fellowship Program (SRFP) 2019, which was a scheme by the Indian Academy of Science (IAS). In the institute, I learnt what research actually meant. Our guide and the scholars mentored us throughout the internship tenure and were highly motivating.

In the first two weeks my co-interns and I were taught the basics of power systems and to simulate power electronic devices and photovoltaic modules using MATLAB Simulink. Later, we were given individual problem statements to study about and find solutions for. I learnt Lyapunov analysis and back-stepping based nonlinear control. The aim was to design a controller for mitigating voltage imbalance in three phase grid connected inverters with LCL filters and to achieve a seamless transition between grid connected and autonomous operational modes.

The campus provided a wonderful atmosphere for research, with well-equipped labs and learned research scholars, ready to help us at all times. During the research period, taking time to explore the city outside, and playing at their well-maintained sports arenas became my stress busters. On the whole, the experience was invaluable as it helped me learn and understand my subjects better, also leaving a lot of memories to cherish.

Purnima U
Year III

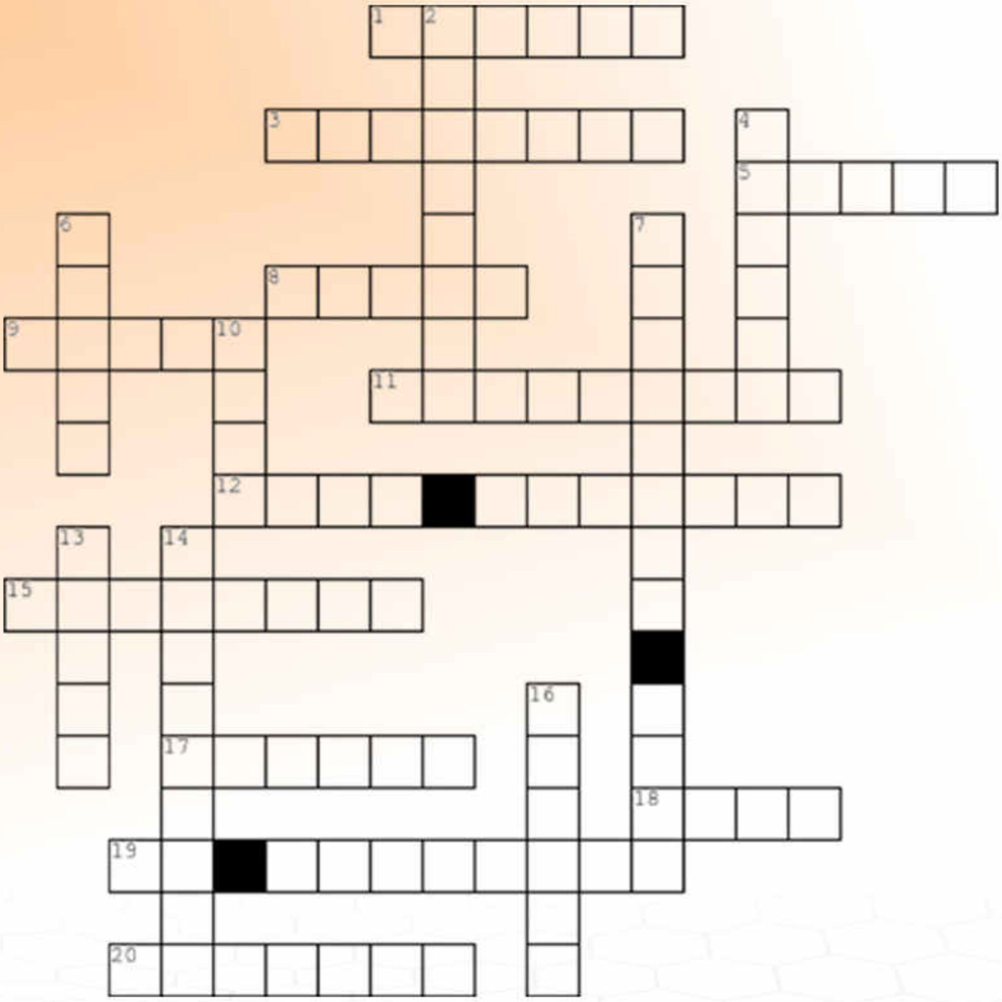
DAAD Internship Experience

I got an opportunity to work at the Cardiovascular Engineering department of the Institute of Applied Medical Engineering, RWTH Aachen as DAAD WISE scholar. So my stay in Germany and my travel was completely funded by the DAAD WISE scholarship. DAAD is a German organization, which promotes internationalization of German institutes of higher education and helps students with various forms of funding opportunities. I had great pleasure working for the project ReinHeart-the artificial heart. My project was to automize a mechanical testbench to calibrate any generic flow sensor, which basically involved design and fabrication of a controller with interactive touchscreen user interface. I got the opportunity to learn a lot of things practically by implementing many things by myself. The researchers at my lab were really helpful and friendly. There was no hierarchy at all. Hardly anyone would control others. People who worked in the lab were driven by their own passion to work and hence they believed in flexible timings as well. The work culture was amazing.

This opportunity helped me to interact with many other students from different countries working on different research areas. These research groups worked in close collaboration with industries and gave so much emphasis on the perfection of a project to the standards of a product. So it was a really good experience to know that something which I worked on and developed would be used by all research groups in their future research work. This internship experience was something which taught me how to live independently. This internship also bestowed me with the opportunity to roam around Europe and enjoy the weekends. So, both from a technical as well as enjoyment perspective, it was a really wonderful and memorable experience.

M P Aradhana
IV Year

CROSSWORD



ACROSS

1. The most efficient device in digital logic families
3. Holding objects tightly to prevent movement
5. Point of perfection for a simple amplifier
8. Code word for 'D' in radio communication
9. Degrees of Truth
11. Incomplete/Inprogress
12. A weed in Transformer
15. A French Engineer who extended Ohm's Law
17. We're too cool to be digital. We're classic
18. Squares formed between Multiple Parallel lines
19. Reactive Components = 0
20. Total added, 'effort'

DOWN

2. Measures the ability to block
4. A popular Anti-virus software
6. Provides a free path by taking a hit of the current
7. Very Mobile, Just like a squirrel
10. Every Picture needs a ___ to be complete and hung on the wall
13. Do not withdraw into your ______
14. Snow, Mountain, Seismic Activity
16. The perfect point in a Loadline

ANSWER:
ACROSS
1.MOSFET 3.CLAMPING 5.OPAMP 8.DELTA 9.FUZZY 11.TRANSIENT 12.EDDY CURRENT
15.THEVENIN 17.ANALOG 18.GRID 19.DC LOADLINE 20.NETWORK
DOWN
2.OHMMETER 4.NORTON 6.SHUNT 7.SQUIRREL CAGE 10.YOKE 13.SHELL 14.AVALANCHE 16. QPOINT

EEE ASSOCIATION


Dr. S Sudha,
HoD, EEE

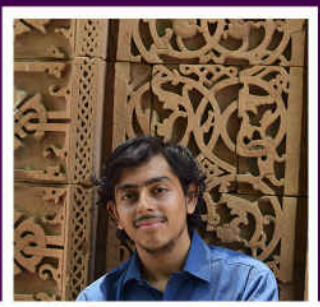

Dr. Manoranjan Sahoo,
Faculty Advisor, EEEA

OFFICE BEARERS


Harinaath Gobi,
Chairman


Umair Chorghay,
Overall Co-ordinator


D C Vivek,
Treasurer


Ananda Rangan N,
Vice-Chairman


Vishnu Dinakaran,
Joint Secretary


Gururagav S,
General Secretary


Devaraj S,
PG Secretary

THE EDITORIAL BOARD