

EPISTEME

NEWSLETTER BY IE E&E



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FOREWORD

BY DR. SAVITHA G. KINI, HOD, ELECTRICAL DEPARTMENT

I am very happy to note that Institute of Engineers (Electrical & Electronics)-Student chapter of MIT is coming out with its newsletter on a regular basis. The newsletter provides a platform for young budding researchers & innovators to contribute articles, showcase their achievements and learn about various new developments in the field of technology. IE (E&E), being a very active technical club of MIT organises regular trips to industries, workshops and other events to promote learning beyond the classroom. The newsletter gives a glimpse of all such activities.

I extend my best wishes to the Editorial team and wish them success in all their future endeavours.

Regards,
Dr. Savitha G. Kini,
HOD, Electrical Department.

FROM THE EDITOR'S DESK

BY ADITI DANKAR

We are delighted to publish the first volume of Episteme, a reinvented version of the annual newsletter published by IE E&E, the official club of Electrical and Electronics Department. "Episteme" is a philosophical term derived from the Ancient Greek word ἐπιστήμη, which can refer to knowledge, science or understanding, and which comes from the verb ἐπίσταμαι, meaning "to know, to understand, or to be acquainted with".

With Episteme, we try to bring to you the latest developments in science and technology from around the world and also the activities in and of the EEE Department. The topics covered in this issue are IoT, and Hyperloop; articles on the recent industrial visits to UPCL, Shakthi Transformer Plant and Varahi Hydel Power Plant and another on the Indwell workshop; and an interview with Mr T. Sudheer Kumar under the heading "Meet Your Teachers". We also have a section on all the events and activities organised by the club during the academic year, followed by Facts and Puzzles. Last, but not the least, we acquaint you with the present board members who are working tirelessly for the betterment of the club.

It is our privilege to put together all these expositions. We would like to convey our deepest gratitude to Dr. Savitha G. Kini, HOD, Electrical and Electronics Department, for writing the foreword for the newsletter. We would also like to thank Mr T. Sudheer Kumar, the faculty advisor of the club, for his guidance along with Mr Vipin Valsan and Ms Shruthi Ramachandra. We also feel glad to acknowledge the kind support and encouragement of all those who contributed directly or indirectly to make this newsletter a success. At last, we would thank all the readers, we hope this will make an interesting read and encourage more students to express their creativity. We welcome any comments or suggestions for the improvement of the newsletter.

Regards,
Aditi Dankar,
Editorial Head, IE E&E.

INTERNET OF THINGS

BY RAHUL RAMAN

What exactly is INTERNET OF THINGS?

Internet of things or as it is commonly referred to as 'IoT' is a modern day technology of interconnecting objects and devices to the Internet. The speciality and uniqueness of this technology lie in the fact that the objects are not merely restricted to the traditional smartphones and computers but the IoT can connect any objects varying from Cars, Home appliances to even heart monitors and other medical devices to the Internet. The Popularity of IoT can be estimated by merely by the fact that it is estimated to attract over 50 billion devices by the year 2020. Going by sheer numbers IoT is definitely the Tech to look out for the future along with Artificial Intelligence, Virtual Reality and other budding and trending technologies.



And, how exactly is IoT beneficial to us?

IoT, as stated earlier, is a technology that connects devices to the internet. The biggest edge this provides to a user is the ease of accessibility since in the present day world, with the spectrum of internet ever rising and with better connectivity and cheaper cost, the IoT provides a perfect platform to control devices with absolute ease from any accessible point without being able to be physically present while being economical at the same time as well. Apart from all this IoT provides a plethora of wide range applications such as 'environmental management', 'smart cities', 'intelligent transportation', 'medical and healthcare' all of which would play as a catalyst for a smart world and a sustainable future.

Applications of IoT:

1. Intelligent Transportation:

The IoT plays a major role in interfacing various communication, information, and control systems like GPS and other systems with the transportation systems. As a result, the progress in transportation system has taken leaps and bounds when we compare the situation to a decade back. Dynamic interaction between these components of a transport system enables inter and intra-vehicular communication, smart traffic control, smart parking, electronic toll collection systems, logistic and fleet management, vehicle control, and safety and road assistance.

2. Environment management:

IoT finds its applications in environment management by providing to offer a variety of traits such as the use of sensors to assist in environmental protection by monitoring air or water quality, atmospheric or soil conditions, and can even include areas like monitoring the movements of wildlife and their habitats.

3. Medical and Healthcare:

IoT has played a crucial role in the advancement of medical and healthcare facilities in the modern day era. It is because of IoT that devices can be used to enable remote health monitoring and emergency notification systems. These health monitoring devices can range from blood pressure and heart rate monitors to advanced devices capable of monitoring specialised implants, such as pacemakers, Fitbit electronic wristbands or advanced hearing aids. Other consumer devices to encourage healthy living, such as connected scales or wearable heart monitors, are also a possibility with the IoT.

Challenges to IoT

Even though IoT has brought along a revolution to modernise the world and has promised a technology to stay for a long time, it does come with a few major drawbacks and challenges the most primary and significant of them to be of "privacy" and "security".

With the ever increasing threat of cyber hackers and other mischievous bugs present on the internet, the IoT will become a foolproof technology only when these issues are sorted out and completely removed from its roots.

To sum it up

With the world ever progressing and new technologies and inventions happening every day the IoT stands here as a knight in shining armour with the potential to become an essential part in the future, the IoT is already metamorphosing the society. With major companies investing big in IoT it won't be long that it becomes a part of our everyday lives soon. With IoT finding its way in real time analytics, machine learning, and embedded systems, it is definitely worth a wait to see how far this technology reforms the future and how much it transforms the world.

HYPERLOOP

BY ADITI DANKAR

Aeroplanes have been the fastest mode of transportation ever since their invention and fast evolution through time, their average speed being around 878 km/hr to 926 km/hr. But, can we travel faster without leaving the comfort of the ground? Hyperloop which is being called the fifth mode of transportation is a figment of Elon Musk's imagination, the founder, CEO and CTO of SpaceX; and co-founder, CEO, and product architect of Tesla, Inc; and is soon to become a reality. The approval of California high-speed rail came as a disappointment to Elon Musk as he could not fathom how the home of Silicon Valley and JPL settle for a train that is one of most expensive per mile and slowest in the world? According to him, if the investment in a project is so huge, the returns that should be equally massive in terms of safety, speed, cost, convenience, immunity to weather and disasters, and usage of power. As a solution, he came up with hyperloop, which he proposed would take the passengers from Los Angeles and San Francisco in about 35 minutes as compared to the 1 hour 25 minutes of flight duration, six hours drive or all day ride by train.

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"WE ARE NOT THE TRAIN, WE ARE NOT THE CAR, WE ARE NOT THE PLANE," SAYS BIBOP GRETA, CHAIRMAN OF HYPERLOOP TRANSPORTATION TECHNOLOGIES.

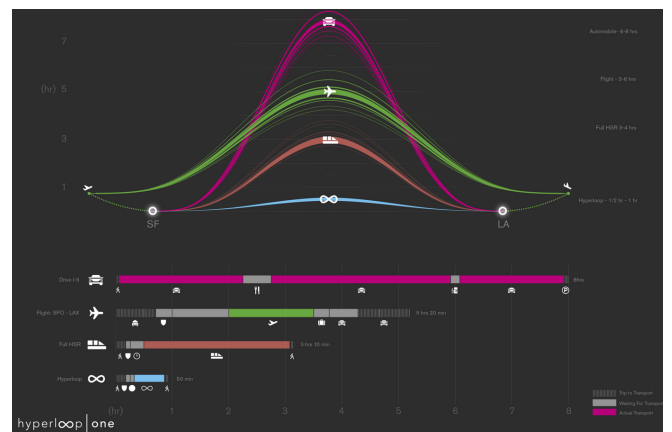
So, what is a hyperloop anyway? And how does it work?

Hyperloop is a proposed mode of passenger and cargo transportation which aims to reduce the time and cost of travel considerably. It comprises a low-pressure steel tube through which pod/capsule like vehicles, 2.23 metres in diameter, can be propelled at both low and high speeds, the maximum speed being 1,220 km/hr.

Hyperloop Transportation Technologies (HTT), an American research company formed by crowdsourcing and led by German entrepreneur Dirk Ahlborn, is one of the leading hyperloop companies. HTT put forth the idea of using linear electric motors to

accelerate the pods to cruising speed and using passive magnetic levitation to help the pods glide above their track. Each pod would have rows of permanent magnets arranged in rectangular arrays, called Halbach arrays, placed on the underside of the pod. The rectangular arrangement would align the magnetic field outwards, i.e., towards the track, and not in towards the capsule. The track, called the Inductrack, would be embedded with closely packed aluminium coils of insulated wire, each forming a closed loop. Inductrack would produce levitating force by inducing an electric current in the track. When the pods move on the track, the magnets in the Halbach array would induce currents in the track's coils, this would generate an electromagnetic field repelling the array which causes the pod to levitate and stay above the ground. Using passive magnetic levitation would eliminate the need for power stations along the track, thus making the system energy efficient.

The transportation by hyperloop would take place in three phases:



Phase 1- Acceleration:

- The thrust force by the linear motor would cause the pod to move forward.
- The forward motion of the permanent magnet would induce a magnetic field.

Phase 2- Levitation:

- Magnetic fields would lift the pod.
- The thrust force would accelerate the pod to cruising speed.

Phase 3- Deceleration:

- The thrust force would be reversed to decelerate the pod.
- Regenerative braking would recharge the battery.

Hyperloop: Earthquake proof and self-sustainable

The pylons supporting the hyperloop tube would have small footprints and sway in the case of an earthquake. The tube, made up of smaller tube sections would not be fixed at any point and have the flexibility to move if the terrain shifts. Since, there would be no constant track that the capsules rely on, the effect of earthquakes can be mitigated substantially.

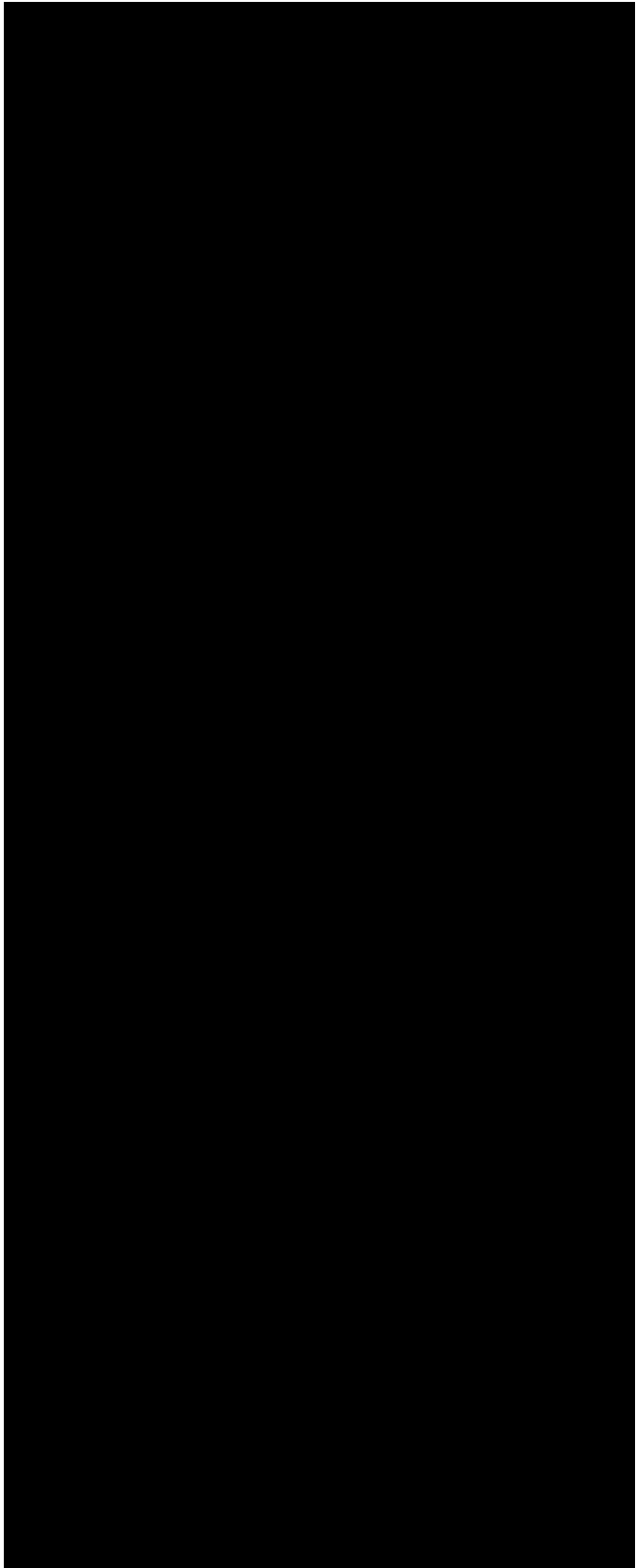
Hyperloop is proposed to have solar cells on the top of the tube, which would generate a far greater amount of energy than needed. The excess energy would be stored in Lithium Ion batteries as suggested by Mr Musk. The stored energy would be used at night and during rough weather conditions, thus making them self-sustainable.

Hyperloop in India

Both HTT and Hyperloop One are in talks with the Indian government and various state governments to build a high-speed travel network.

Hyperloop One that asked Indians, a few months back, to identify the busy routes where the transportation system could be built has chalked out five routes: Delhi-Mumbai, Bangalore-Thiruvananthapuram, Chennai-Bangalore, Mumbai-Chennai and a port connector project. It claims to reduce the travel time between Delhi and Mumbai to 55 minutes and Mumbai to Chennai to 30 minutes, as opposed to 2 hours 10 minutes and 2 hours flight durations respectively.

Hyperloop Transportation Technologies is in talks with five different Indian states, a corporate house for a local partnership, and also an educational institute, besides being in touch with the Union Minister Mr Nitin Gadkari. It has tried to enter the Indian market with a prototype which it asserts is cheaper and more efficient than its competitor's, i.e., Hyperloop One. Once the land and permission are granted, HTT said it can host a passenger within 36-38 months. Though, it later added that it will first need to build a 5-8 kilometre track as a part of its feasibility study.



“Hyperloop has the potential to solve many of today’s most complex long-distance transport issues,” said Gregory Hodkinson, Arup Group chairman, in a statement at the hyperloop testing by Hyperloop One in Nevada.

Although, as promising as it seems, the hyperloop is still in an experimental stage and will require quite some time to materialise. But the day it does, it’ll revolutionise the world transportation.

UDUPI THERMAL POWER PLANT

BY JSVM GAUTAM

At a distance of about forty-five minutes from Manipal Institute of Technology, Udupi Power Corporation Ltd (UPCL), a coal-based power plant, is located to the north of Mangalore, in the village of Yellur, Udupi district. Shambhavi River is the main source of water supply to the plant. This plant is roughly 7 or 8 km from the coast from where the imported coal (mainly from Indonesia) for the power plant is transported to plant through rail line. UPCL is currently owned by Adani Power Ltd.

On 26th October 2016, the club organised an industrial visit to the Udupi Power Corporation Ltd. It was attended by forty-eight third-year students of Electrical and Electronics Engineering department who were accompanied by two faculty members, Mr Vikas Kumar Jhunjhunwala and Mr T. Sudheer Kumar S.

The head of human resources of the company, Mr Rajiv Mistry, took the charge of showing the students around and explaining how the power plant works. There were two generation units and various pressure parts and auxiliaries of different equipment's like boilers, turbines, condensers, cooling systems, air -preheaters, generators, deaerators, boiler drums, electrostatic precipitator, and chimneys to mention a few.

UPCL generates around 2*600MW (1200MW) power. This power is transmitted through a 400kV transmission line to various places in Karnataka. According to power purchase agreement (PPA), 90% of power generated in UPCL is to be sold to Karnataka and other 10% to Punjab state power corporation.

The trip was a very educational experience. This was a place of application of various concepts in real life learned from classroom lectures, revealing how well learning can happen even beyond the four walls of the classroom.

SHAKTHI TRANSFORMERS

BY NAYANIKA NAYAK AND TEJASWI KUMAR

An industrial trip was organised by IE E&E on 25th of January, 2017 for the second years to visit the Shakthi Transformer Plant. The 18,500 sq. ft. area manufacturing facility situated in Manipal with a capacity to manufacture transformers up to 15MVA. The second years were accompanied by the board members of the club, along with two faculties of the EEE Department, Mr James Antony Pinto and Ms Shruthi Ramachandra.

Shakthi Transformers Plant manufactures three phase distribution transformers of 25KVA to 2500KVA, pole mounted transformers of 25KVA to 100KVA, medium power transformers of 500KVA to 5000KVA, BEE 3 star rated transformers of 63KVA and 100KVA and oil filled transformers. They use high conductivity electrolytic grade copper DPC wires/stripes, superior quality low losses core. This requires high insulation for its protection. Hence, fibreglass insulation transformer tube for 10 KV to 220 KV on load tap changer is used. All the transformers manufactured by them are ISO certified.

The visit began with students being taken to a storage room where they were familiarised with the different components that are used in the manufacturing of a transformer. These consisted of various cores and coils, insulating materials, transformer oils, cooling tubes, explosion vents, tap changers and overheads to name a few. The manufacturing area next to the room was a huge one, this was where the different parts of the transformers were assembled and tested for proper functioning. The supervisor of the plant helped in explaining the steps involved in the manufacture of the transformers. Winding and core construction, tapping device assembly, tanking and erection process, drying process, tank fabrication, HT and LT winding termination, painting, oil filling and filtration processes; and different testing processes were explained. The core construction and winding methods were demonstrated to the students from the production line, and from the testing line, the procedures of following tests were explained: short circuit test, voltage test, no load current test, impulse test, accuracy test, power consumption test.

The trip altogether was a wonderful one for the students as they got to learn a lot, and they'll be looking forward to more such opportunities in the future.

VARAHI HYDEL POWER PLANT

BY ABHISHEK BHARGAVA



The Varahi River originates at a height of 730m in the Western Ghats at Hebbagilu, near Agumbe and flows through the state of Karnataka. The Varahi Hydro Electric project, named after the river, consists of Varahi Hydel Station and Mani Dam Powerhouse. Varahi Underground Powerhouse, located in Udupi District, Hosangadi is Karnataka's first underground powerhouse. Mani dam near Manibail village and is constructed across the river. The stages I & II of the Varahi Hydro Electric project has a total capacity of 230MW each. This consists of four 115MW Generating Units at Varahi underground powerhouse and two 4.5MW units in the powerhouse at the Mani Dam site.

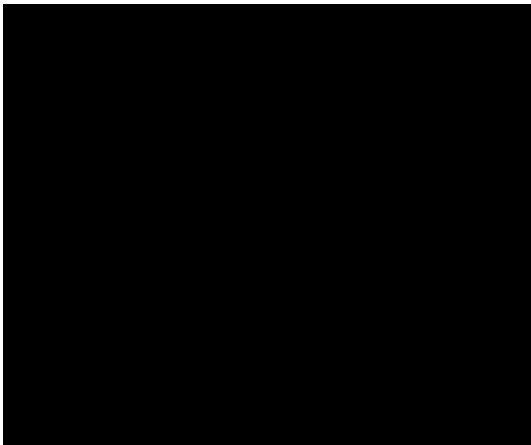
An industrial visit was organized by IE E&E on 27th February, 2017 for the students of 6th semester Electrical and Electronics Engineering, MIT, with Mr Vipin Valsan, Ms Shruti Ramachandra, Ms Bindu S., and Mr Ganesh Kudwa as the faculty coordinators, in order to simulate a better learning and offer a practical understanding of the operation of Hydel Power Plant.

Mr Kiran P., Assitant Engineer, guided the students throughout the visit. After explaining the general layout and different features of the plant, he elucidated the use of penstocks, a channel for conveying and controlling the flow of water to a hydroelectric power station. It was explained how the power produced is transmitted to Mangalore and the neighbouring districts.

The visit was a success, students learned a lot and got the opportunity to compare their classroom learning with the onsite learning.

INDWELL WORKSHOP

BY NEERAJ PRADEEP



The Indwell workshop, conducted from 28th of February, 2017 to 3rd of March, 2017, was IE E&E's endeavour to help train students in the basics of automation technology. The workshop was held by two employees of Indwell Automation, Mr Amit Kumar and Mr Himahshu Kumar, and was supervised by Mr Vipin Valsan and Ms Shruthi Ramachandra, faculty members of Electrical and Electronics Engineering, MIT. The topics covered in the four days included Codesys, GX Developer, HMI/MMI, PLC, and SCADA. All the logistics required, software and hardware, were made available by Indwell Automation.

The first day was an introduction to the automation technology and its various applications. The other activities included making ladder designs in the Codesys software of various applications as taught by the instructors, who were proficient enough to explain much of things with great ease within the first three hours of the four days' workshop.

The next three days included more of practical work. On the second day, participants implemented the LD on the Codesys software by simulating it. Then by making switches and buttons on the software that gave the desired results without simulation. Further, the implementation of the push button and the timer specifications were taught. The instructors took special care to help the attendees grasp the concept of timers.

The instructors brought PLC (MITSUBISHI FX2N64MT) on the third day of the workshop. The PLC which comes under the class of micro PLCs was thoroughly explained with its various parts. The students were taught to take samples on the PLC using a software called GX DEVELOPER, as the PLCs work with that particular software. Attendees were called in to write the code and work on the hardware, and upload the code onto the PLC to get the desired output. Each step being carefully guided by the instructors.

Day four focused on SCADA software and its real life application followed by the merits and demerits of HMI. Interfacing lights & motor with SCADA and simulating them in real time were explained.

After the session on SCADA, a feedback on this workshop was taken from all the participants. Prajwal P.J. and Sanchit Jain gave a feedback speech based on the four days of the workshop. The workshop was ended by a vote of thanks by Shreyash Sinha, the president of IE E&E.

The instructors took a lot of effort in clarifying any doubts and answering all the questions asked by the participants. The four days' (12 hours) workshop covered the basics of automation, the sessions were fun and interactive with a hands-on experience for the students and gave them a good insight into the subject.

MEET YOUR TEACHERS

AN INTERVIEW WITH MR T. SUDHEER KUMAR
BY NAYANIKA NAYAK AND TEJASWI KUMAR

We got an opportunity to interview IE E&E's faculty advisor and one of the most experienced and finest professors in MIT, Mr T. Sudheer Kumar, and here's what he has to say.

Q. We'd like to begin by asking you how long have you been teaching and what has been your experience so far as a teacher?

A. I joined MIT in 1983, 14th November and took a one year break from teaching after 25 years and during that time, I worked for two firms abroad, one was a British firm and the another one called Gulfar, major Indian contracting company. I was always interested in teaching. Many of my friends went out, I was also in an industry in Bombay for some time, but I always had an aptitude for teaching.

Q. How long have you been involved with the club and what does it mean to you?

A. I was participating in the club activities from before but I took over as the faculty advisor around 6 years ago in 2011 and I'm very happy working with the students.

Q. You helped us a lot as a faculty advisor. But, what is your experience as a faculty advisor and how has it helped you?

A. My basic idea is to help and encourage students and club activities help students a lot, we don't have much advantage, though.

Q. What comments do you want to share for the working of the club?

A. We have 54 clubs in MIT if I am right, and I have seen that due to semester based exams and with the number of tests and assignments coming in between they don't have much time for many of the clubs. So, they are unable to give a lot of time for the club activities continuously for four months.

Q. What is your view of the current board?

A. The current board is good, but again, no board of none of the clubs is able to work for a long period of time continuously due to the semester based system.

Q. What initiatives according to you, should we take to make this club better?

A. Once a work is given, the students should start it, and finish it with the same enthusiasm as they started it. So, it requires effort for a longer period of time. For an example, we were conducting a workshop [Indwell Workshop] and Mr Amit Kumar and Mr Himanshu Kumar came [as the instructors], so you have to be there to receive them, you have to assist them, then in the class also you have to help them, until the end, and to see that an appreciation letter is sent back to them. And a lot of was there for arranging this workshop, so you had to do it from the very beginning including the paperwork, till you finished the paperwork.

Q. Compared to others clubs, the involvement of faculty advisor much more in our club. What are your views on it?

A. This is because the type of work involved sometimes. See, for example, Shakti Transformer visit, even I cannot make arrangement for getting the permission to visit it, so we have to go through HOD, through some contact, we have to get the permission so that we can arrange it. Then, of course, you have to know how to arrange for a university bus, I cannot expect my students in a short duration to know all this. So, that way if we involve teachers, everything will be faster. But I know, if you ask Abhishek Anand, the treasurer, he will tell that he knows what to do with the money, how to get all the things.

Q. Why don't we recruit first years for the working committee sir of our club?

A. The thing is when you come to the college, you have to settle down, you have to take care of your education. And the first part is you are studying many different subjects in the first year, so you settle down with that and with that background, at least BET background they'll come to the second year. Then, second year onwards is the correct time for a student to get involved in other activities. I don't think that is the correct decision [other clubs recruiting students in the first year] because I have talked to many students...

Q. But sir, that hampers the popularity of the club, would you like to comment on that?

A. I want to ask another question when we recruited this time, we got only 27 students, why? If they are really interested and if we are doing enough work, why they cannot join? It is not catching the men for this club. Here the strength is not in the number, the strength is in doing activities by the people who are interested. Really interested people will join even in the third semester. I believe all the clubs must work in this manner.

Q. Majority of clubs recruit students from different branches. The thing is when students from different branches work together, there will be different ideas, different backgrounds and more scope for innovation? Why don't we take in students from other branches as well?

A. According to me, when you are having so many other clubs where you have the opportunity, why we cannot be different from other clubs. It is the one which is different, that's all. Actually, limited students in the club means better interaction with the students as well. We are not only being electrical department faculty, I feel that I am closer to electrical students.

Q. What changes has the clubs seen over the years, since you became the faculty advisor?

A. Now we have more number of activities. And if you take this year's work, we have done a good amount of work altogether, especially this semester. Last semester we had a limitation because of the NBA visit, we had to run behind them, a lot of work was there for all the faculty. I told this earlier, every week you can conduct a programme, every week, and the thing is you have to start from the beginning and finish completely including accounting and paperwork.

Q. What is your opinion of the man-com members?

A. Man-com members are good, I hope they'll do better next year. Now you are being trained, we are going in a systematic manner, you'll become board members next time. For now, you have to learn the various aspects of working under somebody. That's the spirit.

EVENTS OF YEAR

COMPILED BY TEJASWI KUMAR AND NAYANIKA NAYAK

1. A student interaction session was conducted on 9th October 2016 by IE-E&E where the 7th semester students interacted and shared their experiences with the 5th year students. The topics of discussion ranged from programme electives to placements and higher education; with lots of tips and advice.

ELECTRIFIC

2. Electrific, organised by the club every year during TechTatva (12th to 15th October 2016) is a group of events aimed at testing the knowledge of students in basic electrical and electronics, through quizzes and various competitions. The events conducted this year consisted of the following:

1. **Chess-O- BOT:** An event that required the participants to build BOTs that could be controlled via a Bluetooth module to traverse through a giant chess board as a Knight.
2. **Inalambrico:** 'Wireless' in Spanish, needed its participants to paint a conductive circuit with conductive paint and implement the problem statement.
3. **Livewire:** The event was to test the knowledge of home wiring and practical usage of electrical wiring among its participants.
4. **Instincts:** An online marathon which included both technical and non-technical questions in the ratio 3:1.

FIELD TRIPS

3. Udupi Power Corporation Limited, Udupi, 26th of October, 2016: A trip organised for 5th semester EEE students. The trip included 49 students and was supervised by Mr T Sudheer Kumar and Mr Vikas Kumar Jhunjhunwala.

4. Shakthi Transformers Plant, Manipal, 25th of January, 2017: An industrial trip organised by the club for 4th-semester students, who were accompanied by the board members of the club, along with two faculties of the EEE Department, Mr James Antony Pinto, and Ms Shruthi Ramachandra.

5. Varahi Hydrel Power Plant, Varahi, 27th February 2017: A field trip for 6th-semester students, with Mr Vipin Valsan, Mrs Shruti Ramachandra, Mrs Bindu, Mr Ganesh Kudwa as the faculty coordinators.

WORKSHOPS

6. A three days' workshop was organised by the club in association with Indwell Automation. The workshop was aimed at developing the skills of the students and making them familiar with certain aspects in the electronics field. The topics taken during the 3-day workshop were:

1. PLC
2. SCADA
3. AC DRIVE
4. INTERFACING PROJECT

DID YOU KNOW?

COMPILED BY RASHI BARNWAL

01

Fireflies produce light using chemical energy from their food. This light is even more efficient than that of one light bulb. Other creatures possess this magic too, like the deep sea squid and glow worms. An electric eel, on the other hand, does not glow, but it can provide a shock of 600 volts, that is double the 220 volts which can be safely plugged into a socket in your home.

02

Thomas Edison built the first power plant, and in 1882 his Pearl Street Power Station sent electricity to 85 buildings. People were initially afraid of electricity and parents would not let their children near the lights.

03

One Google search produces about 0.2 g of CO₂. But since you hardly get an answer from one search, a typical search session produces about the same amount of CO₂ as does boiling a tea kettle. Google handles about 1 billion search queries per day, releasing some 200 tonnes of CO₂ per day.

04

Before the three phase system, two-phase machines were used. As a matter of fact, the generators installed at Niagara Falls in 1895 were the largest electric generators of that time and were two-phase machines.

05

Geomagnetic storms can possibly create a massive blackout and power failure because they induce currents (almost dc) in the long transmission lines affecting the power transformers. Transformers connected to such lines face problems like core saturation and overheating. In extreme cases, the heat can disable or destroy them even inducing a chain reaction that can overload the transformers all through the system.

06

Total number of people who use YouTube: 1,325,000,000
Hours of video uploaded to YouTube every minute: 300 hours
Number of videos viewed on YouTube every day: 4,950,000,000
Number of unique visits to YouTube every month: 900,000,000
Total number of hours of video watched on YouTube each month: 3.25 billion hours

Source: Internet

CROSSWORD



Across

7. Unit of electrical power, named after the Scottish inventor of the steam engine
8. a rotating machine that transforms electrical energy into mechanical energy
9. The kind of electricity you create by rubbing a balloon on your head
13. Atom or group of atoms that carries a positive or negative electric charge as a result of having lost or gained one or more electrons
14. Emission of radiant energy in the form of waves or particles
15. It transmits electricity, like copper
16. Opposition to the passage of an electric current
19. Elementary particle consisting of a charge of negative electricity
20. Smallest particle of an element that can exist either alone or in combination
21. Uncharged elementary particle
22. Electric potential or potential difference

Down

1. Elementary particle that carries a positive charge
2. Electromagnetic radiation in the wavelength range including infrared, visible, ultraviolet, and X-rays
3. Device for making, breaking, or changing the connections in an electrical circuit
4. Flash produced by a discharge of atmospheric electricity
5. Complete path of an electric current including the source of electric energy
6. Inventor of the electric light bulb
10. Force acting on particles of matter, tending to draw them together
11. Electrical charge with more protons than electrons
12. Electrical charge with more electrons than protons
15. Electrical flow through a conductor
17. Definite quantity of electricity
18. Unit of electrical resistance

Source: Internet

SOURCES

IOT

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HYPERLOOP

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