PRIYADARSHINI ENGINEERING COLLEGE
VANIYAMBADI

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issue 6

MECHXION 2K18

A Magazine of MECHANICAL ENGINEERING

WHAT IS INSIDE

ABOUT THE INSTITUTE

Priyadarshini Engineering College, the flagship of Jai Barath Charitable Trust, was established in 1995 at Vaniyambadi in Vellore district of Tamilnadu. The college has been approved by All India Council for Technical Education, New Delhi and affiliated to Anna University, Chennai. Priyadarshini Engineering College situated in the rural area of Vaniyambadi, Vellore District is committed to the vision of developing itself into a multi campus, Inter - disciplinary Institution of Excellence through symbiotic efforts and innovative practices of management and faculty to provide the student with an ambient academic environment, ideal for the pursuit of knowledge and development carrier.

VISION OF THE INSTITUTE

To inculcate in the young rural minds the aptitude to compete with the world class technocrats.

MISSION OF THE INSTITUTE

1. To instill technical skills to compete in the sustainable world.
2. To impart holistic value based technical education.
3. To intensify research and development (R&D) activities in technological development.
4. To imbibe core values of love for motherland, performance of duty, compassion, tolerance, honesty and integrity.

MOTTO

PERSEVERANCE, ENDURANCE, COMMITMENT

"கற்றலும், கற்றவை கேட்டலும், கேட்டதன்கண் நிற்றலும்"

ADMINISTRATOR'S MESSAGE

Greetings to all the readers of this magazine "MECHXION 2K18".I congratulate the faculty and the students of Mechanical Engineering Department of our College on the occasion of release of the their Fourth Department magazine "MECHXION 2K18".Right from its establishment, thecollege has been contributing to provide this country, the best engineering brains and talents. They amply demonstrate the communication skills, poetic,imagination, creativity, humanism, technical competence, and patriotism of the contributors.I wish the initiative, and I hope it will contribute to their professional and career development.

PRINCIPAL'S MESSAGE

Today education means much more than merely acquiring knowledge. I am very happy that the department of Mechanical Engineering is releasing their Department magazine "MECHXION 2K16" which encompasses the Activities of the department, Technical & General articles of the faculty and students for the academic year 2017-18. The magazine contains articles of various like art, jokes, inspiring stories, latest news from the engineering world, etc.Magazines in general will help the faculty and students to learn the latest developments in the fields Mechanical Engineering I owe my hearty appreciations to the HOD, faculty and students of the department for their sincere efforts to release the magazine to highlight the technical advancements in the branch of Mechanical Engineering.

HOD'S MESSAGE

I am happy to inform that our pride rests in the department Magazine "MECHXION 2K18" which highlights the academic and non-academic activities of both staff and students of the department. As a H.O.D, I wish to take the opportunity to assure you that our team will try our best to maximize Student's participation in the department. I hope we will be a good engineer outside this institution also, loyal to work, pray for hardship to solve every problem of this society also beginners will read this magazine and may get inspired and try to improve departmental activities, forma bond of love with devotion to their education and study place with senior students. In this race for regular students it's a challenge to do better and better than before and achieve new

EDITORIAL BOARD'S MESSAGE

Dear Readers,

It gives us great pleasure to bring you the Mechanical Engineering Magazine "MECHXION 2K18" which will be released every year. The name and fame of an institute depends on the caliber and achievements of the students and teachers. As we all know, a department Magazine mirrors a department-Its vision and mission.It will serve to reinforce and allow increased awareness, improved interaction and integration among all of us. Usually we fail to appreciate the good deeds of many people and activities that happen around us as we are engaged in irrelevant talks and assumptions. We would like to place on record our gratitude and heartfelt thanks to all those who have contributed to make this effort a success. We profusely thank our honorable justice Mr.V.Rengasamy and Principal Dr.P.Natarajan for giving support and encouragement and a free hand in this endeavor. I sincerely hope that this edition makes for an interesting read. Please feel free to offer any suggestions for Improvement

ABOUT THE DEPARTMENT

The Department of Mechanical Engineering came into being in the year 1999 and the first batch of Mechanical Engineers graduated in the year 2003.The Department was first started with the intake strength of 40 seats in 1999. After, the intake was increased to 60 seats in 2004.At present the Department offers 120 seats from 2014. The Department has both undergraduate and postgraduate courses in Mechanical Engineering and Design.In the year 2013 Post Graduate Programme in Engineering Design was launched. The Department has laboratory and workshop facilities with modern sophisticated equipment to carry out research in all areas related to Mechanical Engineering. Throughout its history, the department has provided a strong technical foundation to prepare students to meet the changing needs of industry.

VISION OF THE DEPARTMENT

To produce competent Mechanical Engineers specifically from rural based population to confront the latest technological innovations.

MISSION OF THE DEPARTMENT

1. Imparting quality education and training to nurture competitive Mechanical Engineers.
2. Motivating innovations in the various fields of Mechanical Engineering with better infrastructure facilities to meet the industrial and societal requirements.
3. Inculcating ethical values in their careers for their successful life.

PROGRAMME EDUCATIONAL OBJECTIVES(PEOs):

PEO1. Core Competence:

Graduates will Excel in their Professional Career with Strong Fundamental Technical Background.

PEO2. Breadth:

Graduates will be able to demonstrate their Technical Skills in Designing, Fabrication and Installation of New Mechanical Components.

PEO3. Professionalism:

Graduates will be Competent to Exhibit their Multidisciplinary Skills in Related Fields of Mechanical Engineering.

PEO4. Teaching & Research:

Graduates will Pursue Higher Studies in Mechanical Related Disciplines to work in the field of Teaching and Research.

PROGRAMME OUTCOMES(POs):

PO1: Engineering Knowledge:

Apply the knowledge of mathematics, science, engineering fundamentals and core engineering for complex engineering problems.

PO2: Problem Analysis:

Identify, formulate and analyze complex engineering problems.

PO3: Design & Development of Solutions:

Design and develop solutions for complex engineering problems.

PO4: Investigations of complex problems:

Use research based knowledge to conduct investigations of complex problems.

PO5: Modern Tool Usage:

Apply appropriate modern tools and techniques to tackle Mechanical Engineering problems.

PO6: Engineer and Society:

Provide solutions to Mechanical Engineering problems relevant to societal needs.

PO7: Environment and Sustainability:

Acquire contemporary knowledge to sustain in the ever changing environment.

PO8: Ethics:

Apply professional ethics.

PO9: Individual and Team work:

Exhibit individual and leadership qualities in multidisciplinary group.

PO10: Communication:

Comprehend and communicate effectively in a team.

PO11: Lifelong Learning:

Engage independently in lifelong learning.

PO12: Project Management and Finance:

Plan and manage a project in a cost effective manner.

STUDENT CORNER

1. A GOOD STUDENT

A-Always liked by teachers

G-greets everyone with a smile

O-obedient to teachers

O-on time to college

D-dresses nearly

S-study with interest.

T-treats everyone as a friend

U-understands everything that is taught

D-dies homework daily

E- Eager to know new things

N-never misbehavior

T-talks less in class

2. EXCELLENT TEACHER

T-Tolerance
E-education

A-affection

C-character

H-honesty

E-experience

R-role model

3. SIX ETHICS OF LIFE

Before you pray believe

Before you talk listen

Before you react think

Before you spend earn

Before you quit try

Before you die live

[1,2,3]R.RISHIKESAVAN
Third Year Mech

4.JOKES

Teacher: anyone who thinks he's stupid may stand up.

nobody stands up

Teacher: I'm sure there are some.

Little johnny stand up.

Teacher: ohh. Johnny you think you're stupid?

Little johnny: "no…. I just feel bad that you're standing alone…."

S.SURIYA PRAKASH
Third Year Mech

5. MY DAD

My father is a man like no other. He gave me life, nurtured me, taught me, dressed me, fought for me, held me, shouted at me, kissed me, but most importantly he lived me unconditionally.

There are not enough words I can say to describe just how important my father was to me, and what a powerful influence he continuous to be.

T.SRIDHAR
Third Year Mech

6.THOUGHT ABOUT MOTHER

I believe inLove at first sight
BecauseI've been livingMy mother since I opened my eyesA mother's
Heart is a Special place Where Children always have a homeMothers love is peace It need not to be acquired it need not be deserved.

R.MADAN
Third Year Mech

7.THOUGHTS ABOUT FRIENDS

BEST FRIENDS

B-belive in each ohers

E-exchange silly stories

S-share favorite clothes

T-tell it like it us

F-find the answer

R-rely on each other's

I-inspire bravery

E-encourage dreams

N-never stop caring

D-devise crazy schemes.

S-stands by each other.

8.YOUR KIND OF FRIENDSHIP

It takes more than caring

to be a real friend,

The nature of friendship

requires a bund

of warmest compassion

and love deep and true

to reach and to comfort

the way that you do.

That's why I'm so grateful

Because I can see

That your kind of friendship

Is priceless to me.

One thought of you

Is all it takes to

Make me smile

thinking of you always……

7.8B.VINITHKUMAR
Third Year Mech

9.நட்பு

வாழநினைத்தபோது
வாழ்க்கையைதொலைத்தேன் ,
எழுதநினைத்தபோது
எழுதுகோலைதொலைத்தேன் ,
கவிதைஎழுதநினைத்தபோதுபொ
ய்மையைதொலைத்தேன் ,
நண்பனே
!எண்ணில்எல்லாம்தொலைந்தும்நீ
மட்டும்தொலையாதிருக்கும்மர்மம்
என்ன ! இதுதான்நட்பு …
நண்பன்தாய் ,
மனைவிகூடவரமாட்டாள்உன்இறு
திஊர்வலத்துக்கு ,
உன்நண்பன்வருவான்ஊர்வலத்தி
ல்கலந்துகொள்ளஅல்ல ,
உன்னைசுமந்துசெல்ல …..,

10.அம்மா

அரிச்சுவடியைஅழுத்திசொன்னது
ம் ,

அடிப்பட்டதில்பயந்துசொன்னதும் ,

அரைதூக்கத்தில்அலறிசொன்னது
ம் ,

ஒரேவார்த்தைதான் ,

அம்மா

9.10M.VASANTH
Second Year Mech

11.Proverbs by Legends

வெற்றிஇல்லாமல்வாழ்க்கைஇல்லை

வெற்றிமட்டுமேவாழ்க்கைஇல்லை

-பில்கேட்ஸ்

மிககுறைவாகபேசுபவர்கள்

உலகின்மீகசிறந்தமனிதர்கள்

-ஷெக்ஸ்பியர்

யார்என்னசொன்னாலும்

உன்கொள்கையைமாற்றிகொள்ளாதே

ஒருசமயம்நீமாறினால்

ஒவ்வொருமுறையும்

நீமாறவேண்டிஇருக்கும்

-கண்ணதாசன்

முடிந்தால்சமாதானமாகஇரு

ஆனால்என்னநேர்ந்தாலும்

உண்மையைமட்டும்கூறு

-மார்ட்டின்லூதர்கிங்

தொழில்எவ்வளவுகீழ்தனமாக

இருந்தாலும்பரவாயில்லை

சொஅம்பேறியாகஇருப்பதுதான்அவமானம்-
லியோடைல்ஸ்டாய்

கண்பார்வைஅற்றவன்குருடன்அல்ல

தனகூட்டங்களைஉணராதவன்குருடன்-
காந்திஜி

இழந்தஇதயத்தைபிடித்துகொள்ளலாம்

இளந்தகாலத்தைஒருபோதும்பிடிக்கமுடியாது-
நெப்போலின்

12.அன்பின் தன்னம்பிக்கை

மத்தவர்களுக்குஆறுதல்சொல்லும்போது

இருக்கும்தைரியம்தனக்குதேவைப்படும்போது

இருப்பதில்லை
.நண்பர்கள்தவறுசெய்தல்மன்னித்து

விடாதேமறந்துவிடுஏனெனில்அவர்கள்உன்

உறவுகள்அல்லஉணர்வுகள்…..,!

எப்போதும்மறக்காமல்இருப்பதுஅன்புஅல்ல

என்னநடந்தாலும்வெறுக்காமல்இருப்பதுதான்

உண்மையானஅன்பு .

எதிர்பார்ப்புஏமாற்றம்தரும்
,அதுஉண்மை

அதற்க்காகஎதிர்பார்ப்புஇல்லாமல்வாழமுடியாது .ஆனால்

யாரிடம்எதிர்பார்க்கவேண்டும்என்றுதெரிந்துகொள்ளுங்கள்

என்றுஉனக்காகக்கண்ணீர்சிந்தும்ஒருவனை

இழந்துவிடாதே
.என்றும்உன்னால்கண்ணீர்சிந்தும்

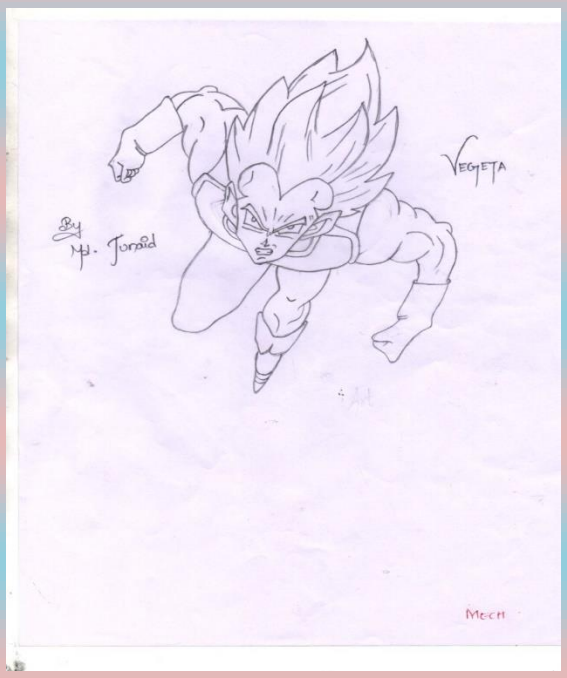
ஒருவனைஉருவாக்கிவிடாதே .

M.UDHAYAKUMAR
Second Year Mech

13.நிலா

வானில்மெருகிட்ட
வெள்ளித்தட்டைஇருந்தாலும் ,
கற்கள்பாரிகள்நிரம்பியதை
இருந்தாலும் ,
சூரியனின்பிரதிஒளிஎன
தெரிந்திருந்தாலும் ,
முழுநிலாதேய்ந்துபிறை
நிலவும்எனஇருந்தாலும் ,
கவிகள்உன்புகழ்பாடி
ஓய்ந்திருந்தாலும் ,
உன்உதயம்மலர்களுக்கு
மலர்ச்சியாகஇருந்தாலும் ,
காதலர்களுக்குசாட்சியாகநீ
இருந்தாலும் ,
உன்னைகாணும்நேரமெல்லாம்
விந்தைதான் !
மனிதனைமயக்குவது
மாயதோற்றம்தானோ ?

A.RAHUL
Second Year Mech

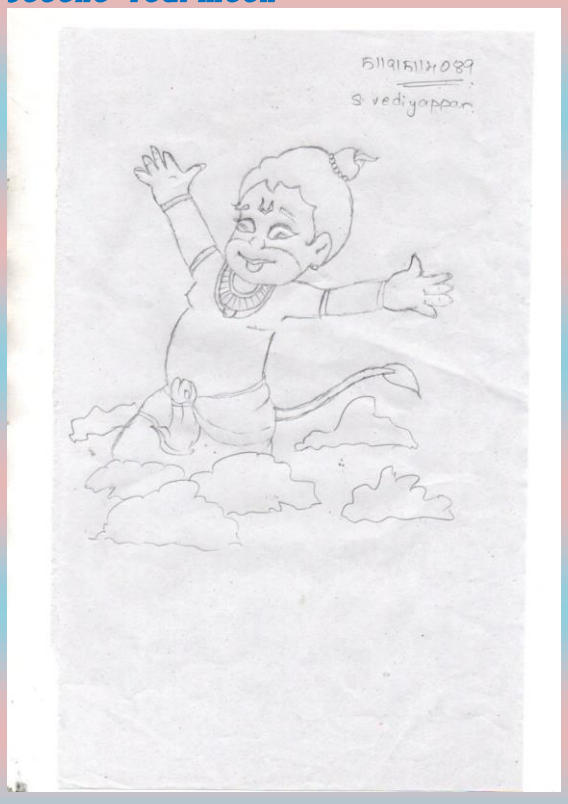


MD.JUNAID
Final Year Mech

A.MOHAMMED RAYAN
Second Year Mech

A.MOHAMMED RAYAN

Second Year Mech



S.VEDIYAPPAN

ThirdYear Mech

14.NEVER HAVE TENSION

The moment you are in tension,
You lose your attention
Then you are in total confusion,
And you will feel irritation
And you will spoil your personal relation,
Ultimately you won't get co-operation
Then there will be complication
Your blood pressure may also rise caution
And you may have to take medication,
Instead understand the situation.
And try to think about the solution,
Many problems will be solved by discussion.
Which will work out better in your profession.
Don't think it's my free suggestion
This is only for your precaution
If you understand my intension
Then you will never again have tension.

For never we will find such a pleasure.

P.BHARATH

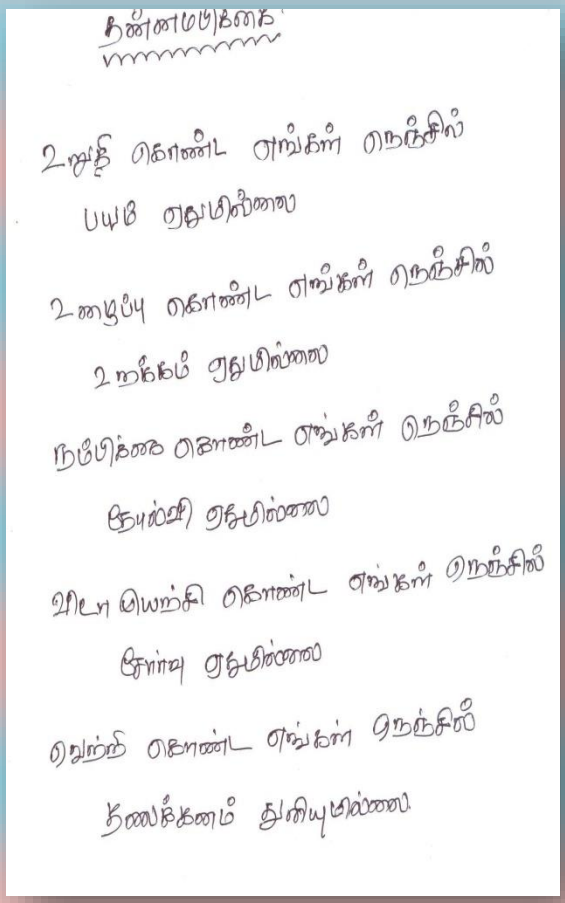
ThirdYear Mech

15.JOKE:

Teacher:u call ur MOTHER as MUM then what will u call ur mother's elder sister and younger sister?
BOY:SimpleIwill call elder as "MAXIMUM" and younger as"MINIMUM".

T.VIGNESH

Third Year Mech



தீண்ணமுடிக்கை

உழுதி கொண்ட எங்கள் நெஞ்சில்
பயம் எதுமில்லை

உழைப்பு கொண்ட எங்கள் நெஞ்சில்
உறக்கம் எதுமில்லை

நம்பிக்கை கொண்ட எங்கள் நெஞ்சில்
ஆயம்பி எதுமில்லை

விடா முயற்சி கொண்ட எங்கள் நெஞ்சில்
சோர்வு எதுமில்லை

தெளிந்த கொண்ட எங்கள் நெஞ்சில்
தீணக்கணம் துணியுமில்லை

K.Ajith

Final Year Mech

R.RAJA

Third Year Mech

R.Vignesh

Final Year Mech

S.P.Prabhu

Third Year Mech

16.FACTS ABOUT INDIA

1.First Mining of Diamond was DoneinIndia

2. Ben Kingsley was bornin Indian descent

3. Adolph HitlerWas BigFanofMajorDhyanchand

4.Shakuntla Devi The HumanCalculator

5. Sugar was FirstConsumed inIndia

6. Largest ProducerofMilk in World

7. Most Vegetarian Friendly Country in World

8.Second Largest English Speaking country in the world

9. First Indian Rocket was Transported on Cycle

10.Switzerland's Science Day is Dedicated to APJ Abd...

11.Water On Moon was Discovered by Chandrayaan

12.Concept of Shampoo was Invented in India

13.Earth Circumference=Wires Used in BandraWorli Sea Link

14.India Have aFloatingPostOffice

15.Snakes and Ladders is an Indian Invention

16.Bangladesh National Anthem is Written by Rabindranath Tagore.

K.Harikrishanan

Third Year Mech

17.AUTHORITY

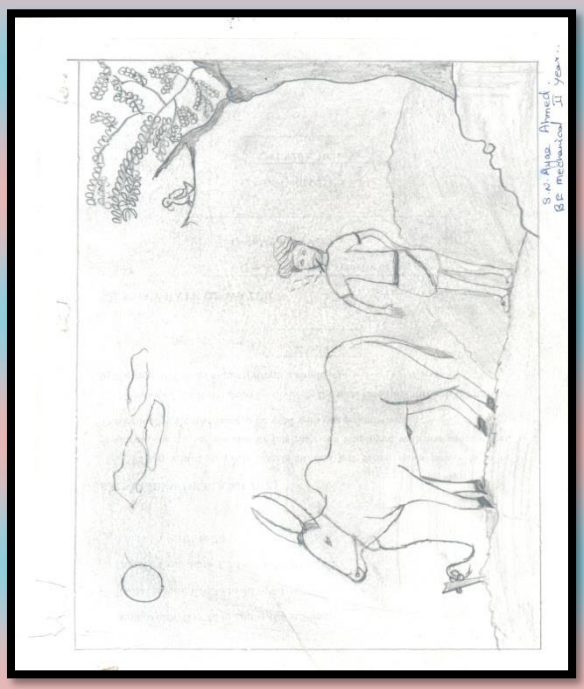
Is not when we start speaking big things,
It is when we start understanding small things….

The worst regret we have in our life,
is not for the wrong things we did,
but for the thousands of rights things we did, for the wrong people….!!!

Relationships are harder now because,
Conversations becomes texting,
Arguments becomes phone calls,
And falling because status updates.

M.Kaliappan

Second Year Mech



K.Kalaiarasan

final Year Mech

18.BENEFITS OF YOGA

Yoga is a group of physical, mental and spiritual practices or disciplines which originated in ancient india. There is a broad variety of yoga schools, practices and goals in Hinduism, Buddhism and Jainism among the most well-known types of yoga are Hatha yoga and Raja yoga.

The origins of yoga have been speculated to date back to pre-vedicindian traditions; it is mentioned in the rigveda, but most likely developed around the sixth and fifth centuries BCE, in ancient india's ascetic and sramana movements.

Yoga gurus from india later introduced yoga to the west following the success of swami Vivekananda in the lake 19th and 20th century. In the 1980s, yoga became popular as a system of physical exercise across the western world. Yoga in indian traditions, however is more than physical exerices, it has a meditative and spiritual core one of the six major orthodox schools of Hinduism is also called yoga.

S.Saikumar
Third Year Mech

19.PARENTING TIPS

*Parents should teach their how to respect the elders and how to tell them.

*Parent should grow their children by teaching them good moral.

*The children should be taught to help other when they are in need.

*Parents should give their children, the freedom to freely discuss their problem.

*Parents should restrict their children when they are out of their way.

S.Jagankumar
FinalYear Mech

20.FACEBOOK & WHATSAP

This networking giant is the second most used website in the world and has an online traffic of about 900 million across the world.

This website is not only a platform for networking but is also useful in bettering education, making news more accessible, advertising and promoting businesses, etc,.

WHATSAPP

Positive effects of whatsapp:

Reduces expensive: unlike SMS that are charged, WhatsApp messaging is free. You can also national roaming and international voice and video calls on any whattsapp number for free using the internet.

Negative effects of whatsapp

No cross compatibility: it's a restrictive platform, meaning you can only connect to those people to who have the sameapplication installed in their smartphone.

Also you can use whatsappwithout the internet connection.And you cannot transfer the data your phone inbox. Once the chat is lost, you can't retrieve it…

S.Naveenkumar
Third Year Mech

21.CANCER PREVENTION

The cancer prevention is defined as the take charge by making change such as eating diet and getting regular screenings.

Then the process is seven types will be using in the methods.

1.Don't use tobacco

2.Eat a healthy diet

3.Maintain a healthy weight and be physically active

4.Protect yourself from the sun

5.Get immunized

6.Avoid risky behaviors

7.Get regular medical care

DON'T USE TOBACCO:

Using any type of tobacco puts you on a collision with cancer.smoking has been linked to various types of cancer-including cancer of lung,mouth,throat,bladder,cervix and kidney.Chewing tobacco has been linked to cancer of the oral cavity and pancreas.

Avoiding tobacco to stop it is one of the most important health decisions you can make.It is also an important part of cancer prevention.

EAT A HEALTHY DIET:

Although making healthy selection at the grocery store and at meal time cant guarantee cancer prevention,it might help reduce your risk.

EAT PLENTY OF FRUITS AND VEGETABLES:

Base your diet on fruits and vegetables from plant sources.such as whole grains and beans.

AVOID OBESITY:

Eat lighter and linear by choosing fewer high calorie foods including refined sugar and fat.

LIMIT PROCESSED MEAT:

A report from the international agency for research and cancer,the cancer agency of world health organization concluded that eating large amounts of processed meat can slightly increase the risk of certain types of cancers.

MAINTAIN A HEALTHY WEIGHT AND BE PHYSICALLY ACTIVE:

Maintaining healthy weight might lower the risk of various cancer.Including cancer of the breast,lung and kidney.

Physically activity counts too in addition to helping you control your weight,physical activity on its own might lower the risk of cancer.

PROTECT YOUR SELF FROM THE SUN:

Skin cancer is one of the most common kinds of cancer and one of the most preventable.Try these tips.

AVOID MIDDAY SUN:

Stay out of the sun between 10 am and 4 pm, when the sun rays are strong.

STAY IN THE SHADE:

When you out door stay in the shade such as the possible sun glasses and broad brimmed hat help too.

A.Vinoth
Third Year Mech

22.BEAUTY TIPS HOMEMADE

The Remedies

1.Yougurt and lemon

2.Milk lemon juice and honey

3.Milk and saffron

1.Yougurt and lemon:

What you need:

One table spoon of fresh and unflavoured yogurt.

One tea spoon of lemon juice.

What you need to do:

*Mix the yogurt and lemon juice throughtly.

*Apply the resultant paste to your face and leave it one for about 20 minutes.

*Wash your face with cold water.

2.Milk lemon juice and honey:

What you need:

*One tea spoon of milk.

*One tea spoon of lemon juice.

*One tea spoon of honey.

What you need to do:

*Mix the ingredients well till you get a smooth paste even consistency.

*Apply the paste to your cleansed face and keep it on for about 20 minutes.

*Rinse your face with cooled water.

3.papaya and fullers earth:

What you need:

*One teaspoon of papaya pulp.

*One teaspoon of fullers earth.

What you need to do:

*Mix the ingredients well till you get a smooth paste even consistency.

*Apply the paste to your cleansed face and keep it on for about 20 minutes.

*Rinse your face with cooled water.

B.Praveenkumar
Final Year Mech

23.AIR POLLUTION SUBSIDY SCHEME FOR NCR

People residing in delhi and surrounding areas have been facing the issues of air pollution commoners never leave home without a mask as the percentage of suspended particles in air is way over the normal mask. The situation become so bad that the state authority banned burning fire crackers during Diwali. Finally the central government stopped in with the new air pollution scheme for NCR.

Launched details of the scheme:

The official announcement of the new program was made by the present finance ministry of the country, Arunjaitely. During the official union budget of 2018. It took place on the 1st of February .the FM said that it will be implemented as soon as possible.

Implementation process:

There is high percentage of farms around the area in question. That way they can added necessary minerals in the soil and also clear the area within notime.

Area to be covered under the scheme:

Air pollution is not something that has been creating problems in the life of people living in delhi and surrounding area alone. The state government of surrounding areas like Punjab, uttarpardesh and Haryana will also implement these evasive measures.

Conclusion:

The lives of million will be at the state if the central the local authorities fail the curb the environmental problem. People need fresh air to brought in otherwise they will not be able to survive. This pollution preventive policy will assist the government in providig satisfactory living conditions for the commoners.

M.N SHEHRAN BASHA
Second Year Mech

24.LAW OF SUCCESS

There is no more dangerous person
Dangerous to himself and to others than
The person who passes judgment
Pretending to know facts.
To love praise, but not worship it, and fear
Condemnation but not go down under it,
is evidence of a well balanced personality.
The person who sows a single beautiful thought in the mind of another,
renders the world a greater service than that
rendered by all the fault finders combined.
There is no lazy man. What may appear to be
a lazy man is only an unfortunate person
who has not found the work for which he is best suited.
Congratulate yourself when you reach that degree of wisdom which prompts
you to see less of the weakness of others and
more of your own, for you will then be walking into the future of really great.

G.Ranjithkumar
final Year Mech

25.A FAMOUS INSPIRATIONAL SPEAKER SAID:

“Best years of my life were spent in the arms of a woman, who wasn‟t my wife.”

Audience was in shock and silence.
He added: “She was my mother.” (A big round of applause and laughter)

A very daring husband tried to crack this at home. After dinner, he said loudly to his wife in the kitchen: “Best years of my life were spent in the arms of a woman, who wasn‟t my wife”

Standing for a moment, trying to recall the second line of that speaker…

26.VOICE OF A STUDENT

You Demand Concentration !
English is composition
Mathematics is calculation
History is civilization
Economics is production
Biology is classification
Chemistry is preparation
Commerce is co-ordination
Accountancy in verification Physics is purely Derivation
Physical Education is Demonstration
Computer Science is computation
Examination though an irritation
For the young students
Ascertaining the victory
Is not possible

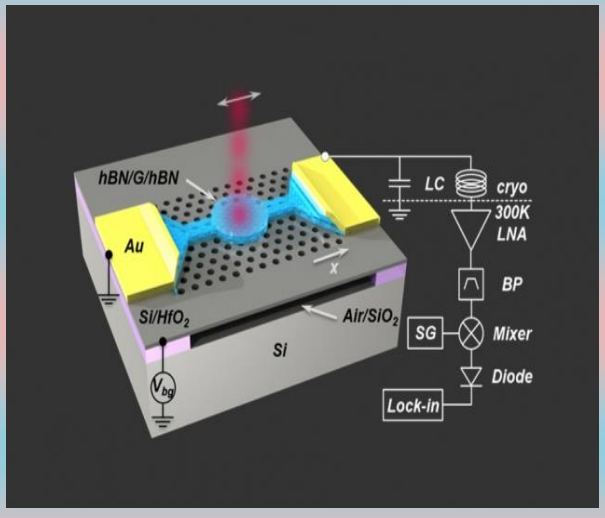
M.Vasanth
Second Year Mech

Technical Articles

1.DEVICE FOR MEASURING ELECTROMAGNETIC RADIATION

Bolometers, devices that monitor electromagnetic radiation through heating of an absorbing material, are used by astronomers and homeowners alike. But most such devices have limited bandwidth and must be operated at ultralow temperatures. Now, researchers say they've found a ultrafast yet highly sensitive alternative that can work at room temperature — and may be much less expensive.

The findings, published today in the journal *Nature Nanotechnology*, could help pave the way toward new kinds of astronomical observatories for long-wavelength emissions, new heat sensors for buildings, and even new kinds of quantum sensing and information processing devices, the multidisciplinary research team says. The group includes recent MIT postdoc Dmitri Efetov, Professor Dirk Englund of MIT's Department of Electrical Engineering and Computer Science, Kin Chung Fong of Raytheon BBN Technologies, and colleagues from MIT and Columbia University.



"We believe that our work opens the door to new types of efficient bolometers based on low-dimensional materials," says Englund, the paper's senior author. He says the new system, based on the heating of electrons in a small piece of a two-dimensional form of carbon called graphene, for the first time combines both high sensitivity and high bandwidth — orders of magnitude greater than that of conventional bolometers — in a single device.

"The new device is very sensitive, and at the same time ultrafast," having the potential to take readings in just picoseconds (trillionths of a second), says Efetov, now a professor at ICFO, the Institute of Photonic Sciences in Barcelona, Spain, who is the paper's lead author. "This combination of properties is unique," he says.

The new system also can operate at any temperature, he says, unlike current devices that have to be cooled to extremely low temperatures. Although most actual applications of the device would still be done under these ultracold conditions, for some applications, such as thermal sensors for building efficiency, the ability to operate without specialized cooling systems could be a real plus. "This is the first device of this kind that has no limit on temperature," Efetov says.

The new bolometer they built, and demonstrated under laboratory conditions, can measure the total energy carried by the

photons of incoming electromagnetic radiation, whether that radiation is in the form of visible light, radio waves, microwaves, or other parts of the spectrum. That radiation may be coming from distant galaxies, or from the infrared waves of heat escaping from a poorly insulated house.

The device is entirely different from traditional bolometers, which typically use a metal to absorb the radiation and measure the resulting temperature rise. Instead, this team developed a new type of bolometer that relies on heating electrons moving in a small piece of graphene, rather than heating a solid metal. The graphene is coupled to a device called a photonic nanocavity, which serves to amplify the absorption of the radiation, Englund explains.

"Most bolometers rely on the vibrations of atoms in a piece of material, which tends to make their response slow," he says. In this case, though, "unlike a traditional bolometer, the heated body here is simply the electron gas, which has a very low heat capacity, meaning that even a small energy input due to absorbed photons causes a large temperature swing," making it easier to make precise measurements of that energy. Although graphene bolometers had previously been demonstrated, this work solves some of the important outstanding challenges, including efficient absorption into the graphene using a nanocavity, and the impedance-matched temperature readout.

The new technology, Englund says, "opens a new window for bolometers with entirely new functionalities that could radically improve thermal imaging, observational astronomy, quantum information, and quantum sensing, among other applications."

For astronomical observations, the new system could help by filling in some of the remaining wavelength bands that have not yet had practical detectors to make observations, such as the "terahertz gap" of frequencies that are very difficult to pick up with existing systems. "There, our detector could be a state-of-the-art system" for observing these elusive rays, Efetov says. It could be useful for observing the very long-wavelength cosmic background radiation, he says.

Daniel Prober, a professor of applied physics at Yale University who was not involved in this research, says, "This work is a very good project to utilize the many benefits of the ultrathin metal layer, graphene, while cleverly working around the limitations that would otherwise be imposed by its conducting nature." He adds, "The resulting detector is extremely sensitive for power detection in a challenging region of the spectrum, and is now ready for some exciting applications."

And Robert Hadfield, a professor of photonics at the University of Glasgow, who also was not involved in this work, says, "There is huge demand for new high-sensitivity infrared detection technologies. This work by Efetov and co-workers reporting an innovative graphene bolometer integrated in a photonic crystal cavity to achieve high absorption is timely and exciting."

2.ON A MISSION TO BUILD THE UNCRASHABLE CAR

Ryan Eustice's interest in self-driving cars began 12,500 feet below the surface of the Atlantic. As a PhD student in the joint MIT-Woods Hole Oceanographic Institution Program, Eustice focused on creating technologies for underwater vehicles to map and understand their environments.

"That's how I got into this line of work originally," explains Eustice, who is currently senior vice president of automated driving at Toyota Research Institute and associate professor at the University of Michigan. "From an engineering perspective, the focus would be on helping the robot better navigate and understand its surroundings."

At MIT and Woods Hole, Eustice would deploy robots on field cruises to take pictures or make a map of the seafloor using cameras, sonar, or LIDAR — an acronym for light detection and ranging. That map would then be used by a geologist or marine biologist for their research purposes. A breakthrough in his career came in 2004, when he had the opportunity to send one of his robots to the site of the Titanic wreck, 12,500 feet below the water's surface off the coast of Newfoundland. "I was able to produce a very accurate reconstruction and map of the wreckage using the downward-looking camera imagery the robot collected."

Professor John Leonard, who served as Eustice's co-advisor while he was a PhD student, found Eustice's work ethic infectious. One day, Leonard was facing a deadline to write some paragraphs for the literature review of one of Eustice's important papers. "I said I would try to write a few paragraphs — and Ryan said 'Do or do not, there is no try,'" recalls Leonard, in reference to the famous quip by *Star Wars* character Yoda. "I stayed late that night and wrote the paragraphs before going home."

After receiving his PhD, Eustice made his way back to his home-state of Michigan. He was offered a faculty position in the University of Michigan's Department of Naval Architecture and Marine Engineering, where he continued his work on underwater robotics. "I've been using some of the same technology that went into mapping the Titanic," Eustice explains. "I'm looking at how robots can be deployed near naval ships so they can do inspection tasks or map the below-water portion of the hull."

Shortly after arriving in Michigan, Eustice was asked to apply the technology he was building for underwater vehicles to cars. In 2007, the U.S. Defense Advanced Research Projects Agency (DARPA) announced their Urban Challenge to build an autonomous vehicle that can drive and navigate everyday traffic scenarios. The team from Ford Motor Company, a few towns over from Ann Arbor, were looking for someone with expertise in mapping, navigation, and LIDAR technologies. Eustice fit the bill.

The Ford Motor Company team finished as finalists in the 2007 DARPA Urban Challenge. Eustice continued to work with them for nearly a decade, before joining Toyota Research Institute in 2016. At Toyota, Eustice leads a team developing a sensor-rich car built around artificial

intelligence. Like many companies around the world, part of the team's research is focused on what they call "chauffeur mode" — where the human is the passenger and the car is fully capable to drive itself.

But according to Eustice, this kind of automation has multiple applications. "We are working on a technology stack that gets us to a full automation scenario, but at the same time we see a tremendous opportunity to use that technology in a different way," says Eustice. "Fundamentally, we want to build an un-crashable car."

With fully autonomous vehicles, the human has to be somewhat alert since the car is unable to handle all individually rare but collectively common scenarios that happen in day-to-day driving — a mattress flipping off a car in front of you, or a crossing guard motioning for you to stop, for example. In those situations, human drivers need to remain alert in the event they have to take over steering control. Humans are expected to watch the AI.

But Eustice and his team are developing technologies that flip that equation. "With 'guardian mode' we say, 'Well let's imagine a system where we have AI guard the human,'" Eustice explains. It's a subtle change but has profound ramifications that can augment the human driver.

Eustice and his team have outfitted test cars with 360-degree sensing around the vehicle, using similar technologies he worked with as a graduate student at MIT. But instead of mapping oceanic environments, he now has one particularly lofty ambition, "to develop a car that is incapable of causing a crash."

3.NEW SYSTEM RECOVERS FRESH WATER FROM POWER PLANTS

Technology captures water evaporating from cooling towers; prototype to be installed on MIT's Central Utility Plant.

A new system devised by MIT engineers could provide a low-cost source of drinking water for parched cities around the world while also cutting power plant operating costs.

About 39 percent of all the fresh water withdrawn from rivers, lakes, and reservoirs in the U.S. is earmarked for the cooling needs of electric power plants that use fossil fuels or nuclear power, and much of that water ends up floating away in clouds of vapor. But the new MIT system could potentially save a substantial fraction of that lost water — and could even become a significant source of clean, safe drinking water for coastal cities where seawater is used to cool local power plants.

The principle behind the new concept is deceptively simple: When air that's rich in fog is zapped with a beam of electrically charged particles, known as ions, water droplets become electrically charged and thus can be drawn toward a mesh of wires, similar to a window screen, placed in their path. The droplets then collect on that mesh, drain down into a collecting pan, and can be reused in the power plant or sent to a city's water supply system.

The system, which is the basis for a startup company called Infinite Cooling that last

month won MIT's $100K Entrepreneurship Competition, is described in a paper published today in the journal *Science Advances*, co-authored by Maher Damak PhD '18 and associate professor of mechanical engineering Kripa Varanasi. Damak and Varanasi are among the co-founders of the startup, and their research is supported in part by the Tata Center for Technology and Design.

Varanasi's vision was to develop highly efficient water recovery systems by capturing water droplets from both natural fog and plumes of industrial cooling towers. The project began as part of Damak's doctoral thesis, which aimed to improve the efficiency of fog-harvesting systems that are used in many water-scarce coastal regions as a source of potable water. Those systems, which generally consist of some kind of plastic or metal mesh hung vertically in the path of fogbanks that regularly roll in from the sea, are extremely inefficient, capturing only about 1 to 3 percent of the water droplets that pass through them. Varanasi and Damak wondered if there was a way to make the mesh catch more of the droplets — and found a very simple and effective way of doing so.

The reason for the inefficiency of existing systems became apparent in the team's detailed lab experiments: The problem is in the aerodynamics of the system. As a stream of air passes an obstacle, such as the wires in these mesh fog-catching screens, the airflow naturally deviates around the obstacle, much as air flowing around an airplane wing separates into streams that pass above and below the wing structure. These deviating airstreams carry droplets that were heading toward the wire off to the side, unless they were headed bang-on toward the wire's center.

The result is that the fraction of droplets captured is far lower than the fraction of the collection area occupied by the wires, because droplets are being swept aside from wires that lie in front of them. Just making the wires bigger or the spaces in the mesh smaller tends to be counterproductive because it hampers the overall airflow, resulting in a net decrease in collection.

But when the incoming fog gets zapped first with an ion beam, the opposite effect happens. Not only do all of the droplets that are in the path of the wires land on them, even droplets that were aiming for the holes in the mesh get pulled toward the wires. This system can thus capture a much larger fraction of the droplets passing through. As such, it could dramatically improve the efficiency of fog-catching systems, and at a surprisingly low cost. The equipment is simple, and the amount of power required is minimal.

Next, the team focused on capturing water from the plumes of power plant cooling towers. There, the stream of water vapor is much more concentrated than any naturally occurring fog, and that makes the system even more efficient. And since capturing evaporated water is in itself a distillation process, the water captured is pure, even if the cooling water is salty or contaminated. At this point, Karim Khalil, another graduate student from Varanasi's lab joined the team.

"It's distilled water, which is of higher quality, that's now just wasted," says Varanasi. "That's what we're trying to

capture." The water could be piped to a city's drinking water system, or used in processes that require pure water, such as in a power plant's boilers, as opposed to being used in its cooling system where water quality doesn't matter much.

A typical 600-megawatt power plant, Varanasi says, could capture 150 million gallons of water a year, representing a value of millions of dollars. This represents about 20 to 30 percent of the water lost from cooling towers. With further refinements, the system may be able to capture even more of the output, he says.

What's more, since power plants are already in place along many arid coastlines, and many of them are cooled with seawater, this provides a very simple way to provide water desalination services at a tiny fraction of the cost of building a standalone desalination plant. Damak and Varanasi estimate that the installation cost of such a conversion would be about one-third that of a building a new desalination plant, and its operating costs would be about 1/50. The payback time for installing such a system would be about two years, Varanasi says, and it would have essentially no environmental footprint, adding nothing to that of the original plant.

"This can be a great solution to address the global water crisis," Varanasi says. "It could offset the need for about 70 percent of new desalination plant installations in the next decade."

In a series of dramatic proof-of-concept experiments, Damak, Khalil, and Varanasi demonstrated the concept by building a small lab version of a stack emitting a plume of water droplets, similar to those seen on actual power plant cooling towers, and placed their ion beam and mesh screen on it. In video of the experiment, a thick plume of fog droplets is seen rising from the device — and almost instantly disappears as soon as the system is switched on.

The team is currently building a full-scale test version of their system to be placed on the cooling tower of MIT's Central Utility Plant, a natural-gas cogeneration power plant that provides most of the campus' electricity, heating, and cooling. The setup is expected to be in place by the end of the summer and will undergo testing in the fall. The tests will include trying different variations of the mesh and its supporting structure, Damak says.

That should provide the needed evidence to enable power plant operators, who tend to be conservative in their technology choices, to adopt the system. Because power plants have decades-long operating lifetimes, their operators tend to "be very risk-averse" and want to know "has this been done somewhere else?" Varanasi says. The campus power plant tests will not only "de-risk" the technology, but will also help the MIT campus improve its water footprint, he says. "This can have a high impact on water use on campus."

4.SELF-DRIVING CARS FOR COUNTRY ROADS

Today's autonomous vehicles require hand-labeled 3-D maps, but CSAIL's MapLite system enables navigation with just GPS and sensors.

Navigating roads less traveled in self-driving cars is a difficult task. One reason is that there aren't many places where self-driving cars can actually drive. Companies like Google only test their fleets in major cities where they've spent countless hours meticulously labeling the exact 3-D positions of lanes, curbs, off-ramps, and stop signs.

"The cars use these maps to know where they are and what to do in the presence of new obstacles like pedestrians and other cars," says Daniela Rus, director of MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL). "The need for dense 3-D maps limits the places where self-driving cars can operate."

Indeed, if you live along the millions of miles of U.S. roads that are unpaved, unlit, or unreliably marked, you're out of luck. Such streets are often much more complicated to map, and get a lot less traffic, so companies aren't incentivized to develop 3-D maps for them anytime soon.

From California's Mojave Desert to Vermont's White Mountains, there are huge swaths of America that self-driving cars simply aren't ready for.

One way around this is to create systems advanced enough to navigate without these maps. In an important first step, Rus and colleagues at CSAIL have developed MapLite, a framework that allows self-driving cars to drive on roads they've never been on before without 3-D maps.

MapLite combines simple GPS data that you'd find on Google Maps with a series of sensors that observe the road conditions. In tandem, these two elements allowed the team to autonomously drive on multiple unpaved country roads in Devens, Massachusetts, and reliably detect the road more than 100 feet in advance. (As part of a collaboration with the Toyota Research Institute, researchers used a Toyota Prius that they outfitted with a range of LIDAR and IMU sensors.)

"The reason this kind of 'map-less' approach hasn't really been done before is because it is generally much harder to reach the same accuracy and reliability as with detailed maps," says CSAIL graduate student Teddy Ort, who was a lead author on a related paper about the system. "A system like this that can navigate just with on-board sensors shows the potential of self-driving cars being able to actually handle roads beyond the small number that tech companies have mapped."

The paper, which will be presented in May at the International Conference on Robotics and Automation (ICRA) in Brisbane, Australia, was co-written by Ort, Rus, and PhD graduate Liam Paull, who is

now an assistant professor at the University of Montreal.

For all the progress that has been made with self-driving cars, their navigation skills still pale in comparison to humans'. Consider how you yourself get around: If you're trying to get to a specific location, you probably plug an address into your phone and then consult it occasionally along the way, like when you approach intersections or highway exits.

However, if you were to move through the world like most self-driving cars, you'd essentially be staring at your phone the whole time you're walking. Existing systems still rely heavily on maps, only using sensors and vision algorithms to avoid dynamic objects like pedestrians and other cars.

In contrast, MapLite uses sensors for all aspects of navigation, relying on GPS data only to obtain a rough estimate of the car's location. The system first sets both a final destination and what researchers call a "local navigation goal," which has to be within view of the car. Its perception sensors then generate a path to get to that point, using LIDAR to estimate the location of the road's edges. MapLite can do this without physical road markings by making basic assumptions about how the road will be relatively more flat than the surrounding areas.

"Our minimalist approach to mapping enables autonomous driving on country roads using local appearance and semantic features such as the presence of a parking spot or a side road," says Rus.

The team developed a system of models that are "parameterized," which means that they describe multiple situations that are somewhat similar. For example, one model might be broad enough to determine what to do at intersections, or what to do on a specific type of road.

MapLite differs from other map-less driving approaches that rely more on machine learning by training on data from one set of roads and then being tested on other ones.

"At the end of the day we want to be able to ask the car questions like 'how many roads are merging at this intersection?'" says Ort. "By using modeling techniques, if the system doesn't work or is involved in an accident, we can better understand why."

MapLite still has some limitations. For example, it isn't yet reliable enough for mountain roads, since it doesn't account for dramatic changes in elevation. As a next step, the team hopes to expand the variety of roads that the vehicle can handle. Ultimately they aspire to have their system reach comparable levels of performance and reliability as mapped systems but with a much wider range.

"I imagine that the self-driving cars of the future will always make some use of 3-D maps in urban areas," says Ort. "But when called upon to take a trip off the beaten path, these vehicles will need to be as good as humans at driving on unfamiliar roads they have never seen before. We hope our work is a step in that direction."

This project was supported, in part, by the National Science Foundation and the Toyota Research Initiative.

5.SOLAR ELECTRIC VEHICLE

Flux, built by the MIT Solar Electric Vehicle Team, was recently unveiled at Johnson Rink in preparation for its participation in the American SolarChallenge.

On a recent April afternoon, MIT sophomore Francis Wang drove out of the Edgerton Center's Area 51 garage, took a left on Massachusetts Avenue, a right onto Albany Street, and then a left through the wide doors into Johnson Rink.

For the team of 25 students on the MIT Solar Electric Vehicle Team (SEVT), the unveiling was as much a celebration of how far they've come and a send-off for how far they want to go. Seventeen hundred miles, to be exact, from Omaha, Nebraska to Bend, Oregon.

Professor J. Kim Vandiver, the Forbes Director of the Edgerton Center and dean for undergraduate research, spoke at the event, and referred to one of the first solar cars, Solectria 4, built by James Worden '89 in 1988. In fact, about five years before the Edgerton Center was founded, Harold "Doc" Edgerton gave the team space in Building 20.

According to Worden, "unveilings" for solar cars were a little more off-the-cuff back then. Held at Worden's house in Arlington, Massachusetts, the team performed midnight test runs on Massachusetts Avenue from one end of Arlington to the other on a stretch of flat and straight, car-free road.

This unveiling was more sedate. Junior Veronica LaBelle, team captain, remarked on the power behind a large group of students engaged in intensive collaboration, and her gratitude for the team's commitment. Membership, she noted, has doubled in the past two years.

She also mentioned a road block in the summer of 2017. The team's $10,000 entry fee for the Australian World Solar Challenge (WSC) had been paid, and Flux was ready to be shipped to Darwin, Australia for the race. But more road testing was needed, and the timeline was too tight to ensure that Flux was in competition shape. After hours of agonizing discussion, the team decided to forfeit their entry fee and use their time to prepare Flux for the ASC.

Flux stands apart from previous iterations of the solar car with its asymmetrical body. The driver sits on the same right-hand side as the wheel base, which means there's less drag as it's racing down the road. The car's body is made from honeycomb wrapped in carbon fiber.

The 5-kilowatt battery primarily stores energy converted from the solar array – 260 silicon solar cells on the canopy of the car. While cruising, the solar array powers the car without much help from the battery. Acceleration, however, requires more than solar power, and some battery power is required to meet the motor's demand. During the ASC, the team will have a charging period and can start each day with a full battery.

Talking about the team's Independent Activities Period road trip to Georgia this January, sophomore Harith Morgan was visibly excited at the memory. "It's an endurance race, so we're not only racing, it's how the car performs and how we perform as a team. If we get a flat, how quickly do we respond to that? Who takes off the wheel, who gets the next wheel, who is tightening the wheel, getting the new wheel secured properly? And we do it in two minutes or less."

Morgan joined the team in his first-year. "When I got to MIT I knew I was interested in mechanical engineering, and I was thinking of a way I could apply mechanical engineering to solving world problems, and I thought energy was a world problem and solar car was the perfect marriage of the two," Morgan added.

The unveiling event gave the MIT community a chance to get up close and personal with Flux, and to learn first-hand what goes into designing, building, and racing a solar car. Some even took their Flux selfies.

After Flux had been sufficiently anointed with good solar car luck at the unveiling, Wang put his helmet on, got back in the car, and drove down Massachusetts Avenue to the Area 51 garage.

The team has a little more work ahead, including crush zone changes (bodywork that allows the car to absorb the impact of a crash) and new turning fairing. Plus some more hours of road training for the driver. And then, full sun-powered speed ahead, the ASC from Nebraska to Oregon.

PRIYADARSHINI ENGINEERING COLLEGE

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