Newspaper Clips
August 17-18, 2014

August 17

Times Of India ND 17/08/2014 P-15

'Math teaching in India is robotic, make it creative'

*Ace number theorist **Manjul Bhargava**, who recently won the Fields Medal, tells **Chidanand Rajghatta** that there is math in everything from music to poetry, and Indian children should be exposed to its beauty early*

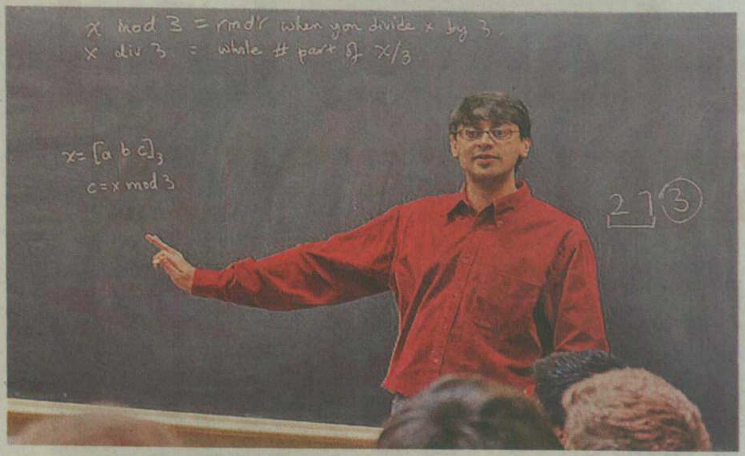
A lot of people are chuffed, both in the US and in India, about your Fields Medal.

I am of course very honoured; beyond that, it is a source of encouragement and inspiration, and I hope that it is so also for my students and collaborators and colleagues. This is their prize too. I hope it will inspire more young people in India to take up mathematics and the sciences in general.

We've heard the story of your early interest in mathematics including the orange-pyramid story. How early can a child grasp complexity in math beyond plain numbers?

I think the orange-pyramid story is a good example of a math problem that can be understood and appreciated by fairly small children, say 8 years. The fact that the number of oranges needed to make a triangular pyramid with n oranges on each side is n times n+1 times n+2 divided by 6: this fact can also be appreciated by small children, and experimented with using small numbers n. If presented correctly, children can acquire this ability fairly early on. Of course, complexity develops gradually, but it is always good to encourage children to start thinking early.

Why do some people have to lie down with a cold wet towel on their forehead the moment they hear the word 'math'?



> **You are taught to solve artificial-sounding problems via a sequence of dull, memorized steps. But in research maths, the problem has to be solved with creativity, and with fun, new ideas**

I think the reason lies in our education system. You are taught to solve artificial-sounding problems via a sequence of dull, memorized steps. But in research maths, problems come up for you in a natural way, either for reasons of artistry, or because there is an immediate application. The problem then has to be solved with creativity, with interaction with others, and with fun new ideas. It is like solving a jigsaw puzzle to make in the end a pretty picture. I wish mathematics was taught like that in school. That is how I try to teach it.

Is math genius a product of meticulous hard work, incremental gaining of knowledge and insight or an outcome of eidetic memory and talent?

While a good memory and a copious supply of talent are very helpful, there is no substitute for hard work. It requires years of hard work put in to get something out. Ramanujan, for instance, was a talent of a level that has never been seen, but he certainly put in the hours as well to get the results he was interested in. It wasn't a case where he saw a problem on the board and then saw how to solve it immediately on account of eidetic memory. In my case, the interest in and enthusiasm and intuition about mathematics did come very early and very naturally. But it is the hard work that led to the discoveries and results.

How do you assess Ramanujan? Why aren't more Indians inspired by his story?

I think Ramanujan should be a true national hero. He dedicated his life to understanding the world, and though he came from such a modest background, he saw things in mathematics that no one could have dreamt of. It is sad that he is known better outside India. One reason could be that few people go into mathematics and scientific research in India. So there aren't enough people to disseminate information about him. But what better time than now? This is the "Golden Age" of mathematics — there are so many exciting advances going on at the moment — so I hope more young people in India will begin to enter the field.

Why is India still a middle power in mathematics despite its famed legacy?

There have been many other great mathematicians in India in recent times besides Ramanujan, most notably Harish Chandra. But there are just not as many as there should be, given India's talent and legacy. We need to spot talent early and foster it.

Mathematics is sometimes not taught in India as a subject in itself and/or a career in itself. It is taught to be a tool for engineering. Students in India should be taught about the great ancient Indian mathematicians like Panini, Pingala, Hemachandra, Aryabhata and Bhaskara. Their stories and works inspired me, and I think they would inspire students across India. Many of these works were written in Indian languages in beautiful poetry, and contain important breakthroughs in the history of mathematics.

Walk us through your introduction to and interest in Sanskrit and tabla.

My greatest influences were my grandfather, a renowned scholar of Sanskrit and ancient Indian history, and my mother, a mathematician with strong interests in music and linguistics. I also developed deep interests in these subjects. I learned to play sitar, guitar, violin, and keyboard. But my favourite instrument was the tabla, which I started playing when I was quite young. Music, poetry, and mathematics are very similar. In school, mathematics is generally grouped in the "science" category. But like music, poetry, or painting it is a creative art.

What are your views on female mathematicians?

The first female Fields medalist has been long overdue. I do not believe men are wired differently for mathematics than females. I think it is a societal issue that fewer females enter the sciences. I am honoured to be a recipient in the same year as Maryam Mirzakhani. Her work is absolutely fantastic. I hope she will be seen not only as a top-rate female mathematician, but also simply as a top-rate mathematician.

Times Of India ND 17/08/2014 P-15

India and math: It doesn't add up

Though mathematicians of Indian origin are blazing a trail of glory in US, the discipline is declining at home

Chidanand.Rajghatta@timesgroup.com

An infinite crowd of mathematicians enters a bar. The first one orders a pint, the second one a half-pint, the third one a quarter pint... "I understand," says the bartender — and pours two pints.

Clever, huh? If you got the joke, odds are you are a math-phile who goes into raptures at the sight of numbers, integers, fractions etc. If not, even a single digit will fracture your spirit. As someone once said, there are 10 types of people in this world: those who understand binary and those who don't. Now, if you didn't get THIS joke, you are seriously math-challenged. Eventually though, there are only two types of people in the world: those that DON'T do math and those that take care of them.

Still, math anxiety is a despairing disability. Few subjects have people breaking out in cold sweat or flaming passion as mathematics. More than any other subject, it evokes extreme feelings. Charles Darwin, who was all biology and no math, is said to have defined a mathematician as a blind man in a dark room looking for a black cat which isn't there (Did he wonder about the classification of the non-existent cat?). Lewis Carroll, who was actually a mathematician, similarly derided math, having Mock Turtle say in Alice in Wonderland that the different branches of Arithmetic are Ambition, Distraction, Uglification, and Derision. Such put-down of math is common, as in the limerick that goes:

There was a young man from Trinity
Who solved the square root of infinity
While counting the digits
He was seized by the fidgets
Dropped science, and took up divinity.

Indeed, on the flipside, there are legions of math aficionados who go into a divine ecstasy over mathematics. Recently, a physicist, whose tribe has been chasing the 'God Particle', conjectured that Black Holes must have resulted from God dividing the universe by zero. But what would a physicist know? He's a notch below the mathematician, as explained in this ditty:

Biologists think they are biochemists
Biochemists think they are Physical Chemists
Physical Chemists think they are Physicists
Physicists think they are Gods
And God thinks he is a Mathematician.

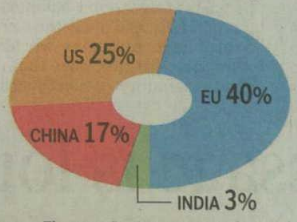
Indians are famously said to be accomplished digerati. Unaware of my math phobia, Miriam Rider, a state department librarian, teased me for years about "your Indian boast of having invented zero...your only claim to fame." "Hey, how about the humble pi?" I'd retort.

Alas and alack (expressed in binary terms as 1 0), mathematics is a declining discipline in India in recent years. In fact, Indian mathematicians are still sought after and feted for their work more in the US than at home, where a buccaneering spirit is driving people to more lucrative areas of academia rather than pursue something as sublime as math where returns can =0 or <0.

Indeed, there are many contemporary mathematicians of Indian-origin whose work is consecrated in eponymous formulations (Karmarkar's algorithm, Viswanath's constant, Rao-Blackwell theorem etc), but they are largely unknown outside the rarefied academic world and are seldom rich and famous. For all the bragging about the legacy of Aryabhata and Bhaskara, and the feats of Ramanujan and Krishnaswamy Ayyangar, India is now a mere middling power when it comes to math. It stood 11th in the 2012 Math Olympiad, its best position in a decade (best ever was 7th at the turn of the century) before dropping precipitously to 29th in 2013 and 39th in 2014 (out of nearly 100 countries). Last year's winner, and indeed, the topper 12 times in the 15 years: China. And for all the moaning about its declining standards, the US has come in second or third place 12 of the last 15 years. Russia, Korea, Japan are also at the top of the heap, burying the country that likes to boast it invented zero.

VITAL STATS

The output of academic papers as a measure of the higher maths scenario in a country



Source: Thomson Reuters report on innovation performance, March 2014

It is in the US that mathematicians of Indian-origin are blazing a trail of glory, illustrated most vividly last week with the awarding of the Fields Medal (a Nobel equivalent to mathematicians) to Manjul Bhargava, a Canadian-American with deep-rooted connections to India (see interview above). In 2007, Srinivasa Varadhan won the Abel Prize, which is also considered a Math Nobel (it comes with a $1 million prize compared to Fields, which gets only $5,000). But like the Princeton-affiliated Bhargava, Varadhan too works with the Courant Institute of Mathematical Sciences (CIMS), which is a division of New York University (NYU). Others like Madhu Sudan of MIT, Ravi Vakil of Stanford, Lov Grover of Bell Labs, and Umesh and Vijay Vazirani at UC Berkeley are carrying the torch passed by pioneers such as UCLA's V S Varadarajan and Purdue's SS Abhyankar, both more celebrated here than in India.

Does that mean India is not producing mathematicians of note despite its storied legacy? Not really, says Bhargava, readily invoking the name of Ramanujan (whose bio-pic is being shot right now in London) and his own Princeton forbear, Kanpur-born Harish Chandra, both, alas, no more. In fact, it increasingly appears that math is one discipline that knows no boundaries. Both Ramanujan and Harish Chandra grew up in India, mathematically and otherwise, and went west to show their wares. Bhargava's own doctoral student Arul Shankar with whom he has done work that earned him the Fermat Prize, is from Chennai. Bhargava shared the Sastra Ramanujan Prize in 2005 with another Chennai-ite Kannan Soundararajan. It's a kinship that crosses national boundaries.

But when an infinite number of mathematicians enter a bar, Manjul Bhargava gets to order the first pint...

Business Standard ND 17/08/2014 P-11

Why maths matters

The first 'desi', and first woman, to win the Fields Medal

Artur Avila, a Brazilian based in France; Martin Hairer, an Austrian based in Great Britain; Manjul Bhargava, a Canadian and Maryam Mirzakhani, an Iranian, both based in the US. The four mathematicians awarded the Fields Medal last week could be cited by advocates for open immigration policies. But they have also set new precedents. Mr Avila is the first Latin American recipient. Ms Mirzakhani is the first woman, and the first Iranian. Mr Bhargava is of course, being joyously feted as the first "desi" — even if he is not, technically, Indian.

The Fields, officially the International Medal for Outstanding Discoveries in Mathematics, is given every four years by the International Mathematical Union. The endowment by Canadian mathematician John Charles Field is modest, and the cash award amounts only to Canadian $15,000. There is also the stipulation that a recipient must be under the age of 40 on January 1 of the year the award is handed out, to encourage further work. This is in spite of the fact that, in general, mathematicians tend to do their best work long before middle age. Alfred Nobel was more interested in practical applications, which is why he did not endow a maths prize. The Fields is usually seen as the equivalent in terms of prestige. In fact, no matter how "abstract" pure mathematics seems, it tends to find practical applications, sooner or later. That's because mathematical logic underpins all natural phenomena and processes. Mr Bhargava, for example, has already caused multiple headaches to cryptographers because his work provides much new insight into the underpinning of cryptographic methods. Ms Mirzakhani's explorations of Riemann geometries could conceivably lead to a new understanding of the energy levels of nuclear particles. Mr Hairer's work in stochastic differential equations may be key to a better understanding of financial derivatives — as well as in the construction of heat-shields for spacecraft. Mr Avila's work in chaos theory has applications in the modelling of climate change and of epidemics.

Mr Bhargava is not the only *desi* mathematician to win recent recognition. Subhash Khot, another Indian based in the US, won the Rolf Nevanlinna Prize, at the same IMU conference. Mr Khot was awarded for his "prescient definition of the 'Unique Games' problem". His work finds application in judging the probable computational complexity of certain types of problems. India has an ancient, if unstructured tradition, of mathematical research. It started with the famed discovery of the zero, which could be more properly described as the development of a positional number system. Down the centuries, Indian mathematicians have discovered many interesting theorems. They investigated the properties of numbers, discovered some infinite series, solved difficult problems in spherical trigonometry and also did some integral calculus. And, of course, the peerless genius of Srinivasa Ramanujan stunned Cambridge in the early 20th century as he generated a stream of incredible results.

A string of recent prizes and awards designed to reward pure maths research indicates that the world is coming to understand how important this is. In India, the Infosys Foundation has an award and the Shanmugha Arts Science Technology Research Academy (SASTRA) from Ramanujan's hometown of Kumbakonam makes the Ramanujan Award (Mr Bhargava is a recipient of both). Norway offers the Abel Prize. The Clay Mathematics Institute of Cambridge, Massachusetts, has million-dollar awards for the solution of seven specified "Millennium problems". (Mr Bhargava and Ms Mirzakhani are potential front-runners to solve at least two of those.) The Russian entrepreneur Yury Milner has teamed up with Mark Zuckerberg and Sergei Brin for the new "Fundamental Mathematics" prize of $3 million, to be awarded from 2015. These new incentives will hopefully inspire more children to consider pure research as a career. The world depends on technology — and technology depends on maths. What is more, maths that seems utterly obscure and abstract can suddenly become essential. Nurturing the gifted and giving them an atmosphere conducive to pure research could turn out to be mission-critical for civilisation.

Amar Ujala ND 17/08/2014 P-6

आईआईटी गेट के लिए आवेदन एक सितंबर से

अमर उजाला ब्यूरो

नई दिल्ली। भारतीय प्रौद्योगिकी संस्थान (आईआईटी) के ग्रेजुएट एप्टीट्यूट टेस्ट इन इंजीनियरिंग (गेट परीक्षा) के लिए आवेदन प्रक्रिया 1 सितंबर से शुरू होगी। एक माह तक चलने वाली इस प्रक्रिया के तहत 1 अक्तूबर तक ऑनलाइन आवेदन किए जा सकेंगे। पोस्ट ग्रेजुएट कोर्सेज में दाखिले के लिए होने वाली इस परीक्षा के आयोजन जिम्मा इस बार आईआईटी कानपुर को मिला है।

अहम बात यह है कि छात्राओं को आवेदन करने के लिए छात्रों के मुकाबले आधी फीस अदा करनी होगी। जहां सामान्य व ओबीसी वर्ग के छात्रों को आवेदन के लिए 1500 रुपये का भुगतान करना होगा, वहीं छात्राओं को 750 ही चुकाने होंगे।

इसी तरह एससी-एसटी व अशक्त छात्रों व छात्राओं को भी 750 रुपये अदा करने होंगे। परीक्षा के लिए आवेदन गेट ऑनलाइन ऐप्लिकेशन प्रोसेसिंग सिस्टम (जीओएपीएस) वेबसाइट के जरिये किया जा सकेगा। ऑनलाइन आवेदन के बाद ऑनलाइन परीक्षा का आयोजन 31 जनवरी 2015, 1, 7, 8 व 14 फरवरी 2015 को सुबह 9 से 12 बजे और दोपहर 2 से शाम 5 बजे तक होगा । यदि कोई परीक्षार्थी किसी दूसरे शहर के केंद्र से परीक्षा देना चाहता है तो वह 21 नवंबर तक परीक्षा केंद्र के बदलाव के लिए आवेदन कर कर सकेगा। मालूम हो कि परीक्षा परिणाम घोषित होने की तारीख से केवल तीन वर्ष के लिए गेट 2015 का स्कोर वैध माना जाएगा।

छात्राओं को चुकाने होंगे 750 रुपये, छात्रों को 1500 रुपये

Nai Duniya ND 17.08.14 P-11

आईआईटी खडगपुर में एम्पेसारियो

नई दिल्ली (नेशनल ब्यूरो)। आईआईटी खडगपुर में वैश्विक बी प्लान प्रतियोगिता एम्पेसारियो, 2015 का आयोजन किया जा रहा है। इसमें दुनिया भर के छात्र-छात्राएं भाग ले सकते हैं। इस प्रतियोगिता में प्रतिभागी सभी प्रकार की व्यापार योजनाएं (जिनमें प्रोडक्ट डिजाइन से लेकर सामाजिक क्षेत्र से जुड़ी परियोजनाएं शामिल हैं) पेश करते हैं। सर्वश्रेष्ठ परियोजना को ढाई करोड़ रुपये तक का इनाम जीतने का अवसर मिलेगा। प्रथम राउंड में प्रतिभागियों को अपनी परियोजना के बारे में एक प्रश्नावली के उत्तर 20 अक्टूबर तक जमा कराने होंगे।

Times Of India ND 17/08/2014
P-9

UPSC: Leave English queries unanswered

Board Says Section Won't Be Evaluated

TIMES NEWS NETWORK

To resolve the row over Civil Services Aptitude Test (CSAT) pattern introduced in 2011, the Centre had recently announced that the marks for English section of Paper II should not be included for gradation or merit

New Delhi: Notifying the new marking scheme for Civil Services Preliminary Examination 2014 in line with the government's decision not to count the marks for English comprehension section of Paper II for gradation, the UPSC on Saturday asked the examinees to leave the questions in this section unanswered as they would not be evaluated. The two-hour duration of the paper, however, would remain unchanged.

"The maximum marks for Paper II would be '200 minus the marks earmarked for the English language comprehension skills (Class X level)'," the UPSC said in a release. The English comprehension skills section, with its 8-9 questions, carries 22.5 marks.

The Centre had, in a recent decision aimed at resolving the row over Civil Services Aptitude Test (CSAT) pattern introduced in 2011, announced that the marks for English section of Paper II should not be included for gradation or merit. It had also said that an extra attempt be granted to all those who had taken the Civil Services examination in 2011, to reappear in 2015.

The DoPT wrote to the UPSC within four hours of Union minister of state for personnel Jitendra Singh making this announcement in Parliament, seeking its implementation. The UPSC, which on Saturday saw its new chairperson Rajni Razdan take oath of office and secrecy, has now issued the revised rules for the August 24 prelims exam.

"Candidates must...note that they do not have to answer the questions in this English language comprehension skills section... candidates can utilize the entire time (two hours) in answering all questions except those in the section....", said the UPSC.

It added, for further effect, that even if candidates were to attempt these questions, "marks will not be counted for gradation or merit".

259 colleges denied affiliation due to non-compliance with AICTE norms and regulations

http://www.deccanchronicle.com/140817/nation-education/article/259-colleges-denied-affiliation-due-non-compliance-aicte-norms-and

Hyderabad: Nearly 174 engineering colleges and 85 pharmacy colleges are expected to be left out of Eamcet Web counselling slated to begin on Sunday morning. Affiliation has been refused to these colleges for non-compliance with AICTE norms and regulations. As a result, students have been deprived of about 1 lakh seats.

Almost all existing engineering and pharmacy colleges in the Andhra University and SV University in Andhra Pradesh got their affiliation renewed. But, affiliations of only 141 engineering colleges and 61 pharmacy colleges in Telangana state were renewed till Saturday evening. The fate of other engineering colleges is not known yet.

Eamcet chief camp officer Dr K. Raghunath said only these many colleges will be available in the Web counselling set to begin from Sunday. “The list of available colleges will be uploaded on the website by Sunday morning,” he said.

Telangana government had categorically said that colleges violating AICTE norms will not be granted renewal. A fresh inspection drive was started again by the JNTU Hyderabad on the insistence of the Telangana government. Managements of engineering colleges are also fuming as they say they have not been given any clear reason as to why affiliations have been revoked.

College managements are gearing up for a legal battle as they said they would move a house motion in the Hyderabad High Court against the move by JNTU. Dr Gautam Rao, chairman, Telangana Engineering and Professional College Managements Association (TEPCMA), said, “They are not telling us the reason of refusing renewal.”

As of now, only about 85,455 seats will be available in Web counselling from Sunday. A total of 1,84,575 seats were supposed to be available before the inspection.

Be job creators, not seekers: IIM chief to students

TNN | Aug 17, 2014, 09.42AM IST

http://timesofindia.indiatimes.com/city/raipur/Be-job-creators-not-seekers-IIM-chief-to-students/articleshow/40319953.cms

RAIPUR: IIM-Raipur celebrated Independence Day on Friday at its campus. Addressing students, institute director BS Sahay reaffirmed the need for high quality education. He encouraged both the faculty and students to engage in good quality research, thereby bringing global recognition to the institute.

Sahay reiterated that for success of the institute, every member is indispensable. He wanted the faculty, staff and students to work hand-in-hand to achieve a common holistic goal. Sahay stated that the institute was working on a plan to cater education services to the backward classes by providing CAT coaching and the pedagogues would be none other than the IIM students themselves.

As a part of social responsibility, the director shared a thought on the institute's future endeavour to adopt a

village and be of assistance to rural people. He also mentioned that IIM-Raipur has signed an MoU with AIIMS to establish fruitful means to exchange knowledge, information and research in the field of healthcare.

"Students shouldn't be job seekers, they should be job creators." he said. Elucidating upon the acute shortage of faculty members in the educational institutes of India, he encouraged students to go for higher studies and fellowship programmes and join academia.

His speech was followed by the cultural programme organized by the Cultural and Sports Club (CUSP) of IIM Raipur attended by students, faculty, staff and their family members.

India needs technological and social innovations: TCS Vice-Chairman S Ramadorai

http://articles.economictimes.indiatimes.com/2014-08-16/news/52873770_1_rd-spending-innovations-india

HYDERABAD: India needs to unleash technological and social innovations that can usher in a new developmental model the world has not seen before, TCS Vice- Chairman S Ramadorai said today.

"We need technological and social innovations that can show the way to a new developmental model, a model where cutting-edge technologies power our quest to understand the outer space and at the same time high-end but low cost technologies help solve simple everyday problems," he said.

Delivering his address at the 13th convocation of the International Institute of Information Technology (IIIT) here, the top TCS executive said that India has many complex problems across developmental, business and economic needs.

"This calls for a higher order of inter-disciplinary thinking to be brought in," he said.

Observing that large Indian corporations need to become research-focused, Ramadorai said that neither there is any dearth of talent in our country and nor of intent as well.

"What is needed is for a few Indian companies to show the way, by forging large scale partnerships in areas of significance for the country and for their business," Ramadorai said.

"In today's knowledge economy, it is economics, not politics, that brings power. Economies are driven by business and technological innovation and advances. Strong science and engineering Ph.D programmes are precisely the catalysts for the amazing growth of China," he said.

Referring to a study, Ramadorai said that India's share in R&D spending to the total global R&D spending stands at 2.1 per cent while the share of China is 12.5 per cent.

"Also the number of Ph.Ds has been growing at the rate of about 9 per cent in India compared to around 18 per cent in China. So if India has to be technologically strong, research is an imperative," he added.

"I believe that the time has really come for our campuses to reshape the learning culture to bring in more of the real world just like IIIT Hyderabad is attempting to do," Ramadorai said, adding that more institutions need to remold the entire learning process and curriculum of the campus so that more bright students focus on addressing the tough problems of the day.

Ramadorai further said that more campuses need to think in terms of introducing an incubator model of learning where students can stoke their entrepreneurial spirit and dare to apply technology to tackle India's problems at scale without fear of failure.

"One tough problem that certainly needs to be addressed is the primary sector - agriculture. Our agricultural yield is amongst the lowest in the world.

"The fact that a small nation like the Netherlands is the world's third largest agricultural exporter should inspire us to create more value from our farms. This can happen only through the application of innovative new technologies and cutting edge science," he said.

Telangana Information Technology Minister K Taraka Rama Rao also spoke on the occasion.

Around 450 undergraduate and post-graduate students, besides five doctoral candidates, were conferred the degrees during the convocation.

August 18

IIT-Kharagpur school to have US flavour

Jhimli Mukherjee Pandey | Aug 17, 2014, 11.36 PM IST

http://timesofindia.indiatimes.com/city/kolkata/IIT-Kharagpur-school-to-have-US-flavour/articleshow/40351729.cms

KOLKATA: In a first, one of the world's best-known schools of medicine has come forward to help shape the country's first IIT-run medical technology school.

Right from the way the labs should be shaped, to the curriculum, equipment and training, everything about the IIT-Kharagpur-run upcoming school of medical technology will have an American flavour. None less than the University of California, San Diego (UCSD), will help shape the showpiece school, which is the first of its kind in the IIT system.

There's another first. UCSD now has an Indian chancellor. It may be noted that no Indian has ever headed any of the top 10 US universities. Pradeep Khosla, who is a 1980-batch graduate of electrical engineering from IIT-Kharagpur, feels that it is now time to give back. He is here to firm up plans for the collaboration. His alma mater, on the other hand, is quite upbeat about it since the school of medical technology, after hitting several hurdles, has finally been put on the fast track by the Union ministry of human resources development.

Khosla will be given an honorary doctorate of science degree at IIT-Kgp on Monday on the occasion of the institute's foundation day. "It might be a cliche, but whatever I am is due to my education at this IIT and it's time to pay back. So, we will start with collaborating between our medical schools. Ours has come a long way and is known as the best in the US, it will be quite challenging to help shape IIT-Kharagpur's unique medical technology school, keeping the Indian requirements in mind," Khosla said.

If things go according to plans, UCSD will train both students and faculty of the IIT as part of the exchange agreement that will be firmed up between the two institutions over the next couple of days. "We are looking forward to the details of this understanding between us since we are planning our medical technology school on the lines of AIIMS," said IIT-Kharagpur director P P Chakraborty.

After earning his B Tech degree, Khosla worked in Tata Consulting Engineers in Bangalore and Siemens, Mumbai for two years before enrolling for a PhD in experimental robotics at the Carnegie Melon University, where he stayed for 30 years. In between, Khosla took a break to work with the US Defence department's DARPA when the world wide web was getting developed and the web browser had just been announced. "It was a crucial juncture. I had secured admission to all the three IIMs but it was the urge to research that egged me on to leave India. During our time, not everyone was wanting to leave hard-core engineering fields to become managers, you see," Khosla reasoned.

The fact that over 90% IIT students are ending up being MBAs and moving away from their areas of training/core competence is a source of intrigue for Khosla. "Even in the IITs, students of civil, material and metallurgical engineering disciplines do not find good employment after graduation, forcing them to lean towards programming. The other streams naturally lean towards the IIMs. It is a question of personal betterment and the student is not to be blamed. The government should bring about commensurate industrial growth so that students stay back in their fields for research and provide meaningful input to their respective industries," he said. In the US, too, this trend persists. "In the US, even if the top layer leaves for business degrees, the second layer of every tech field is equally encouraged to move into research. India today does have the resources to make research a well-paying job at par with the corporate," he felt,

driving home the point that UCSD does research worth $ 1.1 billion, the biggest in the US.

Khosla is part of the global body called "pan-IIT", that is helping the IITs formulate a completely new way of tech study and research that would make staying back for higher studies just as enticing as opting for placements or cracking CAT. "The interesting trend about Indian tech graduates is that they are no longer coming to the US for post graduate studies as was the case in our time. The US varsities have realized that these students will not stay back for research and are unwilling to fund them till they reach the PhD stage. This is another reason for Indian students to opt for MBAs."

Prof Sujit Roy Appointed Acting Director of IITBBS

http://www.newindianexpress.com/states/odisha/Prof-Sujit-Roy-Appointed-Acting-Director-of-IITBBS/2014/08/17/article2384013.ece

BHUBANESWAR: With incumbent Director of IIT-Bhubaneswar Prof MS Chakraborty's tenure ending on Monday and selection process for the new head underway, the Ministry of Human Resources Development (HRD) has appointed Dean of Faculty and Planning of the institute, Prof Sujit Roy as the acting Director.

In a letter to the Chairman of Board of Governors of IIT-BBS, Additional Secretary (Technical Education) Amita Sharma has asked the Chairman of Board of Governors of IIT Bhubaneswar to relieve Chakraborty, who will return to his parent institute IIT-Kharagpur, before he retires in December.

Roy, a Professor of Chemistry, will be acting Director till a regular and full-time Director is appointed.

In fact, the process for appointment of full-time Directors of three IITs, Bhubaneswar, Ropar and Patna, is currently underway by the HRD Ministry.

By the end of October, the new Directors are expected to be posted.

Nearly 140 applications have been received by the Ministry for these posts.

A committee will first chalk out a list of candidates based on the eligibility criteria following which the selection committee, headed by HRD Minister Smriti Irani, will interview them.

Sources said, as many as 18 Professors from IIT-Kanpur have sent their applications for the Director positions while five from IIT-Kharagpur have thrown their hats in the ring.

At least three from IIT-Bhubaneswar have also applied for the top position

IITians work to bridge tech gap in rural India

Aug 18, 2014 |

http://www.asianage.com/mumbai/iitians-work-bridge-tech-gap-rural-india-944

The Indian Institute of Technology, Bombay (IIT-B) played host to the first annual conference, Sammilan, organised by the ministry of human resource development in collaboration with Abhyuday, IIT-B on "Urban Rural Divide- Bridging the Technology gap" on Saturday at its Powai campus. According to the organisers, Sammilan is aimed at increasing student participation in social causes and rural development by using latest technology to develop products catering to health issues in rural India. The initiative is targeted at students from different colleges and institutions across the country in the form of events and competitions.

Speaking about the conference, Gourav Soni, an IITian who is a member of team Abhyuday that works on encouraging IITians and non-IIT students to take up social causes, said that Sammilan was in line with Abhyuday's goals and hence hosting the two-day conference was natural.

"140 participants from colleges all over the country, including faculty members and delegates from various NGOs have attended the conference to mentor students for case studies and group activity," said Mr Soni.

Speaking after inaugurating the conference, Madhav Chavan, the co-founder and CEO of non-profit organisation, Pratham said, "We have designed a low-cost method of providing pre-primary and primary education to poor children living in the urban and semi-rural slums of India. Students participating in Sammilan will also be expected to work on such projects."

Ranjeet Gakhare from Liter of Light, My Shelter, spoke about making cost-effective bottles attached to solar panels, which provide light at night for use in homes of those who cannot afford electricity. "This has been a very enlightening conference and the experiences of the speakers have proved to be a major boost to us in terms of coming up with affordable solutions for the poor in rural areas," said Mr Soni.

500 more IIM seats could be available in 2015

With six new IIMs set to open, 500 more seats are now up for grabs for MBA aspirants in 2015. However, aspirants were doubtful if new institutes will open on time, even though the Common Admission Test website says they can opt for them.

IIT-Kanpur alumni motivate students to join civil services

TNN | Aug 18, 2014, 10.49 AM IST

http://timesofindia.indiatimes.com/home/education/news/IIT-Kanpur-alumni-motivate-students-to-join-civil-services/articleshow/40356558.cms

KANPUR: The first session of the event 'Tips from the Top' — a unique career awareness session, was held under the Project Saraswati at IIT-Kanpur on Sunday. The alumni contact programme of the institute was headed by Prof Prabhat Munshi, dean, resources and alumni.

Alumni of IIT Kanpur were invited at the event to deliver talk about their profession and solve the queries of students.

The theme of the talk on Sunday was career in civil services. Top notch alumni of IIT-K from civil services were present at the event. Around 600 students attended the session. The speakers addressed the students and also had a panel discussion with them.

Sudhir Vyas, ambassador of India in Germany and a President's gold medallist from IIT Kanpur's electrical engineering department, 1975 batch, was one of the key speakers. He motivated the students to join civil services and said that in the past several years, there has been a rise in the number of students joining civil services.

Rupak Kumar Dutta, 1979 batch (chemical department), an IPS officer of 1981 batch (Karnataka cadre) and additional director in Central Bureau of Investigation, New Delhi, also addressed the students. Before joining CBI, he served as director general of police, CID, special units and economic offences in Karnataka. He answered queries of students and spoke about the challenges of his job.

Gaurav Kanaujia, director, Central Board Of Direct Taxes, department of revenue ex joint commissioner of Income Tax at Kolkata of 1995 batch (Mechanical department) and Sunil Kumar, district magistrate and deputy commissioner, Hazaribagh, Jharkhand, of 1993 batch (Computer Science department) also talked about their career.

Research in IITs

http://www.thehindu.com/features/education/research-in-iits/article6325958.ece

The Indian Institutes of Technology (IITs) have the rare standing of being reckoned as quality institutions in the pursuit of higher education and research at the international level. The relatively old institutions — IITs Madras, Bombay, Delhi, Kanpur, Kharagpur, Guwahati, Roorkee, and Varanasi — have fine infrastructure in terms of equipment and faculty. The recently started IITs in Bhubaneswar, Gandhinagar, Hyderabad, Patna, Ropar (Punjab), Rajasthan, Mandi (Himachal Pradesh), and Indore (Madhya Pradesh) are at various stages of development.

One of the objectives of our IITs is to reach global standards in research, particularly in engineering and technology. Studies are made in IITs in certain areas of basic sciences and humanities as well.

According to one estimate, our IITs would increase their capacities so as to produce nearly 10,000 Ph.D.s a year, by 2020. Certainly, it opens up vast opportunities for aspirants.

Research parks

A commendable initiative is the establishment of research parks on the lines of business incubators/innovation labs in some of the centres of educational excellence such as MIT, Harvard, and Stanford. Companies with a research focus can set up their units in the park and leverage the expertise of the institute. These technology parks add value to industry and business enterprises. Also, they promote entrepreneurship and innovation. The collaborative environment involving industry and academia naturally enriches research experience. Some of the IITs have already established such parks with substantial infrastructure

Ph.D. Admission

The usual conditions for eligibility for Ph.D. admission are as follows:

1) Master's degree in engineering/technology or equivalent with at least 60 per cent marks (55 per cent for Scheduled Castes and Scheduled Tribes students)

2) Master's degree in science or bachelor's degree in engineering/technology or equivalent with at least 60 per cent marks (55 per cent for Scheduled Castes and Scheduled Tribes students)

For admission to humanities & social sciences and Industrial Design, the minimum requirement is 55 per cent marks or equivalent (50 per cent for Scheduled Castes and Scheduled Tribes students)

Candidates meeting this requirement should also fulfil one of the following additional requirements:

A valid GATE /CEED Score

CSIR-UGC/NBHM/DBT/DST Inspire Award or Fellowship

Minimum of two years of professional work experience, for Sponsored (SW)/Self-Financed (SF)/Institute Staff (IS) category.

There may be special conditions for special categories/programmes in certain institutions. These shall be indicated separately in further parts of this series, along with the areas of research available in each IIT.

Admission for IIT B.Tech. holders

Those with a CGPA/CPI score of 8.00 (on 0-10 scale) and above are exempted from requirement of GATE qualification. They will be admitted to Ph.D. programmes under TA/RA positions through written test/interview.

Assistantships

a)Those with M.Tech. or equivalent: Rs.18,000 for the first two years and Rs.20,000 a month for the remaining period. Maximum four years or till thesis submission, whichever is earlier.

b)Those with B.Tech. or equivalent, or M.Sc./MA./M.Com. or equivalent and valid GATE score or qualified through a National Level Test UGC/CSIR/NBHM/DBT JRF or having DST Inspire fellowship: Rs.16,000 for the first two years and Rs.18,000 a month for the remaining period. Maximum 5 years or till thesis submission, whichever is earlier.

c) MS in Engineering/Management: Rs.8,000 per month for first three years.

Financial Express, ND 18/08/2014 P-12

Silver bullet or merely silver-plated?

The plans to set up IITs and IIMs in every state may be misdirected unless these are backed by technology-based education strategies

MURALI MURTI

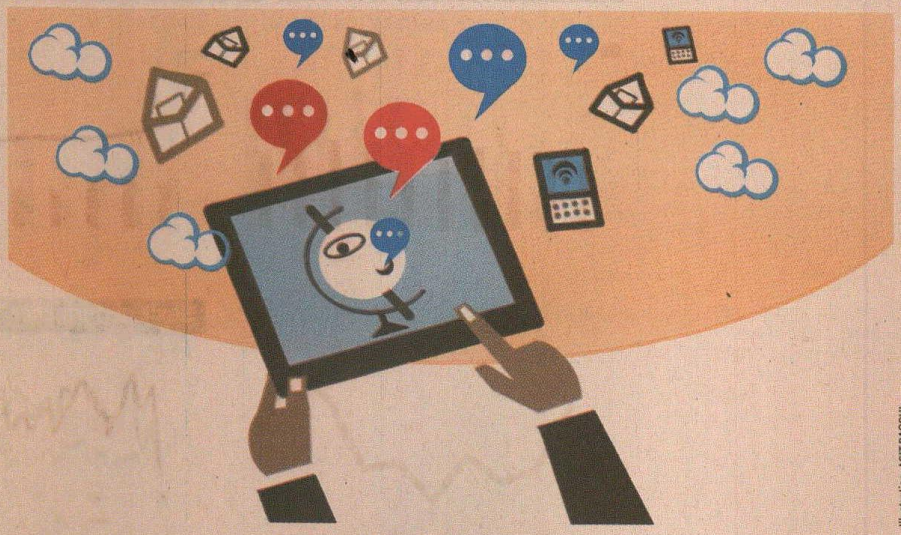


Illustration: ASIT BAGCHI

THE recent proposal to set up an IIT, an IIM and an AIIMS in every state has kicked off a flurry of controversy. The reactions can be grouped into three categories—those enthusiastically in favour of this because their home state will finally have those three magical brand-names close at hand; those aghast at the dilution of the elite 'brands'; and those who are confused but feel it is basically a good thing because we have to try and catch up with China and other countries. In other words, nobody really knows what the final effect of such a move will be on Indian education.

Carl Dahlman, the eminent World Bank economist, observed that a 21st century university should play three major roles. First, training high-level human capital, which is important not only for science and technology but also for managing economies. Second, advancing knowledge through research. Third, application of knowledge in society. Viewed through these three lenses, the proposal of setting up new IITs, IIMs and AIIMS not only starts to acquire shades of clarity, but alternatives and complementary strategies also begin to emerge.

The progress on Dahlman's first objective—training human capital—is generally measured by a country's gross enrolment ratio (GER) in higher education. From 2000 to 2012, India's GER rose from 9.5% to 24.8%. During the same period, China's went up from 7.8% to 26.7%, and the US's from 64.9% to 94.3%. Thus, India and China have performed almost identically on this score, contrary to popular perception. Interestingly, it is the huge expansion in the number of private universities in India that appears to have fuelled this growth.

If the US GER appears daunting, we should remember that the total number of students in higher education in all the three countries are roughly the same in absolute numbers—around 20-25 million. As far as turning out graduates is concerned, these three countries collectively are the powerhouse of the planet. But are the graduates uniformly capable or employable across these three countries? The answer is weighted heavily in favour of the US.

As far as Dahlman's second objective—research output by universities—is concerned, the picture is again revealing. Research output in India, measured by the number of publications, is growing at an annualised rate of 14.8% based on the 2008-12 time frame. This is higher than China, whose research output grew at 10.9% during the same period. Significantly, the quality of India's research also appears to be increasing at a healthy rate of 11.3%, as measured by the share of the top 10% cited articles, and is second only to China at 13.9%. The data indicates that Indian research is particularly successful when performed in collaboration with other international organisations. Here again, contrary to popular perception, India has not done too badly in the recent past.

However, it is when we consider the third of Dahlman's objectives—the application of knowledge to society—that stark differences are apparent. Based on the number of patents granted in 2012, India (at 3,588) is far behind China (152,102). Indian research is also cited infrequently in patent applications. The US remains far ahead even of China, at 276,788 patents granted in 2012. Thus, in the application of knowledge to society, especially in the fields of science and technology, India has tremendous ground to cover.

With this background, it is possible to take a reasoned position on the proposal to set up an IIT, an IIM and an AIIMS in every state. If the purpose is to increase the educational base, it would probably make just as much sense to increase the number of private universities, who are more driven by enrolments in any case. If the objective is to increase research and publication output, an IIT or an IIM in every state is unlikely to dramatically impact the statistic.

The proposal only makes sense if the IIT/IIM/AIIMS in every state is intended to be a catalyst for an economic and industrial development cluster, and if the objective of these institutions is the application of research to society. This is a well-established model, with Silicon Valley in California—centred around Stanford University and the University of California system—being the best-known example. The IT cluster in Bangalore and the manufacturing clusters beginning to emerge in Gujarat, Tamil Nadu and Haryana are evidence of the phenomenon manifesting itself in India. In fairness to the original five IITs, it has to be noted that they have indeed contributed in many significant ways, which unfortunately do not appear on measurement metrics and rankings.

But an even more important criticism that can be levelled against the proposal is that it ignores the much-discussed demographic dividend that India enjoys. With 64% of its population expected to be in the prime workforce age band of 15-59 years by 2026, and contributing up to an estimated 30% of the global workforce in the process, India is well positioned to be one of the strongest stakeholders in the global economy during the next two decades. But this will require India's workforce to be employable in the global economy, with the mix of skills required by corporations worldwide. Such a situation leaves India with no choice. It must do everything it can to quantum leap its GER to 70-80%, because only then will its youth find acceptance anywhere. Not only this, India needs to ensure that the right mix of skills is imparted, and absorbed, by its huge young population.

For this vision to be realised, transformational strategies will need to be developed. An IIT in every state, or increasing the number of private universities, represents linear thinking rooted in the past. It does nothing to reap the demographic dividend. The idea is not paradigm-shifting. India needs a break with the past, not more of the same. It is through technology—by a remarkable coincidence based on India's key strengths in IT—that a solution is possible. With 900 million mobile phones and 200 million internet users, India's youth is already comfortable with technology. Online, technology-based education strategies, with a mix of both short and long courses, both degree and certificate, offer a practical way to achieve the quantum leap in numbers and skills. Establishing IITs and IIMs is not enough. Their role must be to apply knowledge and technology skills to education, to take the IIT or IIM standards and ethos out of the physical classroom into the virtual sphere, directly to those young millions.

The author is vice-president, academic excellence, Avagmah, an online education company

Financial Express, ND 18/08/2014 P-12

Responding to sustainable development issues

News of research and academic initiatives on sustainability has to move from educational supplements to mainstream

RAJIV SETH

This year marks the end of the United Nations Decade of Education for Sustainable Development (2005-2014). Let us just sit back and look at the progress made.

Whilst in India, we have moved ahead in the area of environmental education, it is the core concept of integrating sustainable development into our higher education system that remains a not-so-well-understood concept. The unique holistic and cross-cutting nature of education for sustainable development (ESD) remains a goal to be achieved in most of our universities. In spite of the fact that universities need to be engines and innovation centres in sustainable development, there are just a handful of universities that devote themselves to creating knowledge for sustainable development. So, what needs to be done?

It should be obvious in today's context that universities can inculcate the spirit of sustainability in their students, not just by incorporating more theory into their curricula but more so through an experiential learning platform of field work and exercises to understand and reduce the unsustainable impacts of present lifestyles. We could say that Indian universities have a different, and probably easier, playing ground than other global universities. This comes from the fact that our commitment towards sustainability is rooted in the age-old traditions of living in equilibrium with nature and all its elements. We only have to draw from these traditions as we move ahead.

Universities in India only need to be helped towards responding to sustainable development issues. We need to have a macro-level approach to reorient our higher education. This is an opportune moment, when we have a new government, and when higher education is one of the priority areas. Three aspects need to be looked at—systemic thinking has to be an approach towards our higher education, greater focus towards capacity building at various levels including skill development and involvement of the media to do a blitzkrieg in improving public understanding of sustainable living.

It is imperative that our universities accept the need to move from academic discourses on sustainable development to action-oriented involvement of the youth in solving issues that the world faces

Most universities have responded by adding a couple of courses on sustainability issues. That won't do. What is required is a change in the thinking and the approach of the academia—a movement away from 'environmental education' to 'education for sustainable development'; a movement away from the departmental or stream-wise thinking to a systemic approach to issues and challenges that the world is facing. Curriculum will follow.

Our universities have to focus on capacity building—to raise awareness and provide students with the skills and expertise required for the protection of the environment. This doesn't mean that we do away with theory. Theoretical underpinnings are extremely important. But when the thinking of teachers reorients towards a sustainability-science and systemic approach, skill development amongst students of higher education to tackle the issues the world, a shared home, faces, will automatically follow.

With the time-bomb of climate change not just ticking away but clanging away, only a blitzkrieg by the media and advertising agencies towards promoting public opinion can result in a wider understanding of the principles of sustainable development and an engagement with universities on educational and research initiatives. News of research and academic initiatives on sustainability, like the setting up of a new programme on Water Science and Governance at the Teri University, has to move from educational supplements to mainstream! It is greater public opinion which will result in a growth of greater social responsibility and an understanding of the cause and effect relationship in consumptive lifestyles.

Ultimately, it is imperative that our universities accept the urgent need to move from academic discourses on sustainable development to action-oriented involvement of the youth in solving issues that the world faces, through a holistic and systemic approach.

The author is Registrar, Teri University. Views are personal

Dainik Jagran ND 18/08/2014 P-1

देसी ड्रोन करेगा सीमा की निगहबानी

डा. सुरेश अवस्थी, कानपुर

भारतीय प्रौद्योगिकी संस्थान (आइआइटी) के वैज्ञानिकों ने कंप्यूटर नियंत्रित ऐसा मानव रहित छोटा एयरक्राफ्ट (ड्रोन) बनाने में सफलता पाई है जो सीमा की तो निगहबानी करेगा ही, दंगा नियंत्रण में भी प्रशासन का सहयोग करेगा। उसके सफल परीक्षण से वैज्ञानिक उत्साहित हैं। आइआइटी कानपुर को यह प्रोजेक्ट इस साल 14 जनवरी को मिला था और उसने एयरक्राफ्ट का प्रोटोटाइप तैयार करके अगस्त के पहले सप्ताह में सफलतापूर्वक परीक्षण भी कर लिया। एयरोस्पेस इंजीनियर प्रो. एके घोष के नेतृत्व में इंडस्ट्रीयल मैनेजमेंट एंड इंजीनियरिंग के असिस्टेंट प्रोफेसर डा. दीपू फिलिप व उनकी टीम ने आइआइटी व प्रभु गोयल फाउंडेशन के आर्थिक सहयोग से इसका सफल परीक्षण किया।

विमान की खासियत

यान में शक्तिशाली वीडियो कैमरा है जो नियंत्रण कक्ष में पूरे क्षेत्र की वीडियो फिल्म भेजता है। कार पर रख कर कहीं भी ले जा सकने वाले इस क्राफ्ट को निश्चित समय बाद वापस बुलाया जा सकता है। यह अपने उड़ान क्षेत्र को पूरी तरह से कवर करता है। हालांकि ऐसे लघु एयरक्राफ्ट अमेरिका में बनाए जा चुके हैं परंतु भारत में यह पहला अवसर था, जब सफलता पूर्वक ऐसे ड्रोन का परीक्षण हुआ।

यहां हो सकता है उपयोग

यह विमान सीमा पर तीन किमी की परिधि में घुसपैठ की तस्वीरें भेज सकेगा। नक्सलियों व आतंकवादियों के अड्डों को लक्ष्य किया जाए तो उनकी गतिविधियां कैद कर सकेगा। दंगा ग्रस्त क्षेत्रों की गतिविधियों को देखा जा सकेगा। फसलों की स्थिति की जानकारी मिलेगी। जुलूस, भीड़ आदि की भी निगरानी की जा सकती है।

प्रोफाइल

- **3.3** मीटर है लंबाई
- **1000** फीट की ऊंचाई पर उड़ सकता है
- **93.6** किमी प्रति घंटा है अधिकतम गति
- **24** घंटे तक रह सकता है आसमान में
- **20** किलोग्राम है वजन
- **10-15** लाख रुपये निर्माण में लागत

Mail Today ND 18/08/2014 P-9

India to soon get fuel from plastic

By **Akash Vashishtha**
in New Delhi

INDIA will soon be able to convert its plastic wastes into high-grade petrol and diesel, thanks to a breakthrough by researchers at Dehradun-based Indian Institute of Petroleum.

The IIP, a constituent lab of the Council of Scientific and Industrial Research, has for the first time in the country developed a technology to convert plastic waste into petroleum products. Such a technology is so far available only in Germany, Japan and the US while Australia and the UK are still working on it.

The technology converts plastic into gasoline, diesel or aromatics through the use of a combination of suitable catalysts. It will also produce LPG as a common by-product.

According to IIP Director M.O. Garg, the fuels obtained (gasoline and diesel) through the process employed in the technology meet Euro-III standards and are of ultra high-quality.

With almost nil sulphur content, the diesel obtained through the process is said to be of high quality. It will lead to vastly reduced emissions from engines, officials said. An engine run on this fuel will enable a vehicle to run for at least two km more per litre than ordinary diesel.

"We have applied for a patent. We developed this after nearly a decade of intensive research. We are now planning to commercialise the technology although we are still engaged in the process of engineering to design heavy machinery and processes," Garg told MAIL TODAY.

The new method converts ordinary plastic waste into petroleum products

"The current prices of petrol, which is derived from crude hydrocarbons, range between ₹70 to ₹80 per litre. Petrol in this case costs ₹30 to ₹40 per litre, inclusive of the cost of plant, operations, manpower and land cost," Garg said. "There is a mammoth amount of solid waste generated in the country. It could be procured at a minuscule cost."

The fuel is said to be ideal for captive users like the state road transport corporations, the defence establishment and railways. In the absence of effective implementation and enforcement of Hazardous Wastes (Management and Handling) Rules of 1989, the handling of plastic waste continues to be a major challenge in the country.

The technology, if commercially implemented, will considerably address India's rising problem of hazardous plastic waste.

BIOTECHNOLOGY WOES

THE government's performance in promoting and funding research in biotechnology, one of its key priority areas, has been dismal during 2013-14, according to the latest report of the Department of Biotechnology.

The government received 255 research proposals seeking funding for international collaboration but sanctioned only 53, the report states.

In medical research, 50 projects out of 280 were sanctioned.

Out of 188 proposals for research in biotechnology in areas as important as public health, food and nutrition, the government provided assistance to only 26 projects.

It considered only 49 out of 369 projects for advanced research in non-infectious medical biotechnology worthy of being granted assistance.

The Department of Biotechnology is entrusted with supporting research and development programmes in basic and advanced areas of biotechnology. It is grappling with a minuscule allocation. *Mail Today*

The Indian Institute of Petroleum has developed a technology that uses a combination of catalysts to produce diesel and petrol. Piles of trash like the one above could soon turn into productive assets.

Times of India, ND 18/08/2014 P-13

Shape-shifting robots a reality

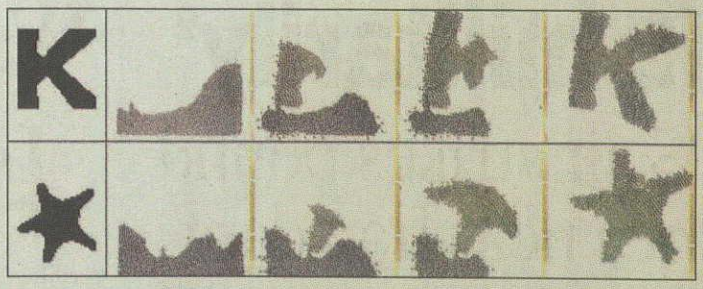
1,024 Self-Organizing Bots Can Assemble Into Pre-Determined Shapes

Washington: Remember Chitti, the lovable shape-shifting robot played by superstar Rajinikanth in the film Endhiran (Robot)? Well, Harvard scientists, including one of Indian-origin, have created the world's largest robotic swarm — 1,024 little bots standing on pin-like legs — that can assemble into pre-determined shapes, pretty much like Chitti.

Researchers at Harvard University demonstrated the robots by sending a command 'form a sea star shape' to the little bots simultaneously via an infrared light.

The robots began to blink at one another and then gradually arranged themselves into a five-pointed star. The robots then also formed the letter K. The 'K' stands for Kilobots, the name given to these extremely simple robots, each just a few centimetres across, standing on three pin-like legs.

Just as trillions of individual cells can assemble into an intelligent organism, or a thousand starlings can form a great flowing murmuration across the sky, the Kilobots demonstrate how complexity can arise from very simple behaviours performed en masse.



BOT OF COURSE: (Top) This photo shows the Kilobots' ability to organize into two-dimensional shapes on command. (Left) A scene from the film Endhiran, which starred the shape-shifting robot Chitti

The self-organizing swarm was created in the lab of Radhika Nagpal, Fred Kavli Professor of Computer Science at the Harvard School of Engineering and Applied Sciences (SEAS) and a Core Faculty Member at the Wyss Institute for Biologically Inspired Engineering at Harvard University.

"We are especially inspired by systems where individuals can self-assemble together to solve problems," said Nagpal. The Kilobots require no micromanagement or intervention once an initial set of instructions has been delivered.

Four robots mark the origin of a coordinate system, all the other robots receive a 2D image that they should mimic, and then using very primitive behaviours — following the edge of a group, tracking a distance from the origin, and maintaining a sense of relative location - they take turns moving towards an acceptable position. The Kilobots also correct their own mistakes. If a traffic jam forms or a robot moves off-course — errors that become much more common in a large group — nearby robots sense the problem and cooperate to fix it.

To keep the cost of the Kilobot down, each robot moves using two vibrating motors that allow it to slide across a surface on its rigid legs. An infrared transmitter and receiver allow it to communicate with a few of its neighbours and measure their proximity — but the robots are myopic and have no access to a bird's-eye view.

"These robots are much simpler than conventional robots, and as a result, their abilities are more variable and less reliable," said lead author Michael Rubenstein, a research associate at Harvard SEAS and the Wyss Institute. "For example, the Kilobots have trouble moving in a straight line, and the accuracy of distance sensing can vary from robot to robot," he said. PTI