IPS Academy
INSTITUTE OF ENGINEERING & SCIENCE
Knowledge, skills and values

MECHAZINE

Department of Mechanical Engineering
Annual Magazine
2015-16

Letter from the Editors

Dear Readers,

It is a great pleasure and we feel honoured to be a part of the first e-magazine ***Mechazine*** of Department of Mechanical Engineering. This is one of the youngest departments of Institute of Engineering & Science, IPS Academy. Its first batch will be passing out in 2017. Students have shown tremendous potential not only in academics but also in co-curricular and extracurricular activities.

The objective of magazine is to update and showcase the latest development of Mechanical engineering and application of Mechanical technology. ***Mechazine*** includes articles from Mechanical Engineering Department.

We take this opportunity to thank our respected Principal **Dr. Archana Keerti Chowdhary,** HOD **Dr. Sanjay Jain** and all the faculty members for their incessant inspiration and kind support.

We hope that this edition would be enjoyable as well as informative.

Editors…

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Editorial Board

S. No.	Name of Student	Year
1.	Mr. Akshat Shrivastava	Third Year
2.	Mr. Aquib Khan	Third Year
3.	Mr. Bobby Choudhary	Third Year
4.	Mr. Pradhumn Vijayvargiya	Third Year
5.	Mr. Huzaifa Yakub Hussain	Second Year
6.	Mr. Tarun Parmar	Second Year

Faculty Coordinators

1.	Mr. Kapil Patodi	Assistant Professor
2.	Mr. Pradeep Singh Hada	Assistant Professor

Content

STUDENTS ARTICLES

New method uses 3D printed polymers to make flaw-free ceramic micro lattices

A new method for 3D printing ceramic microlattices has been developed by researchers in the US. The lattices have fewer flaws than ceramics manufactured by conventional sintering processes, making them much stronger. The potential applications range from micro-electromechanical systems to jet engines, and potentially even more advanced aerial vehicles such as space shuttles.[1]

Although they are inherently very strong, ceramic materials are brittle, which means they cannot easily be machined or cast. They are usually sintered by fusing powder grains at very high temperatures. This introduces microscopic flaws that can nucleate cracks when the materials are stressed, often making the actual strength of ceramic objects much lower than the intrinsic strength of the ceramic. To get around this, materials scientist Tobias Schaedler and colleagues at HRL laboratories used ‘preceramic polymers’ that, when heated, pyrolyze into ceramics. The polymers can be deposited as high-purity liquids, producing a more homogenous material with fewer flaws. The team used a mixture of siloxane and silazane, which, when pyrolysed, produces silicon oxycarbide ceramic, using ultraviolet light to crosslink the polymer in the appropriate areas to form the object.

They tried this approach using two 3D printing methods. Stereolithography can form almost any shape by building the object in a series of 2D slices, but this is slow, and the inevitable stepped edges weaken the object. Simpler objects with perfectly smooth edges can be made more rapidly using self-propagating photopolymer waveguide technology, in which the polymer is irradiated through a single mask at the top and as the light passes through the object and polymerises it, the polymer forms a UV waveguide that traps the light, focusing it deeper inside the object. When the unpolymerised resin is washed away, the polymer structure left can be transformed into a ceramic one by firing.

This method cannot produce thick objects as they crack when fired, but it does allow intricately and precisely structured microlattices with densities as low as $0.22 gcm^{-3}$, which can be rationally designed so that when the material is bent the individual struts stretch or compress, making them much stronger than randomly structured ceramic foams. ‘Any material is stronger in tension and compression than in bending,’ explains Schaedler.

Rishi Raj of the University of Colorado in Boulder, US, whose own group has recently unveiled a method for polymer-derived ceramic manufacture, describes the work as ‘quite significant, maybe very significant’, although he says the unsuitability for thick structures precludes many important practical uses of ceramics such as heat shields. Gian Domenico Sorarù of the University of Trento in Italy agrees that the lack of insulation may be problematic. ‘But maybe that is not the main task for these materials,’ he adds. ‘I think applications are in the field of catalyst support, filters and burners.’

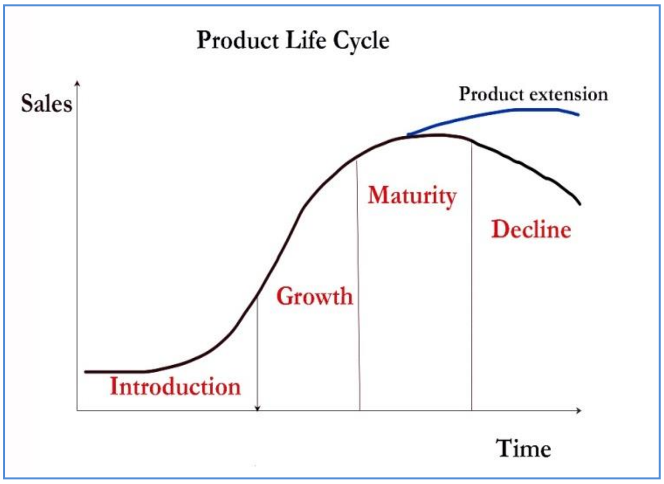
Akchat Shukla (II Year)

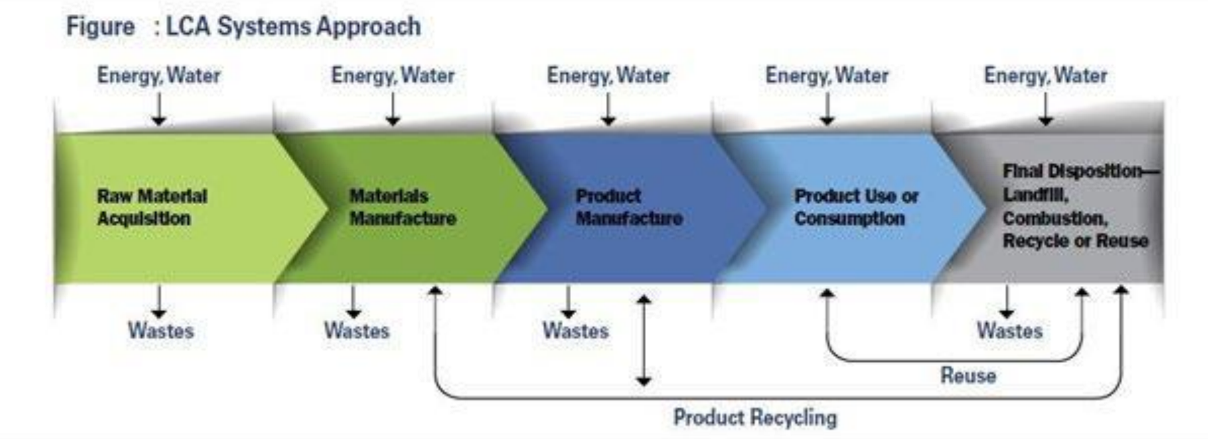
Product Life Cycle Assessment (PLCA)]

Life cycle approach reflects the consideration of cradle to grave conclusions of any actions and guides the overall approach to dealing with environmental and sustainability issues. Thinking in terms of product life cycles is one of the challenges faced by manufacturers today, which requires efforts to increase efficiency throughout the life cycle and do not only lead to an elongated responsibility of the concerned parties. Life Cycle Assessment (LCA) considers the product life cycle as a whole and optimizes the interaction of product design, manufacturing and life cycle activities. The goal of this approach is to prevent resources and maximize the efficiency during utilization by significance of life cycle of product, product data management, technical support and last but not least, by life cycle costing. LCA analysis is both time and resource consuming, due to the collection of the product data needed to enable its performance.

The main tool supporting the life-cycle thinking concept is Life Cycle Assessment, whose prime aim is to designate the environmental consequences of products and accommodations from cradle to grave. The life cycle management concept must be advanced to accommodate as an integral part of engineering, operation and recycling/disposal processes. Fundamental principles must be provided for technical

support, product data management, and technical themes evaluation and assessment of economic and ecological parameters or values. The purpose of LCA





is to compile and evaluate the environmental consequences of different options for fulfilling a certain function and it is a universally accepted approach of determining the environmental consequences of a sustainable product over its entire production cycle. The LCA methodology can be useful to acquire a comprehensive knowledge of the environmental impacts generated by industrial products during their whole life cycle.

Role of LCA in Relation to Products:

LCA can play an important role in public and private environmental management in relation to products. This may involve both an environmental comparison between existing products and the development of new products, which includes comparison with prototypes. For instance, a major application involves 'green' procurement, that is green purchasing policy which can be implemented by both higher entities and companies. However, ranking of resources, materials or products for purchasing reasons need not be done on a quantitative basis utilizing LCA. Another application concerns eco-labelling (assigning a green label to environmentally friendly products), which enables consumers to make comparisons between products. A further application in relation to products is the design of more environmentally cordial products termed as eco-design.

This is an activity of increasing relevance which imposes categorical requirements on the available life cycle information, so that it must be very simple to utilize. In manufacturing, there is a constant need to improve production methods through new machining technology, processes that allow quicker production or new methods that improve the product safety, reliability and to create value. However, for the development of machines and for production strategies, development still exists. In these instances, companies must seek other methods of improvement, such as value stream mapping, which is a philosophy of creating value while mapping the whole process of product. The goal here is to eliminate the waste, to reduce manufacturing costs, improve the quality of the product being manufactured and to shorten the production lead time, allowing quicker delivery of the final product to the customer.

LCA System Approach

If you are looking to examine more than one environmental or energy attribute of a product, and you require to examine trade-offs in making changes that can help identify places to reduce the overall footprint of a product system, it might make sense to consider the broader approach that an LCA presents. LCA is a "systems' analysis" implement that examines the whole system required to distribute accommodations (primarily through the utilization of products) to end-users (consumers). Life cycle Assessment is a foundational tool for a sustainable design. It is a way of quantifying the environmental impact of your designs so that you and your customers can make more informed decisions. Several life cycle stages, unit processes and flows may be taken into consideration, as shown in figure, for example:

- Inputs and outputs in the main manufacturing/ processing sequence;
- Distribution/transportation;
- Production and use of fuels, electricity and heat;
- Use and maintenance of products;
- Disposal of process wastes and products;
- Recovery of used products (including reuse, recycling and energy recovery);
- Manufacture of ancillary materials;
- Manufacture, maintenance and decommissioning of capital equipment;
- Additional operations, such as lighting and heating;
- Other considerations related to impact assessment (if any).

It is necessary to describe the system utilizing a process flow diagram that shows unit processes and their interrelationships. This basic flow diagram shows what definite unit processes for the system being examined are included in every step of the life cycle: An LCA and its results should be relative to a "functional unit." ISO defines a functional unit as the quantified performance of a product system for utilize as a reference unit in an LCA study. Another way to understand the term is to think of the functional unit as the equipollent quantification, or "function," that will LCA study.

The benefits of doing LCA are given below:

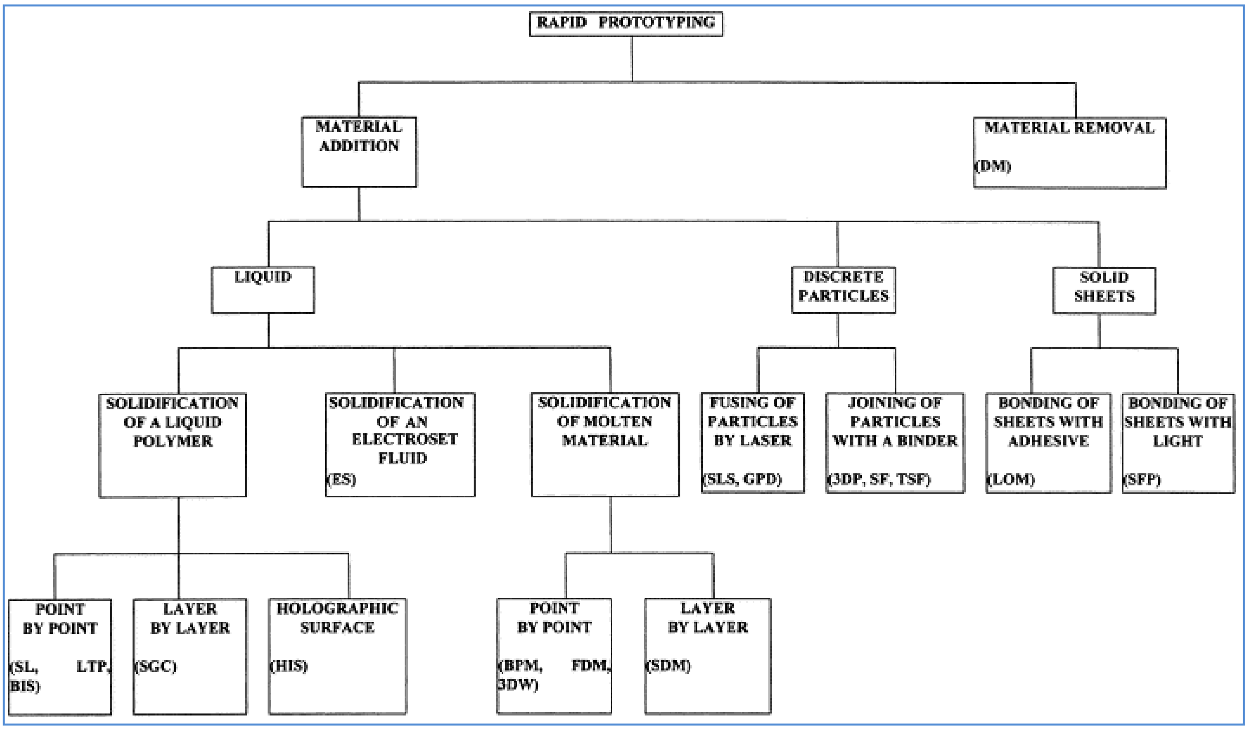
- Improved environmental cost allocation
- Allows you to target supply chain improvements
- Help to shape corporate sustainability strategy
- Assess/justify impact of material choices and operational processes
- Assess your product/service/process against those of your competitors
- Supports communications about environmental friendliness of products/services/processes
- Improved environmental performance and reputation
- Strengthened customer loyalty.

Akarsh Dave (III Year)

Rapid Prototyping: An Overview

Rapid Prototyping (RP) can be defined as a group of techniques used to quickly fabricate a scale model of a part or assembly using three-dimensional computer aided design (CAD) data. What is commonly considered to be the first RP technique, Stereolithography, was developed by 3D Systems of Valencia, CA, USA. The company was founded in 1986, and since then, a number of different RP techniques have become available.

Rapid Prototyping has also been referred to as solid free-form manufacturing; computer automated manufacturing, and layered manufacturing. RP has obvious use as a vehicle for visualization. In addition, RP models can be used for



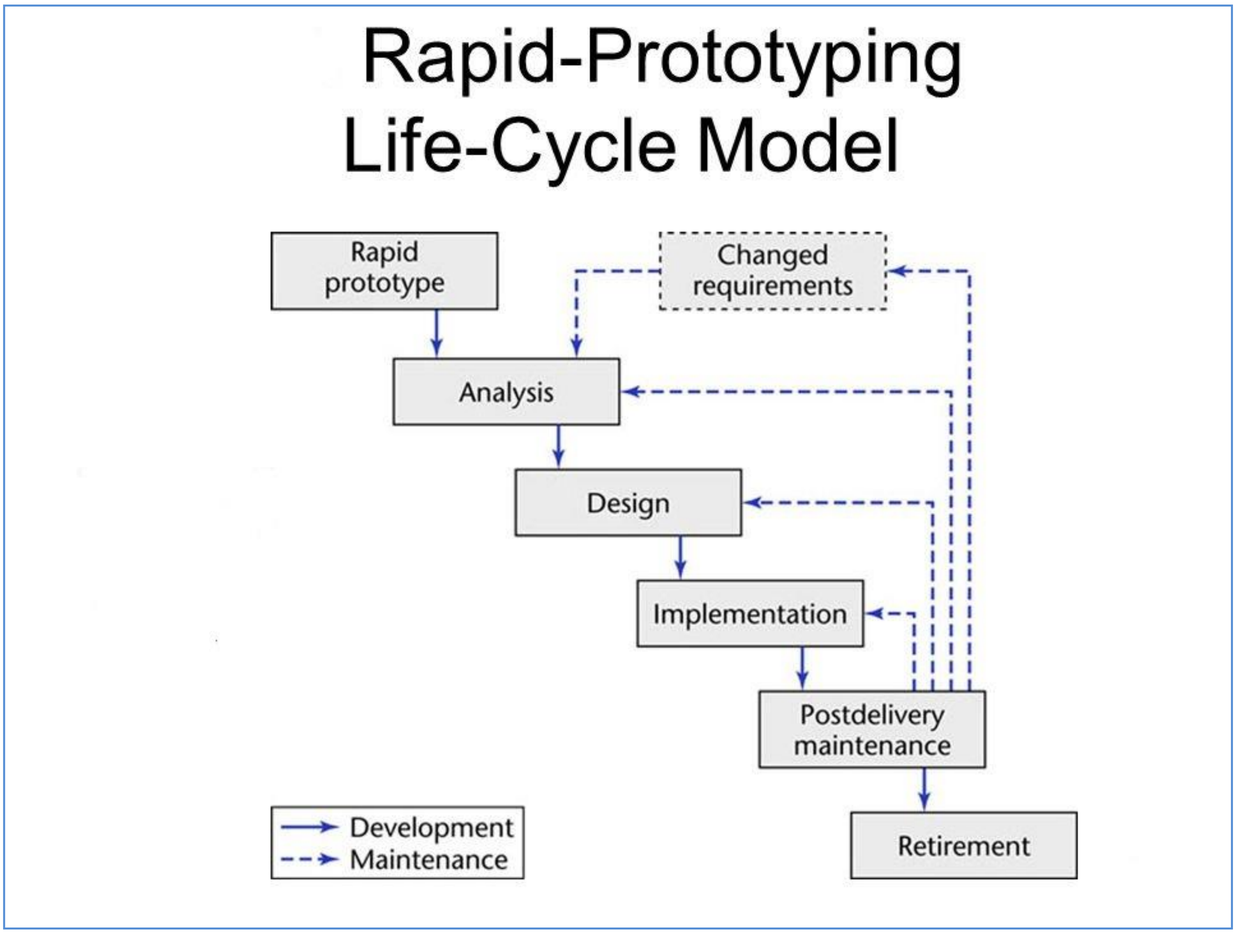
testing, such as when an airfoil shape is put into a wind tunnel. RP models can be used to create male models for tooling, such as silicone rubber molds and investment casts. In some cases, the RP part can be the final part, but typically the RP material is not strong or accurate enough. When the RP material is suitable, highly convoluted shapes (including parts nested within parts) can be produced because of the nature of RP.

There is a multitude of experimental RP methodologies either in development or used by small groups of individuals. This section will focus on RP techniques that are currently commercially available, including Stereo lithography (SLA), Selective Laser Sintering (SLS®), Laminated Object Manufacturing (LOM™), Fused Deposition Modeling (FDM), Solid Ground Curing (SGC), and Ink Jet printing techniques.

Why Rapid Prototyping?

The reasons of Rapid Prototyping are

- To increase effective communication.
- To decrease development time.
- To decrease costly mistakes.
- To minimize sustaining engineering changes.



- To extend product lifetime by adding necessary features and eliminating redundant features early in the design.

Rapid Prototyping decreases development time by allowing corrections to a product to be made early in the process. By giving engineering, manufacturing, marketing, and purchasing a look at the product early in the design process, mistakes can be corrected and changes can be made while they are still inexpensive. The trends in manufacturing industries continue to emphasize the following:

- Increasing number of variants of products.
- Increasing product complexity.
- Decreasing product lifetime before obsolescence.
- Decreasing delivery time.
- Rapid Prototyping improves product development by enabling better communication in a concurrent engineering environment.

Methodology of Rapid Prototyping

The basic methodology for all current rapid prototyping techniques can be summarized as follows:

1. A CAD model is constructed, and then converted to STL format. The resolution can be set to minimize stair stepping.
2. The RP machine processes the .STL file by creating sliced layers of the model.
3. The first layer of the physical model is created. The model is then lowered by the thickness of the next layer, and the process is repeated until completion of the model.

The model and any supports are removed. The surface of the model is then finished and cleaned.

Vishal Makhija (III Year)

Wind Power

Wind is the movement of air from an area of high pressure to an area of low pressure. In fact, wind exists because the sun unevenly heats the surface of the Earth. As hot air rises, cooler air moves in to fill the void. As long as the sun shines, the wind will blow. And wind has long served as a power source to humans.

Ancient mariners used sails to capture the wind. Farmers once used windmills to grind their grains and pump water. Today, more and more wind turbines wring electricity from the breeze. Over the past decade, wind turbine use has increased more than 25 percent per year. Still, it only provides a small fraction of the world's energy.

How it Works

Most wind energy comes from turbines that can be as tall as a 20-story building and have three 200-foot (60-meter)-long blades. The wind spins the blades, which turn a shaft connected to a generator that produces electricity.

The biggest wind turbines generate enough electricity in a year (about 12 megawatt-hours) to supply about 600 U.S. homes. Wind farms have tens and sometimes hundreds of these turbines lined up together in particularly windy spots. Smaller turbines erected in a backyard can produce enough electricity for a single home or small business.

The Booming Wind Energy Industry

Wind is a clean source of renewable energy that produces no air or water pollution. And since the wind is free, operational costs are nearly zero once a turbine is erected. Mass production and technology advances are making turbines cheaper, and many governments offer tax incentives to spur wind-energy development.

Drawbacks include complaints from locals that wind turbines are ugly and noisy. The slowly rotating blades can also kill birds and bats, but not nearly as many as cars, power lines, and high-rise buildings do. The wind is also variable: If it's not blowing, there's no electricity generated.

Nevertheless, the wind energy industry is booming. Thanks to global efforts to combat climate change, such as the Paris Agreement, renewable energy is seeing a boom in growth, with wind energy leading the way. From 2000 to 2015, cumulative wind capacity around the world increased from 17,000 megawatts to more than 430,000 megawatts. In 2015, China also surpassed the EU in the number of installed wind turbines and continues to lead installation efforts.

Industry experts predict that if this pace of growth continues, by 2050 one third of the world's electricity needs will be fulfilled by wind power.

Nikhil Agrawal (III Year)

Lasers in Industries

The very first production laser was introduced in 1965. Developed by Western Electric, a major American electrical engineering and manufacturing company responsible for many seminal developments in industrial engineering, it was used to drill holes in diamond dies. Two years later, a German scientist engineered the laser cutting nozzle and used an oxygen assist-gas to cut 1 mm thick steel sheet with a focused CO_2 laser beam. Fast forward another couple of years, when three researchers at Boeing wrote a paper concluding that, with significant R&D, laser gas-assist could be an effective tool for cutting hard materials such as titanium, Hastelloy, and ceramic. The first commercially available moving optics CO_2 laser cutting system, with a configuration comparable to today's modern equipment, was introduced in 1975. The technology did not stand still. Foresighted industrial entrepreneurs adapted laser technology for engraving and marking, and the 1980s ushered in the development of laser welding as a precise, clean, high speed, and easily automated solder-free alternative to traditional methods of joining. Lasers for industrial processes continue to get more powerful, accurate, and efficient to meet the ever growing quality and financial challenges of precision manufacturing.

Laser technology provides an elevated level of accuracy, consistency, control, and flexibility to manufacturing. As a non-contact process with no heat affected zone, laser increases the engineer's ability to process sensitive and highly engineered materials. Advanced computer controls and positioning systems promote accuracy and consistency from part to part and lot to lot. Lasers have the ability to cut intricate, complex, shapes, precisely drilled micro holes, and seamless welds with striation free edges and smooth surfaces. A minimal tooling requirement promotes rapid prototype development, simplifies execution of design changes, and allows flexible capacity to handle spikes in demand. The growing complexity of medical devices combined with stringent regulatory validation and traceability requirements compels medical device companies to forge a supply chain of component manufacturers that can unfailingly provide accurate, consistent, repeatable, and timely results.

Laser Cutting

A laser cutter works by focusing the output of a high-power laser on the material to be cut. The intense beam of coherent light heats, melts, or vaporizes the selected area and leaves a clean, burr-free edge with a high-quality surface finish. Precise computer controlled positioning systems enable lasers to create any geometry with pinpoint accuracy and consistent repeatability. Lasers are capable of creating distortion-free cuts in flat or tubular stock of almost any metal, plastic, or composite material, and create a minimal "heat affect zone" that could potentially compromise the microstructure or properties of the base material.

Laser Welding

For applying thermal energy to a very small area, no other method is as efficient as a laser. By delivering a pulse of light focused on a very narrow spot, the surface absorbs the light, vaporizes the material, and allows it to fuse together and form a strong structural bond. Tightly controlled laser beam and motion parameters result in welds that are quite small and have an excellent cosmetic appearance. Laser welding equipment with pulse-shaping capability allows for precision welds and high welding rates. No filler is required, which makes it an ideal method of joining two dissimilar metals without any risk of contamination, and little if any joint preparation is required. Millisecond-long pulses effectively weld thin materials, while continuous laser systems are more suitable when deep welds are required.

Laser Drilling

Laser drilling is the process of repeatedly pulsing focused laser energy at a material, vaporizing it layer by layer until a thru-hole is created. Short-pulse lasers are capable of drilling holes with exacting precision in materials such as stainless steel, nickel, titanium, and other alloys, as well as polymer and rubber. In addition to creating holes that are clean and uniform with excellent surface quality, some lasers offer the advantage of virtually no heat affected zone to maintain material integrity, even on thin walled geometries. Lasers are particularly successful in producing micro holes in polymer tubing, which cannot be electro discharge machined, and where mechanical drilling would leave burrs and debris that would be costly to clear and dangerous to leave behind.

Laser marking

Marking lasers produce durable and biocompatible markings with important specification and traceability data and graphical information. As a non-contact form of engraving that offers high processing speeds and consistent high quality marks, they make it possible to convey important product details without using toxic inks or chemicals. The marks they make are flat, so there is no risk of creating fissures or crevices that could potentially harbor harmful pathogens. Using lasers that meet approved guidelines ensures that medical products are FDA compliant and safe to use.

Krishna Singh (II Year)

The Great Mathematician : Srinivasa Ramanujan

It is one of the most romantic stories in the history of mathematics: in 1913, the English mathematician G. H. Hardy received a strange letter from an unknown clerk in Madras, India. The ten-page letter contained about 120 statements of theorems on infinite series, improper integrals, continued fractions, and number theory. Every prominent mathematician gets letters from cranks, and at first glance Hardy no doubt put this letter in that class. But something about the formulas made him take a second look, and show it to his collaborator J. E. Littlewood. After a few hours, they concluded that the results "must be true because, if they were not true, no one would have had the imagination to invent them".

Thus was Srinivasa Ramanujan (1887-1920) introduced to the mathematical world. Born in South India, Ramanujan was a promising student, winning academic prizes in high school. But at age 16 his life took a decisive turn after he obtained a book titled *A Synopsis of Elementary Results in Pure and Applied Mathematics*. The book was simply a compilation of thousands of mathematical results, most set down with little or no indication of proof. It was in no sense a mathematical classic; rather, it was written as an aid to coaching English mathematics students facing the notoriously difficult Tripos examination, which involved a great deal of wholesale memorization. But in Ramanujan it inspired a burst of feverish mathematical activity, as he worked through the book's results and beyond. Unfortunately, his total immersion in mathematics was disastrous for Ramanujan's academic career: ignoring all his other subjects, he repeatedly failed his college exams.

As a college dropout from a poor family, Ramanujan's position was precarious. He lived off the charity of friends, filling notebooks with mathematical discoveries and seeking patrons to support his work. Finally he met with modest success when the Indian mathematician Ramachandra Rao provided him with first a modest subsidy, and later a clerkship at the Madras Port Trust. During this period Ramanujan had his first paper published, a 17-page work on Bernoulli numbers that appeared in 1911 in the *Journal of the Indian Mathematical Society*. Still no one was quite sure if Ramanujan was a real genius or a crank. With the encouragement of friends, he wrote to mathematicians in Cambridge seeking validation of his work. Twice he wrote with no response; on the third try, he found Hardy.

Hardy wrote enthusiastically back to Ramanujan, and Hardy's stamp of approval improved Ramanujan's status almost immediately. Ramanujan was named a research scholar at the University of Madras, receiving double his clerk's salary and required only to submit quarterly reports on his work. But Hardy was determined that Ramanujan be brought to England. Ramanujan's mother resisted at first--high-caste Indians shunned travel to foreign lands--but finally gave in, ostensibly after a vision. In March 1914, Ramanujan boarded a steamer for England.

Ramanujan's arrival at Cambridge was the beginning of a very successful five-year collaboration with Hardy. In some ways the two made an odd pair: Hardy was a great exponent of rigor in analysis, while Ramanujan's results were (as Hardy put it) "arrived at by a process of mingled argument, intuition, and induction, of which he was entirely unable to give any coherent account". Hardy did his best to fill in the gaps in Ramanujan's education without discouraging him. He was amazed by Ramanujan's uncanny formal intuition in manipulating infinite series, continued fractions, and the like: "I have never met his equal, and can compare him only with Euler or Jacobi."

One remarkable result of the Hardy-Ramanujan collaboration was a formula for the number $p(n)$ of partitions of a number n. A partition of a positive integer n is just an expression for n as a sum of positive integers, regardless of order. Thus $p(4) = 5$ because 4 can be written as 1+1+1+1, 1+1+2, 2+2, 1+3, or 4. The problem of finding $p(n)$ was studied by Euler, who found a formula for the generating function of $p(n)$ (that is, for the infinite series whose nth term is $p(n)x^n$). While this allows one to calculate $p(n)$ recursively, it doesn't lead to an explicit formula. Hardy and Ramanujan came up with such a formula (though they only proved it works asymptotically; Rademacher proved it gives the exact value of $p(n)$).

Ramanujan's years in England were mathematically productive, and he gained the recognition he hoped for. Cambridge granted him a Bachelor of Science degree "by research" in 1916, and he was elected a Fellow of the Royal Society (the first Indian to be so honored) in 1918. But the alien climate and culture took a toll on his health. Ramanujan had always lived in a tropical climate and had his mother (later his wife) to cook for him: now he faced the English winter, and he had to do all his own cooking to adhere to his caste's strict dietary rules. Wartime shortages only made things worse. In 1917 he was hospitalized, his doctors fearing for his life. By late 1918 his health had improved; he returned to India in 1919. But his health failed again, and he died the next year.

Besides his published work, Ramanujan left behind several notebooks, which have been the object of much study. The English mathematician G. N. Watson wrote a long series of papers about them. More recently the American mathematician Bruce C. Berndt has written a multi-volume study of the notebooks. In 1997 *The Ramanujan Journal* was launched to publish work "in areas of mathematics influenced by Ramanujan".

Pranshu Gupta (II Year)

Departmental News & Updates

Students Achievements

1) ACHIEVEMENT

S. No.	Name of Student	Achievement
1.	Keyur Soni	First Position in All India Poetry Competition held at Kolkata

2) WORKSHOP ATTENDED

S.No.	Name of Student	Date	Details of Seminar	Topic
1	II Year Students	17-19 Feb 2016	Entrepreneurship Awareness Camp(EAC)	Entrepreneurship

3) CULTURAL

List of Students Shining in Cultural Activities

S. No.	Name	Year	Event	Position
1	Keyur Soni	III	Cinegraphy	First Position
2	Om Kumar	II	Poster Making	First Position
3	Samarth Jain	III	Poster Making	Third Position

4) SPORTS

Winners of Sports

S. No.	Student Name	Organize Place	Name of Events	Awards
1.	Umesh Swarnkar Pranshul Gupta Anurag N.Jagde Smarth Jain	IES-IPSA	Badminton	First
2	Shubham Pandey & Team	IES-IPSA	Football	First
3	Shubham Pandey Pritesh Goyal Shashank Dass	IES-IPSA	Shot Put	First

5) List of Students Who Got First/Second Position (Academics) (UG)

S. No	Name of Student	Year	Position	Percentage
1	Krishna Kumar	I	First	8.64
2	Aman Vyas Hujaifa Yaquib Hussain	I	Second	7.97
3	Akshat Shrivastava	II	First	8.81
4	Prakhar Shrivastava	II	Second	8.44