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INSTITUTE OF ENGINEERING & SCIENCE

Knowledge, skills and values



Department of Mechanical Engineering
Annual Magazine
2024-25

Letter from the Editors

Dear Readers,

It gives us great pleasure to present the **2024–2025 edition of the Department of Mechanical Engineering Magazine, MECHAZINE**. This magazine provides a platform for students to share their technical knowledge, innovative ideas, and research interests in various emerging areas of mechanical engineering. It reflects the academic activities, creativity, and achievements of our students and department.

This edition includes student articles on topics such as **3D printed polymers for ceramic micro-lattices, Product Life Cycle Assessment (PLCA), Rapid Prototyping, and the contributions of Srinivasa Ramanujan**. The magazine also highlights departmental news, activities, and placement details of our students.

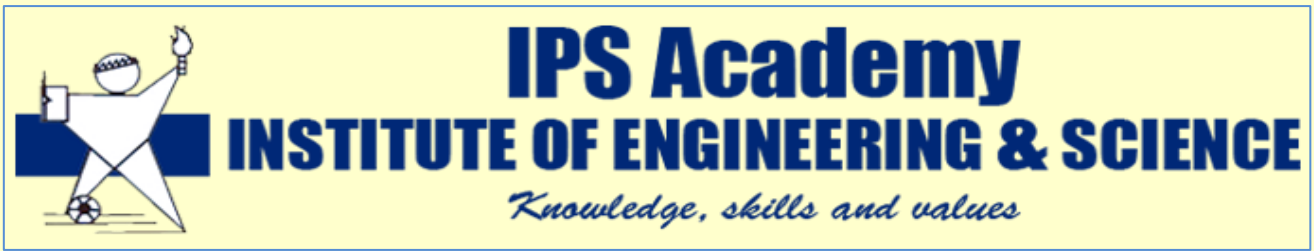
We sincerely thank all the students, and contributors for their support in bringing out this magazine and hope that it will inspire students to continue learning, innovating, and contributing to the field of mechanical engineering.

We take this opportunity to thank our respected Principal **Dr. Archana Keerti Chowdhary**, HOD **Prof. Ashwini Joshi** 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...





Editorial Board

S. No.	Name of Student	Year
1.	Mr. Goutam Goswami	Final Year
2.	Mr. Gyanendra Tiwari	Third Year
3.	Mr. Shailendra Tiwari	Third Year
4.	Mr. Nirmal	Second Year

Faculty Coordinators

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



Content

S.NO.	TITLE	PAGE NO.
	<i>Letter from the Editors</i>	i
	STUDENT ARTICLES	
1.	New method uses 3D printed polymers to make flaw-free ceramic micro lattices	2
2.	Product Life Cycle Assessment (PLCA)]	3
3.	Rapid Prototyping: An Overview	6
4.	The Great Mathematician : Srinivasa Ramanujan	8
	Departmental News & Updates	12
	Placement Details (2020-2024 Batch)	14



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 0.22gcm^{-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.’

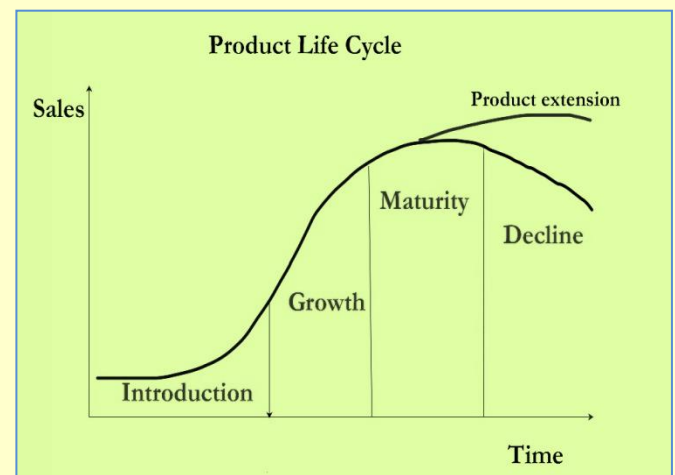
Shiv Sen (IV Year)

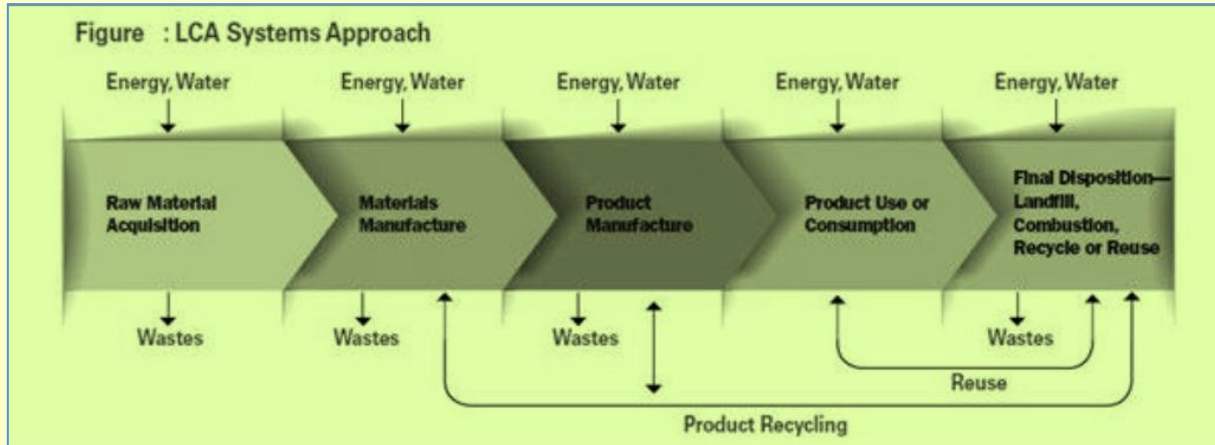
Product Life Cycle Assessment (PLCA)]

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.

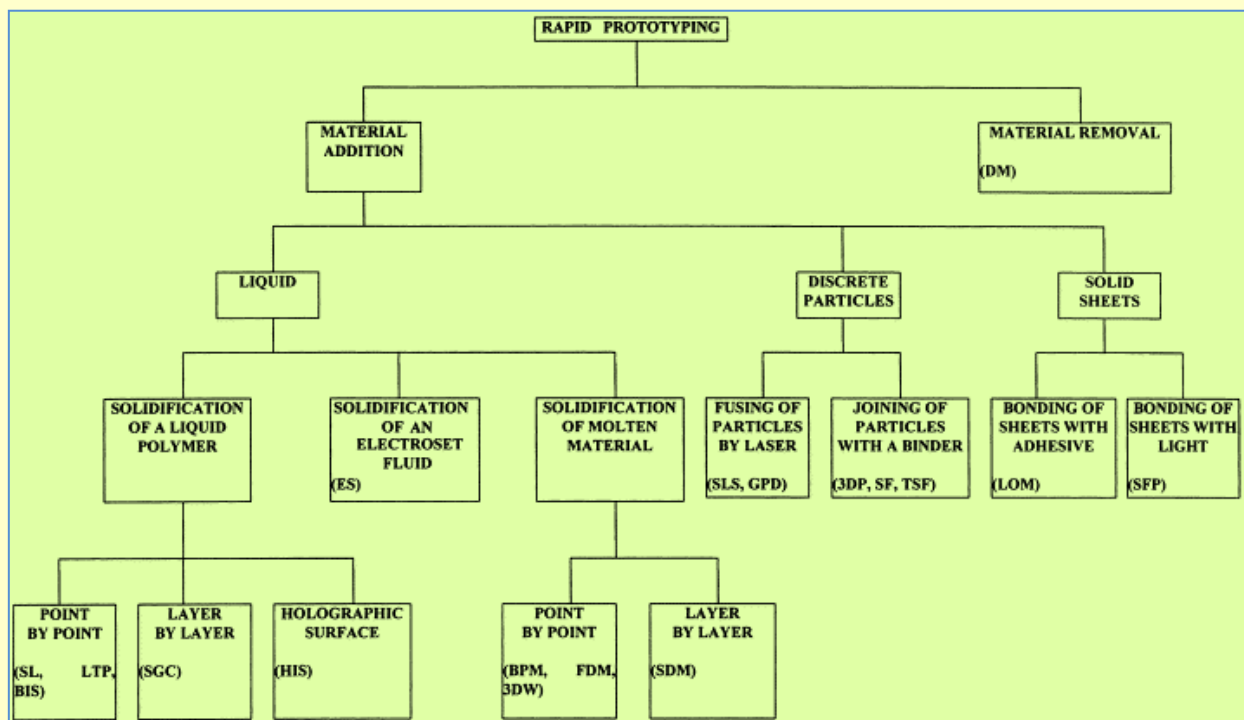
Mayur Gehlot (III Year)

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.

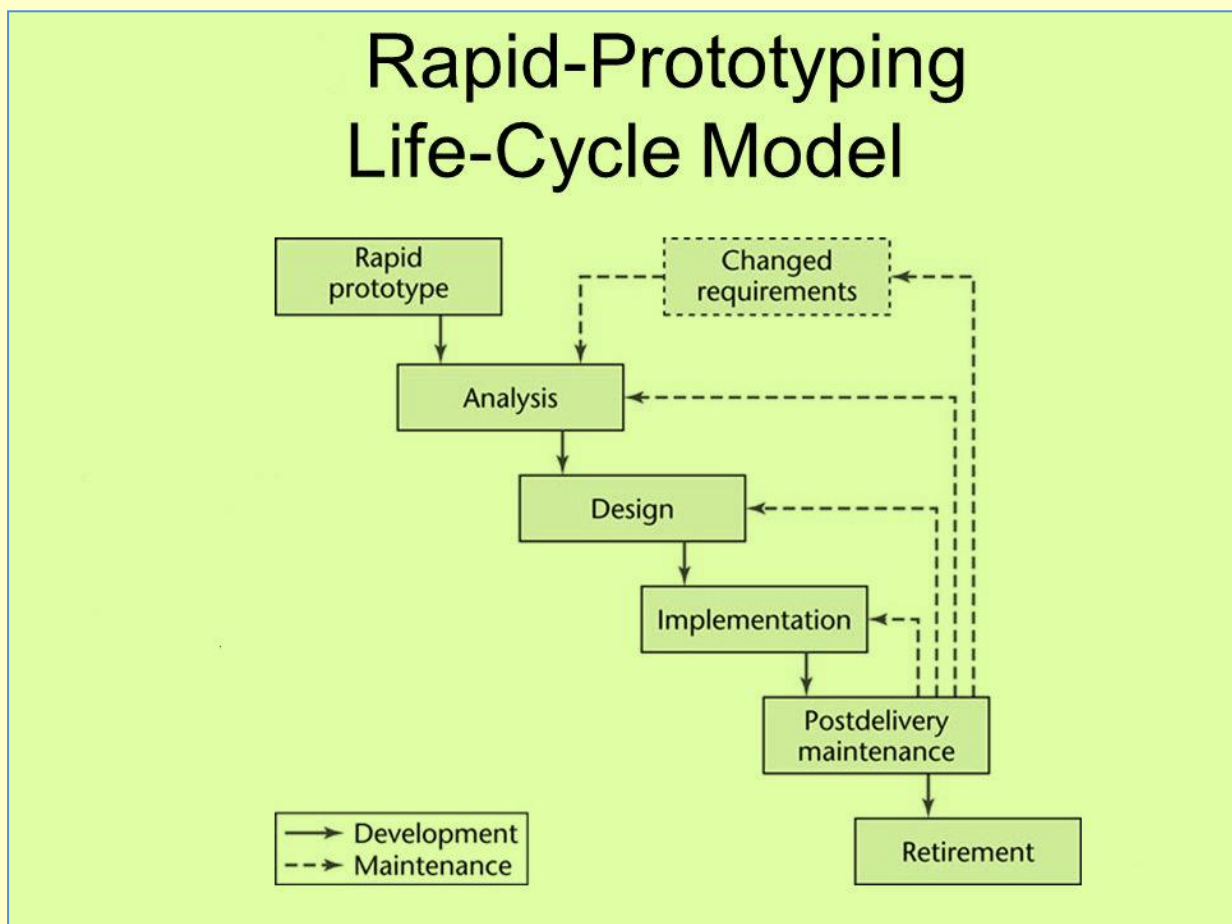
There is a multitude of experimental RP methodologies either in development or used by small groups of individuals. This section will focus on RP techniques that

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.

Anil Makwana (III 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 n th 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".

Ankit Parmar (II Year)



Departmental News & Updates

Students Achievements

1) SPECIAL AWARD

S. No.	Name of Student	Achievement
1.	Md. Noor & Team	Win Beat Debutant team Award

2) WORKSHOP ATTENDED

S.No.	Name of Student	Date	Details of Seminar	Topic
1	All Students II,III & IV Year	03.03.2025- 08.03.2025	MDP on Entrepreneurship	Entrepreneurship



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







S. No	Name of Student	Year	Position	Percentage
1	SHIVAM GOYAL	II	First	8.81
2	BHARAT ARYA	II	Second	8.70
3	ANISHA SINGH	III	First	8.72
4	NIKHIL PAL	III	Second	8.57
5	SHIV SEN	IV	First	9.32
6	YUVRAJ SAINI	IV	Second	8.90



Placement Details (2020-2024 Batch)

S.No.	Name of the	Student Name	Company's logo
1	Vijayshree Packaing	Abhinav Borwanker	
2	Adani Group	Ajeet Kumar Shah	
3	Adani Group	Amir Khan	
4	Adani Group	Anirudh Mishra	
5	Aviotron Aerospace	Asmit Joshi	
6	Aviotron Aerospace	Abhishek Chandrapuriya	
7	Aviotron Aerospace	Harsh Tayde	
8	Aviotron Aerospace	Harshit	
9	Aviotron Aerospace	J. Neeraj Kishore	
10	Aviotron Aerospace	Krish Chouhan	
11	Aviotron Aerospace	Manish Patidar	
12	Aviotron Aerospace	Mithilesh Kumar Yadav	



13	Green Power Equipment, Pune	Mo Noorulain	
14	Green Power Equipment, Pune	Pushpraj Rathore	
15	Green Power Equipment, Pune	Rajat Korde	
16	Green Power Equipment, Pune	Roshik Vyas	
17	Vijayshree Packaing	Sabhajeet Surya	
18	Magma HDI General Insurance Company	Shivam Shukla	
19	Magma HDI General Insurance Company	Shrey Kolte	
20	Magma HDI General Insurance Company	Shubham Dabi	
21	Techure Ltd	Siddharth	
22	Techure Ltd	Vikas Anjana	
23	Techure Ltd	Rahul Rimjha	