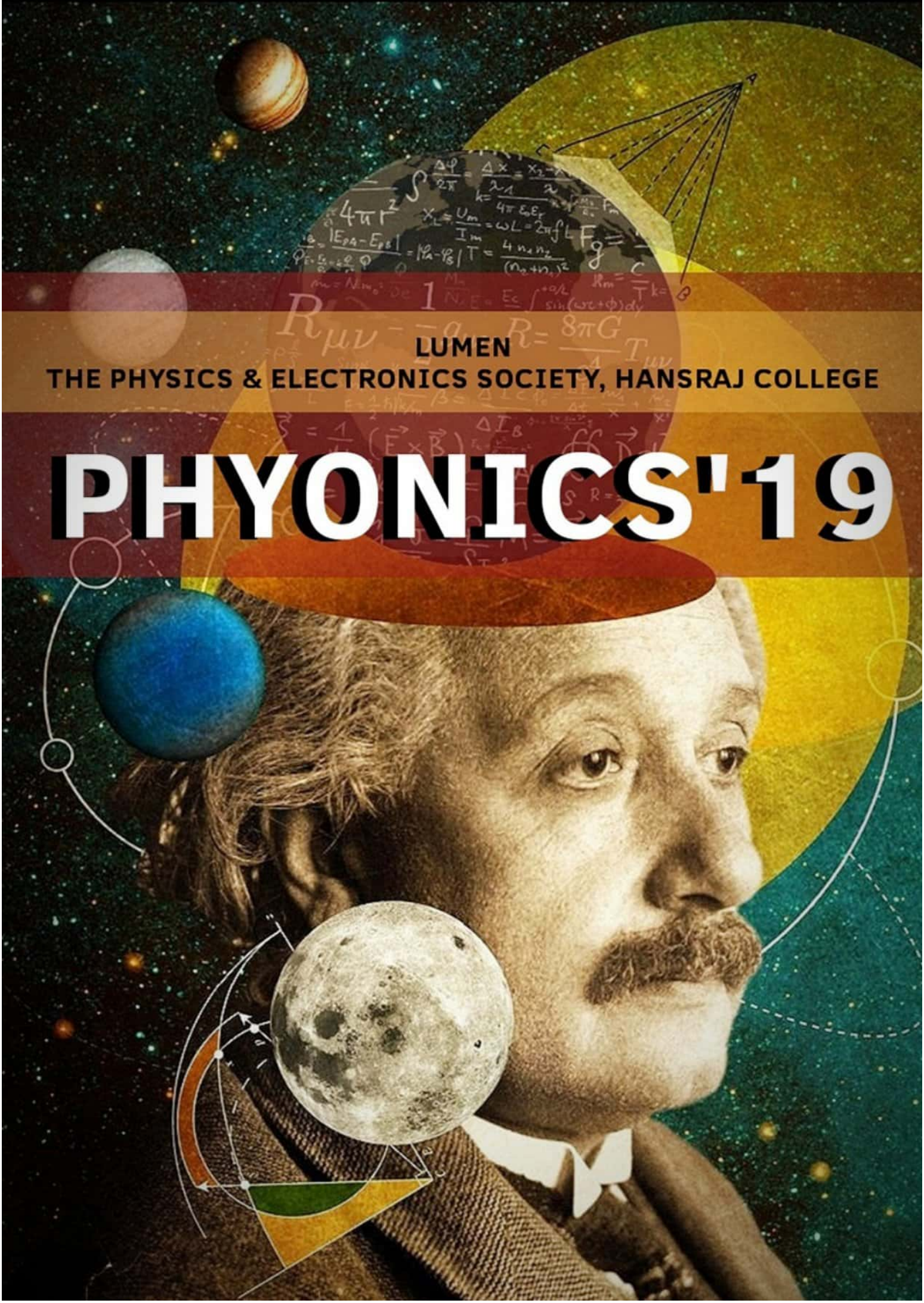


About Lumen

Lumen is the Physics And Electronics Society of Hansraj College, Delhi University, currently working under the guidance of Dr Maya Verma and Dr Sukhbinder Singh and is a team of
60+ members.
The sole aim of the society is to provide budding physicists with a platform to learn and compete on larger scale.
For we believe that these students are the future of our society, country and the world at large, and they deserve to have the best of the opportunities.
The Society actively promotes the highest ethical principles in scientific research, critical thinking, openness to social, scientific, technological and educational changes.
Lumen looks forward to award and appreciate the innovative streak, talent and skills that the graduation pursuing students possess.

Editorial :
Umang Shah , Tamanna Saini, Shruti Bhatia, Abhishek Dhall, Ayush Parashar, Drishti Chadha, Vipin Kumar, Harshita Agarwal

Technical:
Aniansh Raj Singh, Vibhor Bhardwaj

Contents

FROM THE PRINCIPAL'S DESK

भौतिकी विज्ञान की वार्षिक पुस्तिका के तृतीय संस्करण के प्रकाशित होने पर समस्त अध्यापक गणों एवं विद्यार्थियों को हार्दिक बधाइयां !

जब मुझसे कहा गया कि मैम, हमारे डिपार्टमेंट की वार्षिक पुस्तिका प्रकाशित होने जा रही है और हमें आपका संदेश प्रेषित करना है, तो यद्यपि में हिंदी ऑनर्स की छात्रा रही हूं लेकिन विज्ञान के विषय में मेरा व्यक्तिगत मत रहा है कि विज्ञान ने मनुष्य को प्रकृति के बारे में गहन अध्ययन करने को बढ़ावा दिया है, तकनीक को और बेहतर बनाने का मूलभूत ज्ञान प्रदान किया है और अन्य क्षेत्रों के विषय में भी हमारा ज्ञान विकसित किया है! इसमें कोई संशय नहीं है कि दिल्ली विश्वविद्यालय देश का श्रेष्ठतम विश्वविद्यालय है तथापि हम प्रयासरत हैं बेहतर को बेहतरीन बनाने में, इसे सिर्फ देश का ही नहीं विश्व के श्रेष्ठतम विश्वविद्यालयों में शुमार करने का! पूरे भारतवर्ष की प्रतिभाएं दिल्ली विश्वविद्यालय के विभिन्न महाविद्यालयों में अध्ययनरत है! मैं चाहती हूं कि हंसराज महाविद्यालय की भौतिक विज्ञान कोर्स में अध्ययनरत यह क्रीम हंसराज महाविद्यालय की प्रसिद्ध पूर्व छात्र छात्राओं की गिनती में शुमार हो और द वॉल ऑफ हंसराज को अपनी मुस्कुराती हुई तस्वीर से अलंकृत करें !

सभी छात्र-छात्राओं को शुभकामनाएं और आशीर्वाद!

डॉ रमा,
प्राचार्या, हंसराज कॉलेज

A Message From the Teacher In Charge

Greetings to all dear readers!

As we all know that we here at Hansraj College are committed to providing a caring and safe environment to promote the emotional, social and academic development of our students. We also have here a creative platform (Lumen Society), which is both stimulating and challenging. It was overwhelming to see that our students during this academic session have given their best and have beautifully executed as well as participated in various cultural and academics events like workshops, seminars, fest, etc. All these events have allowed the students to explore their surroundings and exercise their imagination. The success of these efforts is motivating other students as well and we look forward to having more such events in the next academic year with greater enthusiasm and participation. I believe that with the constant support of teachers and students, the Physics and Electronics department at Hansraj College will continue to make learning a joyful and meaningful experience.

Dr Namrata Soni
Teacher Incharge
Department of Physics and Electronics

Message From the Convenors

We are immensely delighted to see that the creativity and efforts of the students from the Physics and Electronics department are growing exponentially every year.

The department magazine "PHYONICS-2019" reflects the sincere efforts of all the students that they have put in throughout the year. Various activities comprising of seminars, workshops, national science day and annual fest "Eureka" were organised by the LUMEN society with great enthusiasm. Organising these activities inculcated and developed creative and scientific temperaments amongst both the organisers and the participants.

This magazine provides the students with an appropriate platform to express their creative and scientific aptitude in the form of articles, poems and colourful photographs.

We appreciate the efforts of each and every member of LUMEN society who has worked hard for organising all the activities throughout the year and in releasing the magazine.

Best wishes and Blessings to all for their future endeavours.

Dr Maya Verma
Dr Sukhbinder Singh Rait

PRESIDENTS' MESSAGE

The transition from school to college for any student is like stepping into a completely different world, a world of greater independence but bigger challenges and utmost commitment. But all the worrisome moments and doubts were put to rest due to comforting presence of loving teachers, supportive batchmates, helpful seniors and relaxing ambience of our college, and in no time college became like a second home.

Time passes so quickly. It seems like it was just yesterday when college started and I realised my desire to do something for my department and college, and consequently was bestowed with the responsibility of heading Lumen : The Physics & Electronics Society as the President, and now suddenly an entire year has passed by and it will soon be time to pass on the baton to the next batch. It was truly an astounding journey with all the ups and downs which made the experience of being at the helm of affairs more thrilling And a great team was like cherry on top of the cake. This year's council was a diverse set of competent people, and together, we were able to pull off a series of rich events throughout the year.

We took several initiatives to brush up the skills of our students. The session 2018-19 started with our 'Inaugural Ceremony' where eminent speakers like Dr Rathnasree Nandivada, Sh. Poornendu Chaturvedi and Ms Seema Charla were invited. Next, we had a technical workshop on 'Photoshop' attracting students not only from different departments of our college but other colleges too. Post this, we had a paper presentation competition, 'Unearth'. We ventured into the New year by organising a hands-on workshop on AURDINO, which again saw massive participation from various colleges. We also got a chance to celebrate 'National Science Day' on 28th February 2019 which comprised of speaker sessions from Professor V.K. Jain and Professor Vinay Gupta. The day concluded with the Science Exhibition and Poster Presentation Competition.

In addition, we had our annual department fest, 'Eureka'. With various games like Hit the toss, Break the Buzzer, Bucket Ball, Science Quiz, Human Ludo, Treasure Hunt etc., it witnessed a huge footfall on both days.

Apart from this the society also set up 'The Physicist Wall' this year in the department in memory of the great Indian Physicists and their contribution in their respective fields.

None of these achievements was possible without the support and guidance of our Principal Dr Rama, Teacher Incharge Dr Namrata Soni, Convenors Dr Maya Verma and Dr Sukhbinder Singh, who has always been there as able guides, helping us accomplish our goals. We also owe our success to our wonderful teachers, deputies, secretaries and team heads who have extended their unflinching support to us. We would also like to thank all the volunteers who selflessly worked so hard.

This third edition of Phyonics'19 encapsulates all the events, tells us about the teachers and showcases the talents of the students. Kudos to all members of the editorial board and technical team who have worked hard to make this venture successful. Happy reading!

Hardik Agarwal, Mohita Gandotra
Presidents, Lumen

FRESHERS PARTY

Lumen organized its Fresher's party 'Su-swag-atam' on 11th September in the college auditorium. Going with the theme,'Mismatch' juniors pulled out really creative and fascinating combinations.

We initiated the party by congratulating our respected Principal Mam, Dr Rama for becoming the permanent Principal of Hansraj College.
Post that, first-year students introduced themselves and showcased their talents which kept the audience entertained.
Next up was a funny skit by the third year students depicting 'College Life in DU'. The script, acting and execution all was appreciated by the faculty even.
After this, There were various individual and group performances like a magic show, various dance and singing performances, which showcased the hidden talent and calibre of our juniors. some fun activities like paper dance, Make the Pose etc. were also organised to make it a full fun filled event. In the end, the following titles were given to the first years for their performances:

Mr. Fresher: Prerak Saxena
Miss Fresher: Riya Jain
Most Talented: Vipin Kumar
Mr Sassy: Himanshu Sihag
Miss Sassy: Nisha Rajput

Inaugral Ceremony

As Albert Einstein used to say, "I am no special talent. I am only passionately curious".
Keeping alive the zeal to acquire knowledge, Lumen celebrated it's inaugural on 11th September 2018 with three edifying lectures.
The inaugural commenced with a colourful welcome to the guest lecturers followed by lamp lighting. It was trailed by an inspirational speech given by the respected Principal- Dr Rama Mam. With a brief Introduction about the working of Lumen by our President, Mr Hardik Agarwal, our convenor Dr Maya Verma enlightened us with her kind informative words

.

With astrophysics being one of the most fancied fields of science.
The first guest lecturer, Dr Rathnasree Nandivada, Director of Nehru Planetarium Museum, spellbound everyone with the shutter tick-tocks of Star Trail and gave students an insight into the utter bliss that astrophysics is.

What next followed was an illuminating lecture by Sh. Poornendu Chaturvedi, Centre Head for Advanced Semiconductor Technology at DRDO. He connected with the audience, interacting with the Evolution of Communication.
To put an end, with tales of science meeting spirituality we had Ms Seema Charla to familiarize everyone with meditation, it's power and also the various benefits it shares. Also, she insisted on developing a good EQ and IQ to have a flying future.
To keep the atmosphere vibrant, Quiz sessions were hosted in between in which the audience keenly participated in and were duly awarded.

Prizes were distributed among the students who presented innovative ideas for the society's upcoming year. Adding to it, as a surprise element, lucky draws were drawn.
The event was wrapped up by a vote of thanks presented by our convener Dr Sukhbinder Singh.

TECHNICAL WORKSHOP ON PHOTOSHOP

LUMEN organised a Technical Workshop on Photoshop on 27th September 2018 to familiarize the students about the basics of photoshop.
The workshop focused on basic tools of Adobe Photoshop and was taken by Mr Rahul Chawla from BSc (H) Electronics, 3rd Year, who also happens to be the Vice President of the society.
The tools demonstrated were the Move Tool, Marquee Tool, Lasso tool, Magic Wand, Text box, Shape Tool, Gradient Tool, Crop Tool, Brush Tool and Eraser Tool. The concepts of Rasterize Layer and Pixels were also taught.

The main motive of the workshop was to teach the students how to incorporate creativity with Photoshop.
To make the event more fruitful, E-Poster and GIF design were also introduced to the students.
Via the event, the students learnt a lot and were dispersed with a sincere hope to broaden their horizons.

UNEARTH

Lumen organized a trans institutional topic presentation competition,"UNEARTH" on 30TH October, 2018. Unearth was an initiative by Lumen to inculcate a much needed sense of curiosity and interest in students towards Physics by giving students the following exciting modern Physics topics to discuss like:

1. What is inside the black hole?
2. Is time travel possible?
3. Why is matter more as compared to antimatter?
4. What is Quantum Entanglement?
5. What is the size of the universe?

The event was guided and judged by eminent teachers of our department, Dr. Chetana Jain, Mr. Dibyajyoti Das and Dr. Fela Washburn Renthlei
The first prize was awarded to Mridul Pandey, a third year B Sc. Physics(H) student from Hansraj College who gave a stunning presentation on Quantum Entanglement.
The second prize was awarded to Amit Kumar Jha, a third year B Sc. Physics(H) student from Jamia Millia Islamia University who proposed a beautiful theory concerning the insides of a Black Hole.
The event proved to be an excellent brainstorming platform for all those who attended it.

ARDUINO WORKSHOP

After the great success of Unearth, Lumen organised a technical workshop on Arduino on 6th February 2019, in collaboration with Elecbits.

The workshop for students was aimed at providing the fundamental and basic introduction to the Arduino Microcontroller. Students from various colleges and courses, including B.tech and B.Sc courses actively participated in the event.

The workshop broadly constituted the installing of Arduino IDE(Integrated Development Environment), designing basic circuits, uploading program sketch on Arduino and working with it. It was lead by Amanpreet Singh(Embedded Engineer, Elecbits).

Students learned to blink an onboard built-in LED followed by working with LDR and making one's own DIY Automatic Night Lamp. They were taught to built Disco Light using Sound Sensor and got a chance to make their own Piano with the use of Pushbuttons. They Worked with LM35 (Temperature sensor) and made their own Temperature Indicator by using the blinking LED's. The event culminated with the most awaited project of Anti-Theft alarm which was developed using Ultrasonic sensors and buzzer. Participation certificates were given to all the participants.

The workshop thus established a platform of collaborative learning and practising. We received an overwhelming response from all the participants.

THE PHYSICIST WALL

On 6th March 2019, Lumen inaugurated "The Physicists Wall".

The wall stands in B - block, where the department is located, as a remembrance and tribute to the eminent and finest physicists India has produced.

Portraits of Sir C.V.Raman, Dr A.P.J. Abdul Kalam, Dr Jagdish Chandra Bose, Dr Meghnad Saha and other prominent Indian physicists have been placed on the wall along with a brief introduction of their lives and accomplishments. The wall stands as a beautiful lamp of motivation for all those who pass it.

The inauguration of the wall came a few days before Eureka - the annual fest of Lumen, that took place on 11th - 12th of March, 2019.

VIGYAAN MELA

Lumen on 28 February 2019 celebrated the National Science's Day to mark the discovery of RAMAN EFFECT by our eminent scientist and Nobel Prize winner, Sir C.V. Raman. To make this event a memorable one, first ever VIGYAAN MELA was organised in our college this year.
Firstly, to illuminate the minds of budding future scientists we had Prof. V.K Jain and Prof. Vinay Gupta on board with us. Prof.(Dr.) V.K JAIN is former Director Grade Scientist, Solid State Physics, DRDO and Prof. Vinay Gupta is an erudite professor at Dept. of Physics & Astrophysics, University of Delhi. Following the guest lectures, we had "VIGYAAN MELA" which involved Science Exhibition and Poster Presentation Competition, the overwhelming response to which was really praiseworthy. The participants gave excellent presentations of their science models and posters which turned into a very informative Q/A session, where our guests seemed pleased and all the projects were thoroughly appreciated.

The winners of the competition are as follows:
SCIENCE EXHIBITION:

1st Position- Arushi Kanojia (Model: Green Solutions To An Automobile Industry)
2nd Position-Shared : Aniansh Raj Singh(Model: Algorithm to develop Self Learning Robots) and Vipin Kumar(Model: Wireless data transmission using Li-Fi)

POSTER PRESENTATION COMPETITION:

1st Position- Shared: Rishabh Jain (Poster: Identification of Inhibitors against HMGB1) and Akansha Sengupta (Poster: Low cost water purification system)
2nd Position- Shared: Supriya Pandey (Poster: Black Paradox) and Himani Sahay and Chinkey (Poster: Arduino phone)

Consolation Prize: Rashi Wadhwa ,Vishnu Priya ,Sonal (Poster: Cosmic Ray Muon Detector)
The event provided an excellent platform for all the budding scientists to explore the vibrant aspects of Science and proved to be one of the major highlight of the year.

EUREKA 2019

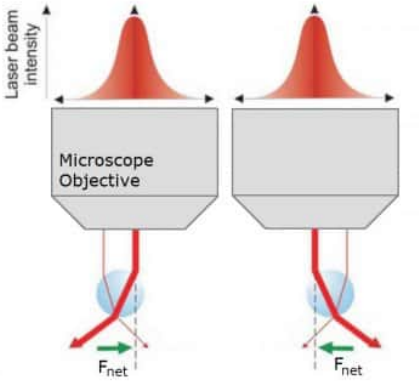
Lumen has always believed in feting science by providing impetus to novices pursuing it. Going ahead with the same notion, Lumen was back with yet another zestful and full of pep event- Eureka.
The Annual Fest of Lumen was held in the college premises on the 11th and 12th of March,2019

Day 1 brought along itself a gala day. The venue was adorned with vibrant and exquisite decoration much like a carnival, with overhead garlands and the balloons dangling around. The event enticed crowds of various colleges as well as courses. A wide variety of interactive and rousing games stalls with a smidgen of applied science with them were laid to entertain the crowd. While the game sessions were being held outdoors, the science block of Hansraj College was hosting an edifying and convivial Quiz Competition. The first day ended with an impromptu DJ session for and by the Lumen organizing team to celebrate the success of the day.

While all the activities of Day 1 were immobile, day 2 was all set to be a huge adventure. With games like:
Human Ludo: A slight twist to the evergreen game where the floor layout was the board on which participants walk on.
Treasure Hunt: Spread over the whole college campus, were hidden different clues testing the contender's knowledge along with promptness. The winner was awarded a cash price and not to forget a 'Eureka!' moment too. This game attracted the largest participation.
At the end of the two-day long fest, everyone adored and highly appreciated the organizers. Eureka is a modus of Lumen to detach apprentices of the superstition of science being narrowed only to the curriculum alongside instilling them with imagination and inquisitiveness.

Optical Tweezers

Noble Prize in Physics 2018



The 2018 Nobel Prize in Physics was awarded to pioneers of laser technology that made a big impact on our world. Arthur Ashkin won half of the prize for his invention of optical tweezers, which allow small particles and cells to be trapped and maneuvered with light. This article is written to give the reader a brief introduction to the same.

So, how can light be used to move matter? The idea is as simple as it is original. The key idea is that light carries momentum. In optical tweezers, the momentum of a beam of light is used to push around a solid object. The easiest way to understand this is by considering a small transparent object, like a sphere in the adjacent figure. This will act as a tiny lens, bending the path of a light beam coming in. In cases where the diameter of a trapped particle is significantly greater than the wavelength of light, the trapping phenomenon can be explained by using simple ray optics.

As shown in the figure, individual rays of light emitted from the laser will be refracted as it enters and exits the small spherical bead. The laser profile usually used in optical traps is a Gaussian Beam. As shown in the top of the figure, the intensity of a Gaussian laser beam is highest at the axial centre of the beam and decreases as a Gaussian function as you move radially outwards away from the axis of the beam. The axis of the beam here is shown by the dotted line. This creates some interesting behaviour. Let's imagine, two light rays, one, a highly intense one along the axial centre of the laser beam, and another, a low-intensity beam a bit outwards from the centre, are both refracted from the spherical particle.

If the refractive index of the particle is greater than the medium in which it is present, the light rays will get refracted as shown in the figure. As you can see, both rays will exit in a direction different from which it entered. Since light has a momentum associated with it, this change in direction indicates that its momentum has changed. Due to Newton's third law, there should be an equal and opposite momentum change on the particle. Since both rays are unequally intense, the momentum change will exert a force on the particle. In this case, if the particle is displaced from the centre of the beam (towards left and right in first and second figure respectively) , the particle has a net force returning it to the centre of the beam spot because more intense beams impart a larger momentum change towards the centre of the spot than less intense beams. The net momentum change, or force, returns the particle to the beam centre. And voila! The particle is trapped. Such a particle is now attached to the axis of the laser beam just like a particle stuck to a spring.

Nearly four decades ago, Arthur Ashkin performed experiments upon micron-sized spheres with a visible (argon ion) laser. With a single, horizontally propagating laser beam he saw the microspheres aligning on the propagation axis, subsequently to be pushed along it, due to radiation pressure of the beam: this was the first observation of optical guiding.

Over the next decade and a half, Ashkin and others experimented with various optical systems that could trap microscale objects, as well as atoms and molecules. A major breakthrough came in 1987 when Ashkin used the tweezers to capture living bacteria without harming them. He immediately began studying biological systems and optical tweezers are now widely used to investigate the machinery of life.

Turning optical tweezers from a manipulation tool into a measurement device has allowed biologists to study the workings of the individual molecular motors which are responsible for movement in the biological world. Such motors transport chemicals within molecules, allow cells to swim and, when acting collectively, allow whole creatures to move.

Ashkin showed us all just what can be done by having an idea and then seeing it through to completion. For years he worked in a minority field, pioneering and then refining his ideas inventing techniques that scientists now use as an essential tool of their trade.

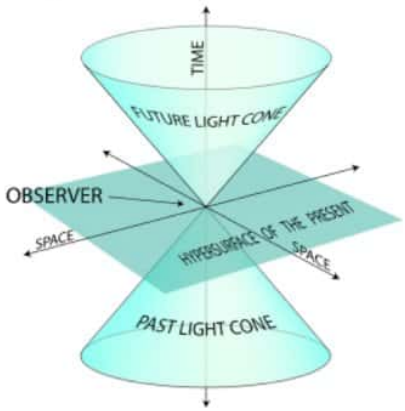
- Dibyajoti Das
(Assistant Professor, Department of Physics and Electronics, Hansraj College)

Mysteries of the Cosmos

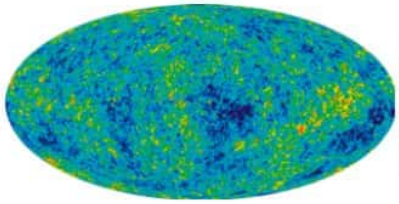
Inflation, dark matter and energy

The Big Bang was what came after something physicists call a singularity. In mathematics where the singular point is where the function fails to be well behaved; moreover, the behaviour of the function after this point of singularity is independent of the behaviour before this point. A singularity is an event where all laws of physics break down, and this singular point in the evolution of our cosmos coincides with the Big Bang. Similar to the mathematical definition, the universe (function) which emerges after the singularity will bear little semblance to its earlier version. Fundamental laws such as conservation of matter and conservation of energy will break down at the singularity. This initial singularity was of infinite density thought to have contained all mass and space-time (a mathematical model which brings together three dimensions of space and the one dimension time into a four-dimensional field known as the Minkowski space) of the Universe. According to the works of Hawking, Ellis and Penrose, the concept of space did not exist before the singularity rather space as we know it began inside of the singularity.

The very fundamental question arises from the above statement; the "beginning of time" this question is answered in a beautiful paragraph from one of Stephen Hawking's lecture on the Beginning of Time; Professor Hawking says "As we look out at the universe, we are looking back in time, because light had to leave distant objects a long time ago, to reach us at the present time. This means that the events we observe lie on what is called our past light cone. The point of the cone is at our position, at the present time. As one goes back in time on the diagram, the light cone spreads out to greater distances and its area increases. However, if there is sufficient matter on our past light cone, it will bend the rays of light towards each other. This will mean that, as one goes back into the past, the area of our past light cone will reach a maximum, and then start to decrease. It is this focusing of our past light cone, by the gravitational effect of the matter in the universe that is the signal that the universe is within its horizon, like the time reverse of a black hole. If one can determine that there is enough matter in the universe, to focus our past light cone, one can then apply the singularity theorems, to show that time must have a beginning."



The light cone is a representation of the path that a flash of light would have taken to reach an event and the paths that it can take in the future. The word "Inflation" is the very basis of the Big Bang approach, popular to contrary opinion the Big Bang was not an explosion but it was an expansion. The inflation lasted for 10-36 seconds.



The image reveals 13.77 billion year old temperature fluctuations (shown as color differences) that correspond to the seeds that grew to become the galaxies. The signal from our galaxy was subtracted using the multi-frequency data. This image shows a temperature range of ± 200 micro Kelvin. Credit: NASA / WMAP Science Team WMAP # 121238 Image Caption 9 year WMAP image of background cosmic radiation (2012)

Inflation is generally assumed to be driven by a field (the inflation) whose physical properties are as-of-yet unknown. The postulated field, nevertheless, would still leave imprints in the cosmic microwave background (CMB) radiation, the vestigial light from the Big Bang, and in the large-scale structure of the universe that can be examined today.

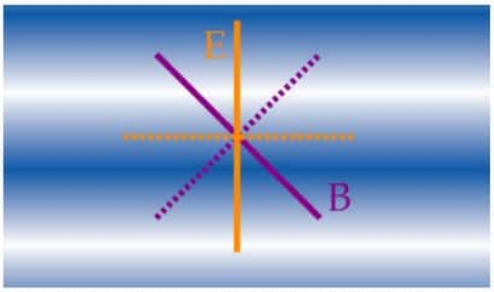
The cosmic microwave background is the remnant of the electromagnetic radiation. It is a faint cosmic background radiation that is filling all space that is an important source of data on the early universe because it is the oldest electromagnetic radiation in the universe

On this matter, Stephen Hawking says "In the case of the universe, the fact that the microwave background has such an exactly thermal spectrum indicates that it must have been scattered many times. The universe must, therefore, contain enough matter, to make it opaque in every direction we look, because the microwave background is the same, in every direction we look. Moreover, this opacity must occur a long way away from us, because we can see galaxies and quasars, at great distances. Thus there must be a lot of matter at a great distance from us. The greatest opacity over a broad waveband, for a given density, comes from ionised hydrogen.

It then follows that if there is enough matter to make the universe opaque, there is also enough matter to focus our past light cone. One can then apply the theorem of Penrose and myself (Hawking-Penrose), to show that time must have a beginning.

The Hawking-Penrose Theorems are a set of results in general relativity that attempt to answer the question of when gravitation produces singularities.

An interesting prediction from the theory of inflation is the emergence of gravitational waves. These waves are ripples in space-time left over from quantum fluctuations in the universe's earliest moments. A possible way to look for primordial gravitational waves is through the imprints they would leave in the polarization of the CMB. In particular, gravitational waves would give rise to a certain type of polarization known as "B-modes.



Here the plane wave is going in the up-down (North-South) direction. If the polarization is parallel or perpendicular to this direction, it is called an E-mode polarization. If it is crossed at 45 degree angles, it is called a B-mode polarization. Gravitational waves generate both and so have a component of B-mode polarization. (Source: University of Chicago on CMB)

The discovery and study of data from Gravitational waves will further help us understand the energy scale of the formation of the universe.

The universe is still expanding, Why?

In order to address these question, further studies were carried out to understand the matter around us.

Measurements suggested that ordinary matter—including familiar things made of atoms and molecules—comprises only about 5 percent of the stuff of the universe. Some 27 percent of the total is thought to consist of dark matter, which is unlike any known particles, while the remaining 68 percent is classified as dark energy. Both are labeled "dark" because they don't emit or reflect light, nor do they interact with photons in a noticeable way.

The quest for cosmologists and dark matter physicists currently is to characterize dark energy and discover dark matter to make further progress.

According to a NASA article, there are three possible cases and one of the suggestions that have also emerged is that Einstein's theory of relativity was wrong.

The possibilities have been presented below:

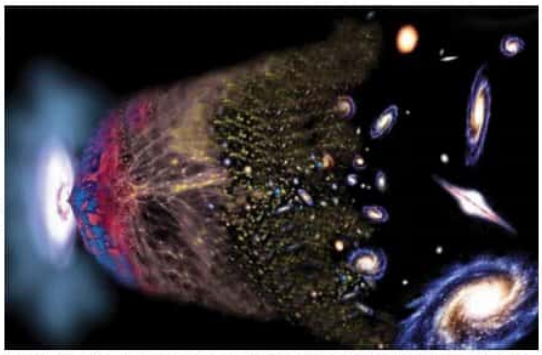


Image courtesy: David A. Aguilar, Harvard-Smithsonian Center for Astrophysics. The above image shows the expansion of the Universe with time.

- Dark energy is that it is a new kind of dynamical energy fluid or field, something that fills all of space but something whose effect on the expansion of the universe is the opposite of that of matter and normal energy.
- Another explanation for how space acquires energy comes from the quantum theory of matter. In this theory, "empty space" is actually full of temporary ("virtual") particles that continually form and then disappear. But when physicists tried to calculate how much energy this would give empty space, the answer came out wrong - wrong by a lot. The number came out 10^{120} times too big...
- One explanation for dark energy is that it is a property of space. Albert Einstein was the first person to realize that empty space is not nothing. Space has amazing properties, many of which are just beginning to be understood. The first property that Einstein discovered is that it is possible for more space to come into existence. Then one version of Einstein's gravity theory, the version that contains a cosmological constant, makes a second prediction: "empty space" can possess its own energy. Because this energy is a property of space itself, it would not be diluted as space expands. As more space comes into existence, more of this energy-of-space would appear. As a result, this form of energy would cause the universe to expand faster and faster. Unfortunately, no one understands why the cosmological constant should even be there, much less why it would have exactly the right value to cause the observed acceleration of the universe.

Astronomers cannot see dark matter directly, but can study its effects. They can see light bent from the gravity of invisible objects (called gravitational lensing).

The search for Dark matter continues to be a quest for all scientists working in this field.

-Ameya Vikram
(Third Year, B Sc. Physics (H.), Hansraj College)

STRINGS OF NATURE

"A physicist, hailing from Texas Brings dimensions galore to perplex us.
But the extra ones all Are rolled up in a ball
So tiny it never affects us."

The laws of nature in classical and quantum mechanics are usually formulated in terms of point particles. In this semi-technical review, we discuss string theory(and all that goes by that name)as a framework for a quantum theory of gravity.

The main paradigm shift in string theory is that the formulation of the dynamical laws is not restricted to point particles. Historically, the first example beyond point particles is the one- dimensional string. Strings can be open or closed. The open string sweeps out a world sheet with endpoints moving at the speed of light (Figure 1). The closed string sweeps out a cylindrical surface in space-time.

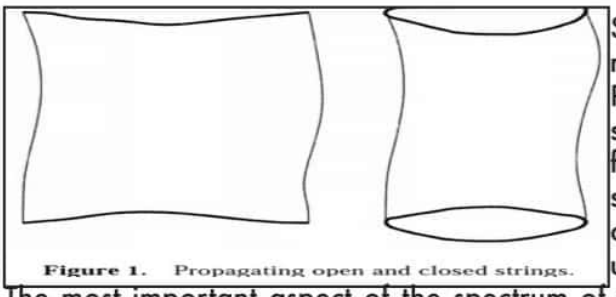


Figure 1. Propagating open and closed strings.

String theory comes with an intrinsic length scale which is related to the string tension $T = l_s^{-2}$, which is of order of Planck length (10^{-35} m). One of the great discoveries of string theory is that a string can carry bosonic as well as fermionic coordinates: $X^{\upsilon}(\sigma, t)$, $\Psi^{\upsilon}(\sigma, t)$, $\Psi^{-\upsilon}(\sigma, t)$. X^{υ} is a space–time coordinate and Ψ^{υ} , $\Psi^{-\upsilon}$ are additional 'anti-commuting' coordinates. This is a radical extension of our usual notion of space–time.

The most important aspect of the spectrum of the string is that in 10 space-time dimensions (and none other), its spectrum has a graviton and a gluon. The graviton (J = 2, M =0) is the massless particle of the closed string, while the gluon (J = 1, M = 0) is the massless particle of the open string. Their space-time supersymmetric partners are the gravitino (J = 3/2; M = 0) and the gluino (J = 1/2, M = 0).

Studies of string theory have also yielded a number of results on the nature of black holes and the gravitational interaction. There are certain paradoxes that arise when one attempts to understand the quantum aspects of black holes, and work on string theory has attempted to clarify these issues. In late 1997 this line of work culminated in the discovery of the anti- deSitter/conformal field theory correspondence or AdS/CFT, first proposed by Juan Maldacena in late 1997. This is a theoretical result which relates string theory to other physical theories which are better understood theoretically. The AdS/CFT correspondence has implications for the study of black holes and quantum gravity, and it has been applied to other subjects, including nuclear physics and condensed matter physics.

The raison d'etre of string theory is elementary particle physics and cosmology, and the quest to answer basic questions related to the fundamental structure of matter and the laws of the cosmos. However, like all fertile ideas in science, string theory and its methods make a connection with other areas of physics and mathematics.

Its ability to solve outstanding strong coupling problems in condensed matter physics is being realized in the AdS/CFT correspondence. The connection with fluid dynamics is also tantalizing and may perhaps shed light on the problem of turbulence.

In summary, it is fair to say that we presently do not know string theory well enough both conceptually and technically to provide answers to questions and issues we have discussed above. It seems certain that we will need to explore models in which both cosmology and particle physics are tied up in a dynamical way.

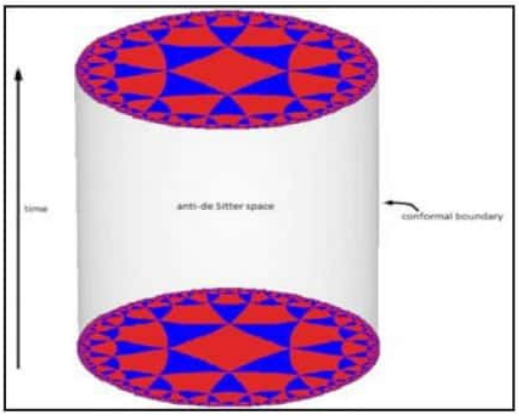


Figure 2 - Three-dimensional anti-de Sitter space is like a stack of hyperbolic disks, each one representing the state of the universe at a given time. The resulting space-time looks like a solid cylinder. (Image from Wikipedia , AdS CFT Correspondence)

-Mridul Pnadey
(Third Year, B Sc. Physics (H.), Hansraj College)

Do Aliens Exist?

The existent curiosity of the human mind has for long propelled him to heights of imagination and intellect. When in the times of Galileo, we began to realise that our place in the universe was not "special" and we just occupy a negligible reality of this vast universe, the prior forbidden questions about intelligence beyond our own soon occupied the minds of thinkers. Thus was caused a revolution of thought and the longing to explore the beyond, but would this exploration, both of thought and of the universe yield us anything significant? Would we ever encounter anything of "intelligence" in our search?

The consistency of physical laws extends throughout the observable Universe and hence we believe that if water serves as a necessity for life here on earth it should be necessary for life in other parts of the universe as well. This is because the processes that facilitate the growth of life follow certain rules of nature which should be the same on other planets. Water has been found in various forms on Mars in our search of alien life.
Though life may seem unique to us, something whose existence is guaranteed only by the meeting of special requirements like a necessity of water, optimum temperature and so on but in this insanely big universe the probability of finding such requirements becomes very high and they become not so special. As we ponder over the vastness of the universe, the question of alien existence becomes almost trivial, since it seems absurd to even think that no other life could exist except that on a blue dot called Earth whose size tends to 0 as compared to that of the universe.

Many attempts have been made by scientists like Carl Sagan and Frank Drake to show the great probability of finding alien life. The Drake equation, though not an equation in the exact sense and controversial, gives a probabilistic argument for the existence of alien life. But the size of the universe, which makes alien life highly probable, also conceals from us any interaction with such life. This apparent contradiction between the high probability of the existence of alien life and lack of evidence for such life is known as Fermi Paradox. On the other hand, doesn't it seem obvious as to why we yet not have encountered extraterrestrial life ? Our best effort yet, in space exploration, has been the success of Voyager 1 which has reached the outer edge of our solar system and will continue to transmit data till 2025. This is a big achievement but till we accomplish intergalactic space travel we won't probably find any sign of alien life especially the one which is intelligent unless they find us first.

We yet do not have enough data to decide anything. Whether aliens exist, as an inevitable consequence of the size of the universe, or don't like lack of evidence suggests, will only be known in the future. But let's keep the search on!

-Sunandan Malviya
(First Year, B Sc. Physics (H.), Hansraj College)

POEMS

Wait for your Day

You are born in this world to make an impact,
You will struggle until you succeed is your pact!

You have to face challenges , there is no way out,
You are capable and able, and there is no doubt!

People will mock, but you got a spark,
Remember only dogs bark!

You have to wake up before the sun rises,
One day you will be out of your debt and crisis!

Your hunger and passion won't let you sleep,
You will be introduced before you speak!

You will live the life you have dreamt of,
But before that you won't take a day off!

You have to go through pain,
Let not your efforts go in vain!

You have come to far , do not cry,
On your day your eyes should not be dry!

- Rahul Chawla
(Third Year, B Sc. Physics (H.), Hansraj College)

उलझन

न्यूटन के गुरुत्वाकर्षण के बल को पढ़ते हुए सातवीं क्लास मे हुआ भौतिकी से परिचय,
तब से प्रश्नों का सिलसिला जारी हैं,
मैनें तो कभी नहीं निकाला, मेरे और मेरे भाई के बीच कितना गुरुत्वाकर्षण बल हैं,
शायद कभी जरुरत महसूस ही नहीं हुई!
लोग रिसर्च में लगे हैं अणु परमाणु में इलेक्ट्रॉन की स्थिति जानने में,
और मेरा प्रश्न था कि जो आँखो से दिख नहीं रहा क्यों उसकी स्थिति ज्ञात करने में लगे हो?
कभी कभी सोचा करती थी कि जब इलेक्ट्रॉन कोशों में चक्कर लगा रहे होते हैं तो हमारे चलने पर पैरों तले
आकर क्या वो इलेक्ट्रॉन मर नहीं जाते?
ऐसे अनेक हास्यात्मक प्रश्नों को घोंट लिया है खुद में,
जवाबों की तलाश में ही मैनें किया हैं भौतिकी विशेष का चुनाव,
देखती हूं यह गुत्थी कब सुलझ पाती है!

- Harshita Agarwal
(First Year, B Sc. Physics (H.), Hansraj College)

हार का भय

हार के भय से तुम्हारी भेंट तो हर बार होर्ग
क्या पता किस की कहॉ कब जीत होगी हार होर्ग
कुछ करना है, जगना होगा
मत सोचो सोती ये दुनिया सारी है,
संघर्ष के तुम मानी समझो
दिखलाओ कितनी खुददारी है,
अब तक तो सूर्य जला दिन भर
अब तो चंदा की बारी है,
"माना सारे दिन नहीं पढ़ा
यारो ! पर रात हमारी है,"

तज दिया विश्राम तुमने
अपना बैरी मान कर,
कुछ कर गुजरने की तड़प में
जगते रहे तुम रात भर,

कल नया होगा सवेरा और नयी अभ्यास होगी।
हार के भय से तुम्हारी भेंट तो हर बार होगी।।

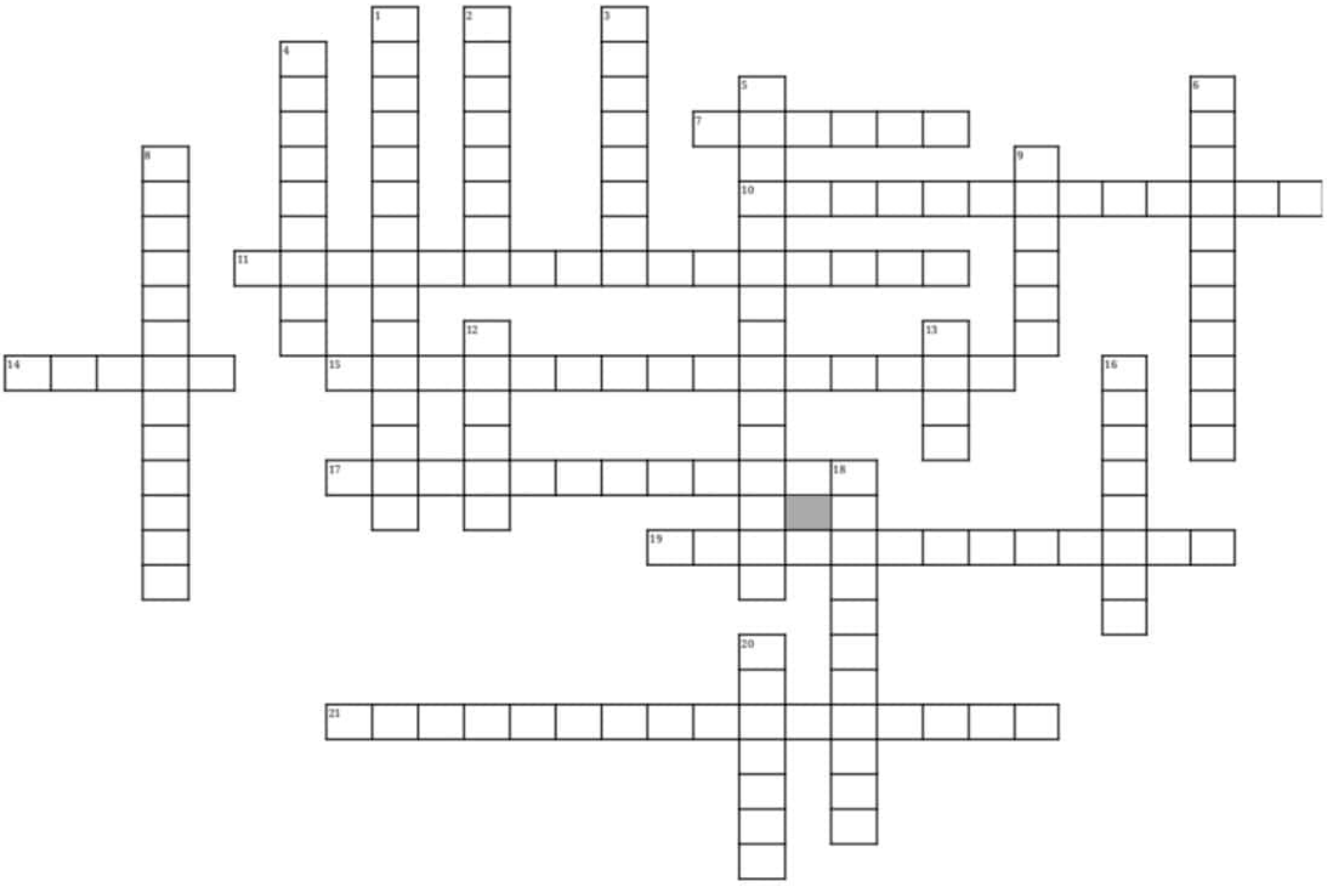
विदग्ध होना ही पड़ेगा
सोने से सपनो के लिये,
"अपने लिये तुम ना पढ़ो
पढ़ना है अपनो के लिये,"
राते बनी ना दिन बने
रो रो के कटने के लिये,

ये जिन्दगी है आपकी
कुछ कर गुजरने के लिये,

नीद से आलस्य से हार ,
गर जो मान कर
सो गये गर आज जो तुम
फिर रजाई तान कर,
कल नया होगा सवेरा पर वही अभ्यास होगी।
हार के भय से तुम्हारी भेंट तो हर बार होगी।।

- Sudhanshu Yaadav
(First Year, B Sc. Physics (H.), Hansraj College)

Crossword



Across

7. Measure of the force of gravity on a body.
10. Maximum speed of a falling object.
11. Acceleration of an object depends on the net force acting on it and the mass of the object.
14. Substance that continually deforms (flows) under an applied shear stress.
15. Used to show the relative magnitude and direction of all the forces acting on a body in a given situation.
17. Similar to Newton's First Law.
19. Force acting in the opposite standard unit is the Pascal direction.
21. Velocity at which a falling object stops accelerating.

Down

1. For every action, there is an opposite reaction.
2. Resistance that one surface object encounters when moving over another
3. Force per unit area standard unit is the Pascal
4. One value increases at the same rate that the other decreases
5. Object at rest will stay at rest and an object in motion will stay in motion with the same speed and in the same direction unless acted upon by an unbalanced force.
6. Process by which elementary particles interact with each other
8. Frictional force air exerts on a moving object
9. 1 newton per square meter
12. International System of Units - Unit of force
13. The quantity of matter in a body
16. Unit of mass equal to 1000 grams
18. Force acting in one direction
20. The resistance an object has to a change in its state of motion

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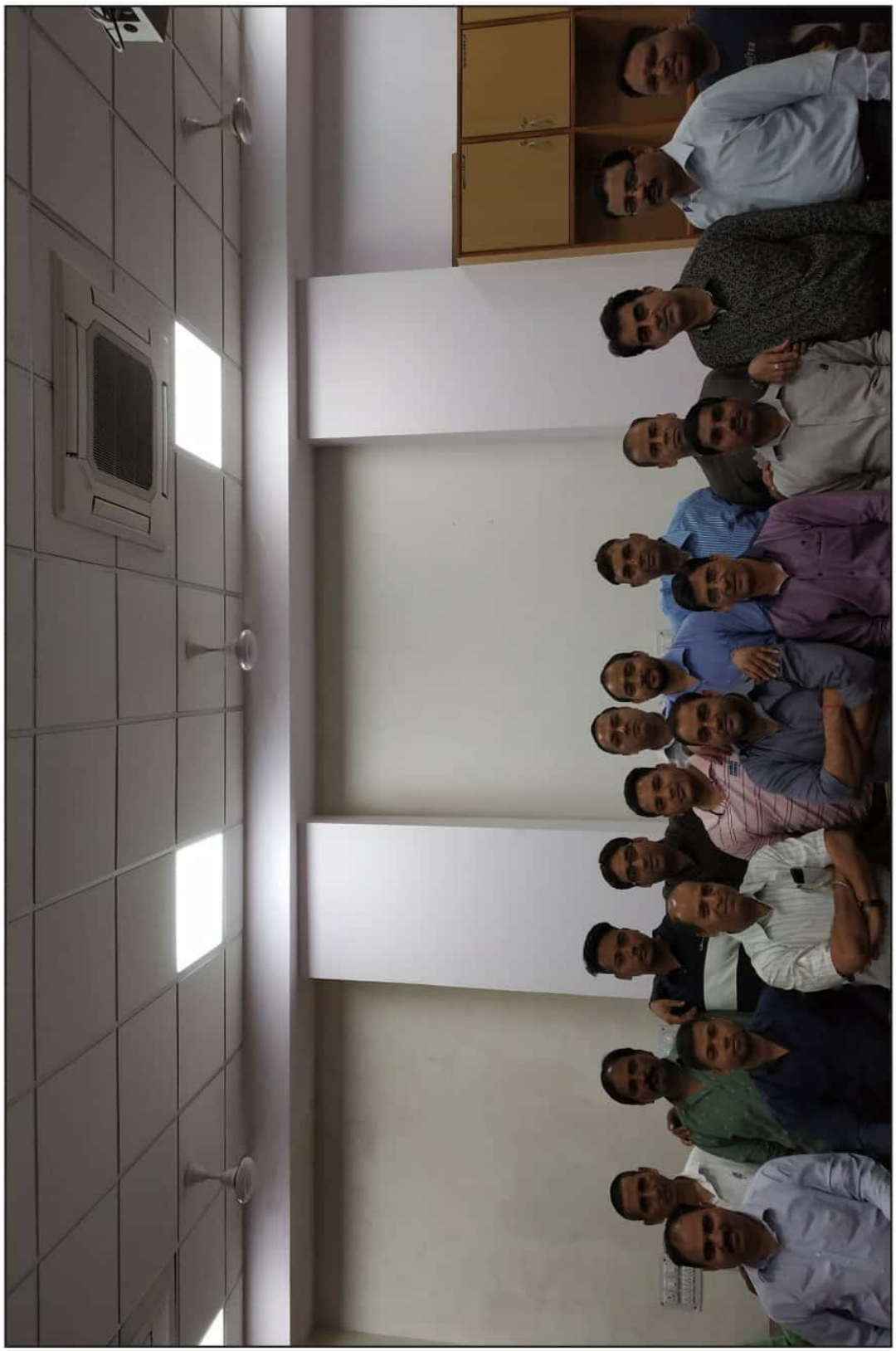

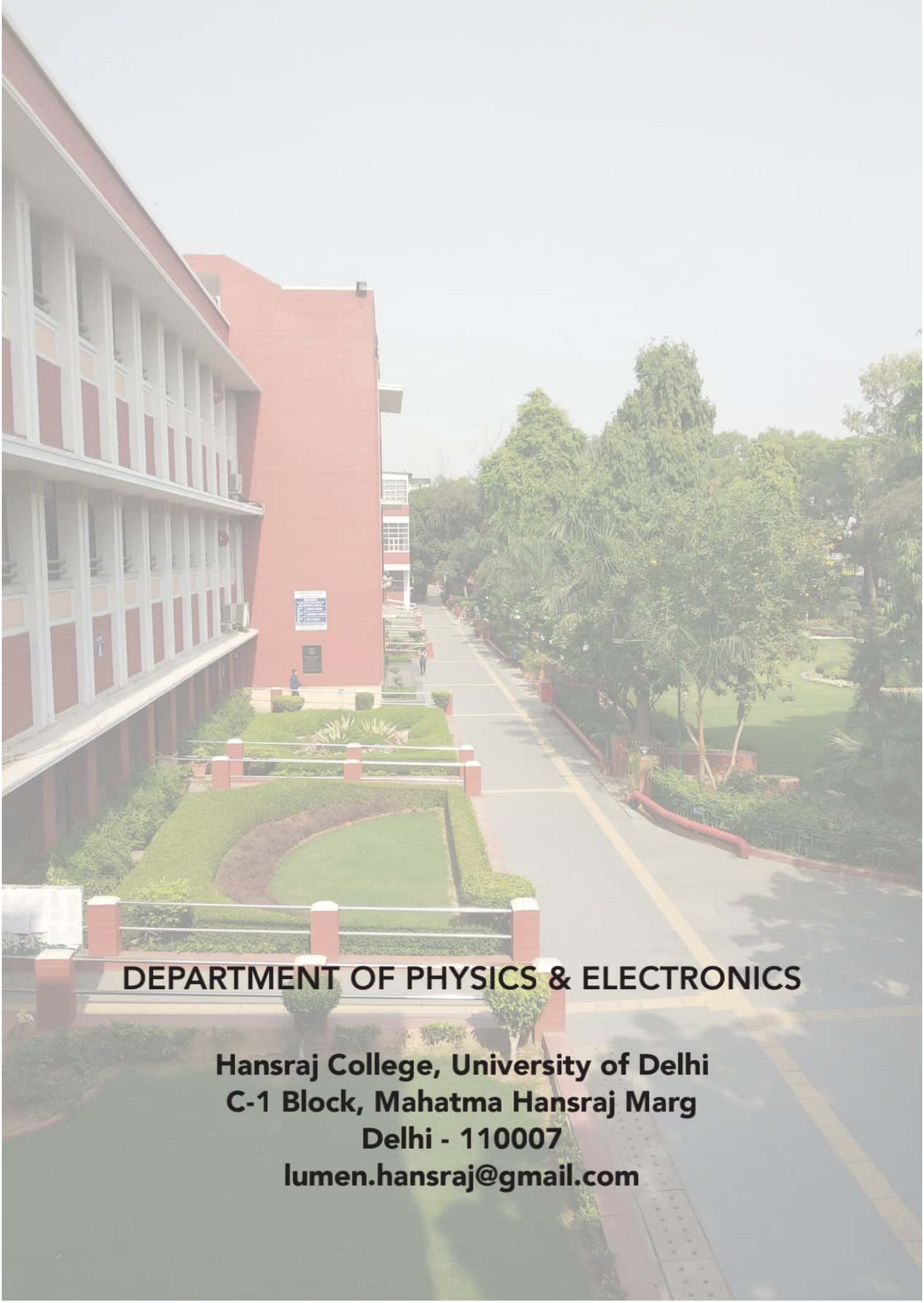

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