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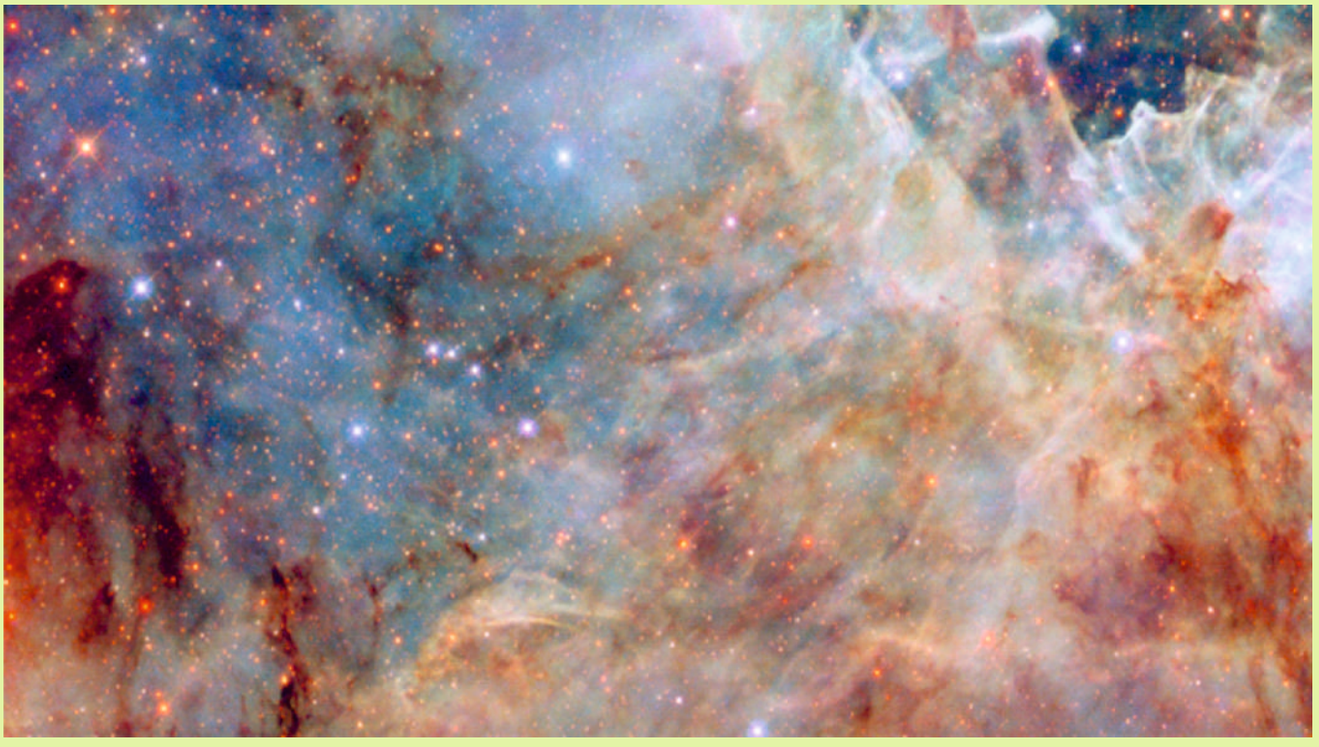

This NASA/ESA Hubble Space Telescope image features a dusty yet sparkling scene from one of the Milky Way's satellite galaxies, the Large Magellanic Cloud. The Large Magellanic Cloud is a dwarf galaxy situated about 160,000 light-years away in the constellations Dorado and Mensa.

Despite being only 10–20% as massive as the Milky Way galaxy, the Large Magellanic Cloud contains some of the most impressive nearby star-forming regions. The scene pictured here is on the outskirts of the Tarantula Nebula, the largest and most productive star-forming region in the local universe. At its center, the Tarantula Nebula hosts the most massive stars known, weighing roughly 200 times the mass of the Sun.

The section of the nebula shown here features serene blue gas, brownish-orange dust patches, and a sprinkling of multicolored stars. The stars within and behind the dust clouds appear redder than those that are unobscured by dust. Dust absorbs and scatters blue light more than red light, allowing more of the red light to reach our telescopes, which makes the stars appear redder than they are. This image incorporates ultraviolet and infrared light as well as visible light. Using Hubble observations of dusty nebulae in the Large Magellanic Cloud and other galaxies, researchers can study these distant dust grains, helping them better understand the role that cosmic dust plays in the formation of new stars and planets.

Link: https://www.nasa.gov/image-article/hubble-studies-the-tarantula-nebulas-outskirts/

Bulletin of The Indian Association of Physics Teachers

http://www.indapt.org.in

The Bulletin is the official organ of the IAPT. It is a monthly journal devoted to upgrading physics education at all levels through dissemination of didactical information of physics and related areas. Further, the Bulletin also highlights information about the activities of IAPT.

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Editorial

Futuristic Agenda for IAPT

We are into a new term of three years (2025-27), when after the elections of the executive committees at both central level and Regional/ sub regional council levels new teams take charge and start their activities according to the vision and mission of the IAPT as envisioned by our founders and strengthened by exemplary work of the honorable members spread across the country.

I convey our heartiest congratulations on behalf of the central team and on my personal behalf to the members of the new executive teams and welcome them to the task ahead. There are numerous members who have worked voluntarily and are role models for us. Fortunately, Technology has brought us closer to share our ideas, experiences, and initiatives to make things happen at a much bigger scale and at a faster pace.

However, with new aspirations and expectations, challenges have also become bigger on the ground inviting us to take up opportunities to contribute meaningfully. I want to share with you areas of concern, positive pathways, and programs which we should pursue doggedly, as listed below.

- **NEP and Physics Curriculum**: The quality implementation through new curriculum frame works floated under NEP 2020 desires that in the name of multidisciplinary approach the quality of Physics Content as a basic science does not get diluted. For this IAPT is duty bound to keep an eye on curriculum development and contribute to its necessary elements as a major voice at all the levels and to identify the gaps and fill those with desirable interventions.
    - Choice based Credit System has its own concerns: how to distinguish physics major from physics minor, physics as an essential subject for engineering and medical students, how can curriculum open up opportunities for meaningful employment, physics as an essential knowledge for a common man, how physics needs to be integrated as part of General Science to be learnt by every school pass out, how AI and quantum revolution 2 is going to impact the choice of courses to be taught and their inclusion in the curriculum without sacrificing the essential physics.
    - This requires a concerted effort by each one of us under the umbrella of IAPT through discussions, deliberations, workshops via dedicated small teams leading to meaningful documentation in the form of white papers, model curricula, resource material, worksheets, lab practices, virtual classrooms and so on.
- **IYQ Initiatives**: 2025 is an International Year of Quantum Science and Technology (IYQ) for which we need to work at three levels: awareness, in depth programs on topics of immediate relevance in the form of model courses and lastly resource generation and its availability. Some pilots have emanated from Bengaluru schools and in other schools across the country through IAPT *Quantum Zoom School of Bharat (India) across different schools*. Another one is *official curtain raiser of International Year of Quantum Science and Technology*, which will be organized in rotation through out the year under the auspices of different regional/ sub regional councils (first program was conducted from 29-31 January 2025 in the form of a 2 hour webinar on each day in the evening), another program Quantum Revolution (a journey across Orbits) is being organized by sub regional council RC12 in the form of an interactive workshop. One of the important aspects of each of these programs must be (i) delivering content through best teachers, (ii) focused content followed by (iii) gathering of structured feedback on various components of these programs. For schools, we need to be extra cautious that the program does not remain marathon sessions of 2 hours of lecturing by experts but should remain mindful of the fact that attention span of the school students is too small, and for this extra care needs to be taken. Pilot studies can also lead to a research paper in the IAPT bulletin which puts before the community the lessons learnt from them and what concrete programs/ strategies can emerge for their conduct in the country.

- **Long Duration Schools/Workshops**: Summer schools, winter schools and workshops of IAPT are also attracting a large number of students and teachers. These activities have taken place in virtual classrooms, where participants engage through assignments, quizzes, tests, and interactive sessions. These are particularly good initiatives and should become our USP to set quality benchmarks in physics topics. A small registration fee for these initiatives can bring seriousness among the participants and generate resources for bearing the cost of conducting these programs.
- **Olympiad Programs**: In 2024 we saw the commendable achievements of *Asian Physics Olympiad* Laboratory, at Graphic Era Hill University Dehradun under the charge of Prof. Vijay Kumar and *International Junior Science Olympiad* Under the charge of Dr. Achuta and Dr. Raghvendra in Vidya Vardhak educational College, Bengaluru and IISC Training Centre at campus at Chellikri under the guidance of Director of the Centre Professor Subba Reddy. These two facilities are fully responsible for resource generation and training of teams for selection to these two international events every year. HBCSE made way for this to happen and shows faith in the working of IAPT. All the Olympiad event teams gave an outstanding performance.
- **National Workshops**: We also commend that Chanchal Kumar Majumdar National workshop at SN Bose Institute Kolkata organized by RC15 (West Bengal, Sikkim and Andaman and Nicobar) and Professor Babulal Saraf Memorial National Workshop on Experiments at IPS Academy, Indore organized by RC 9 (Madhya Pradesh) are continuing with their conduct every year. Their resources should be documented and published as e-books for a wider audience. These are flagship programs of IAPT inspired by two doyens of IAPT.
- **Digital Question Bank of IAPT**: NSE cell of IAPT which every year carries out a herculean task of conducting NSEs in Physics Chemistry, biology, astronomy and Junior Science has a huge question bank of items, it is desirable that Zonal Vice Presidents come forward in collaboration with a RC in their region to do two fold task on this question bank: Training IAPT members through of question item writing workshops and classification of NSE question items as per Bloom's Taxonomy. For this other subject associations can also come forward. Resource persons for generating question items is one of the urgent tasks for sharing the responsibility of conduct of NSE. A comparable exercise can be performed for the question bank of the National Graduate Physics Examination (NGPE). The experience of APHO cell and IJSO cell can also come very handy in conduct of these workshops. The new question banks will have because of Bloom's Taxonomy classification a value addition to the questions. When digitized this question bank can generate assessment tools for various training activities.
- **Centre of Scientific Culture**: During my discussion with Professor SC Samantha and Prof. CK Ghosh, I was delighted to know that IAPT Midnapore College Center for Scientific Culture is also undertaking a task to create worksheets/ manuals of the low-cost experiments developed there over a period. It will be a welcome step for improving the quality of Physics laboratories in the schools and can help schoolteachers to use these experiments during class interactions and suggesting project ideas for secondary and higher secondary students. With this documentation, the conduct of teacher training workshops for schoolteachers will also get a boost.
- **Physics Education Research**: After Successful conduct of PER Lecture Series, we are gearing up for the conduct of PER based workshops to get our teachers and research scholars into this especially major area of subject based education research to improve the quality of physics education. We also need to make a case for conducting PER in Physics Departments of Universities and Autonomous Colleges for which we plan to write to chairpersons of Physics Departments in the Universities of the countries, University Grants Commission and Ministry of Education Govt. of India. This is also pertinent in the light of the start of four-year undergraduate programs in Education at IITs, NITs and IISERs and central universities.

- **Physics Education Journal and ICPE 2025**: There are two good pieces of news which I want to share with you. Firstly, IAPT Journal of Physics Education has a boost for its revival, DAE BRNS has approved a grant of Rs. 3.50 lakh per year from 2024-25 to 2028-29. Prof. OSKS Sastri is the Chief Editor and under his care, it is bound to flourish. Secondly, International Union of Pure and Applied Sciences C14 group on Physics Education has approved the holding of International Conference in Physics Education 2025 in INDIA. Along with IIT Ropar and IISER Mohali, IAPT will cohost this conference. The event is from December 16-20, 2025. It has come to India after 20 years. The most recent ICPE in India was organized by IAPT which took place in 2005, with Professor Pratibha Jolly as the convener. For this Professor Arun Grover, member IUPAP C-14 group, and Former Vice Chancellor of Panjab University Chandigarh has been instrumental in getting this conference for India. Additional details about the program will be provided to IAPT stakeholders in due course. I hope together we will do an excellent job and gain international experience on current progress and innovations in physics education. I hope a large number of IAPT members will participate in it.
- **IAPT@50:** We also gathered responses on the drafting of Vision IAPT @ fifty document through structured google forms. We are in the process of analyzing your aspirations and dreams for IAPT. The draft will be sent to members soon. A Profile document of IAPT is also under preparation for circulation among new members and presenting IAPT as a dynamic subject society. We will also circulate its draft soon.
- **National Networks of IAPT**: Let us not forget to reach the unreached. National Anveshika Network of India (NANI) is the biggest reach out program specifically targeted to school students and has made a name for itself through a strong network of Anveshika Coordinators. Schools should remain a priority. On a similar pattern, National Astronomy Network of India (NASNI) has also been initiated, which has a plan to meet every first and last Wednesday of the month to conduct programs on astronomical events, skywatching and practical tips for identifying astronomical projects.
- **Status of Official Website**: Official IAPT website, www.indapt.org.in , has been having a great footfall. It has facilitated reaching out to our members through regular emails carrying e-bulletin of IAPT and other information. The total association emails sent from the website in the last two years to its members is 2,88,620 and 3564 platform mails. It is essential that our RCs/Sub RCs begin utilizing this platform to share reports of their activities and events, as well as post their photo galleries. During the Annual Convention of IAPT in Dharamshala it was used very effectively. Time has come to have a single website of the university and wind up the old websites to avoid confusion for the stakeholders.
- **Liaising with RC's**: Soon the central team plans to conduct a workshop for office bearers of the RC's and Sub RCs to have better liaising with central office and maintenance of records at both.

You are most welcome to share your thoughts on this agenda to give it a realistic time bound shape. E-mail or WhatsApp choice is yours. On a lighter vein, everything is theoretically impossible unless it is done.

PK Ahluwalia
President

Corrigendum

The report titled 'Nandini Raha Memorial Workshop on Physics Experiments ' published in January 2025 issue of IAPT Bulletin (page No. 23) is from RC-15 and not from RC-05 as mentioned on the 'Report-RC05' and also in the list of contents on page 36. Online version has incorporated the correction. The inadvertent error is regretted.

Editor

Physics News

New technique to detect dark matter uses atomic clocks and lasers

A team of international researchers has developed an innovative approach to uncover the secrets of dark matter. The team used data from atomic clocks and cavity-stabilized lasers located far apart in space and time to search for forms of dark matter that would have been invisible in previous searches. This technique will allow the researchers to detect signals from dark matter models that interact universally with all atoms, an achievement that has eluded traditional experiments. The team analyzed data from a European network of ultra-stable lasers connected by fiber optic cables and from the atomic clocks aboard GPS satellites. By comparing precision measurements across vast distances, the analysis became sensitive to subtle effects of oscillating dark matter fields that would otherwise cancel out in conventional setups.

Read more at: https://phys.org/news/2025-01-technique-dark-atomic-clocks-lasers.html

Original Paper: Physical Review Letters (2025). DOI: 10.1103/PhysRevLett.134.031001

Clocking nature's heaviest elementary particle: CMS tests whether top quarks play by Einstein's rules

In the first study of its kind at the Large Hadron Collider (LHC), the CMS collaboration has tested whether top quarks adhere to Einstein's special theory of relativity. Some theories, including particular models of string theory, predict that, at very high energies, special relativity will no longer work and experimental observations will depend on the orientation of the experiment in space-time. Remnants of such Lorentz symmetry breaking could be observable at lower energies, such as at the energies of the LHC, but despite previous efforts, they have not been found at the LHC or other colliders. In its recent study, the CMS collaboration searched for Lorentz symmetry breaking at the LHC using pairs of top quarks. In this case, a dependence on the orientation of the experiment would mean that the rate at which top-quark pairs are produced in proton–proton collisions at the LHC would vary with time. The new CMS result, which is based on data from the second run of the LHC, agrees with a constant rate, meaning that Lorentz symmetry is not broken and Einstein's special relativity remains valid. The results pave the way for future searches for Lorentz symmetry breaking based on top-quark data from the third run of the LHC.

Read more at: https://phys.org/news/2025-01-clocking-nature-heaviest-elementary-particle.html

Provided By: Physics Letters B (2024). DOI: 10.1016/j.physletb.2024.138979

Fox and rabbit in the quantum world: Atomic particles with antagonistic interactions

Researchers at the University of Basel have shown that quantum systems can have antagonistic interactions, too—one agent attracts the other, but the other way around, there is a repulsion. Such interactions could be realized using cold atoms that are coupled to each other. However, nature is often not that mutual; for instance, when predators and prey are involved, the fox is attracted to the rabbit and chases it, but the rabbit runs away from the fox. This results in a kind of dynamic that can also be seen in other systems of so-called active agents such as nanoparticles or colloids, in which particles are finely distributed inside a medium. In such systems, energy can constantly be supplied to the quantum particles from the outside, for instance in the form of light, which causes them to become "active." Moreover, the particles need to influence each other in a specific way to create an antagonistic interaction. According to the Basel researchers, such an open quantum system could be realized using atoms that are constantly driven by laser light. Under certain conditions, this can result in an antagonistic interaction between the phases of the atomic spins.

Read more at: https://phys.org/news/2025-01-fox-rabbit-quantum-world-atomic.html

Original paper: Physical Review X (2025). DOI: 10.1103/PhysRevX.15.011010

Soumya Sarkar
IISER PUNE

Article

Some subtle issues in teaching Physics at higher secondary level

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Abstract

Physics at the higher secondary level is a crucial bridge between basic conceptual learning and advanced scientific thinking. However, certain subtle issues often hinder students from fully understanding core concepts. These challenges typically arise from abstract ideas, mathematical formulations, and misconceptions due to oversimplified teaching methods. This article aims to identify and address these subtle issues.

1. Introduction

Students encounter difficulties when moving from simplified concepts to more rigorous treatments of physical phenomena. For example, the electric field due to an infinite line charge is often presented as having a simple inverse dependence on distance, yet the underlying assumptions and approximations of infinity are rarely discussed in detail, leading to confusion about the conditions in finite systems becoming infinite one. Similarly, in magnetism, the temperature dependence of magnetic susceptibility is typically introduced without giving equations and specific materials involving. For example, diamagnetic susceptibility is said to be temperature independent in many higher secondary textbooks, but Landau diamagnetism is temperature dependent. Another misconception arises in electromagnetic wave theory, where students learn that the amplitudes of electric and magnetic fields in a wave are related by $B = \frac{E}{c}$, where c is the velocity of light, but this relationship is often misunderstood or wrongly interpreted. Many wonder why the figure of electromagnetic wave is not according to this relation of amplitude. We wish to discuss such issues here. Only three issues are discussed in this article and in the forthcoming articles we will discuss more. Any reader can point out such difficulties openly or can send to the mail id given above which we will try to address.

2. What is aninfinite line charge distribution?

In higher secondary classes, we explore the electric field produced by different charge distributions. When a charge is present in a given space, the surrounding region where a test charge experiences a force is referred to as the electric field. For continuous charge distributions, we can easily determine the electric field by applying Gauss's law [1–5].

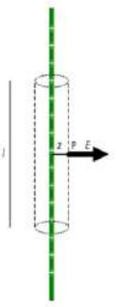

Figure 1:Electric field due to a infinite line charge distribution

Typically, when teaching Gauss's law, we calculate the electric field generated by an infinite line charge distribution using Gauss's law.Gauss's law states that the total electric flux through a closed surface is equal to the total charge enclosed within that surface divided by the permittivity of the medium. In this scenario, we treat a line charge as being infinitely long,

allowing us to ignore the effects of its endpoints. For this analysis, we can consider a cylindrical Gaussian surface, as illustrated in the Figure 1. The field at a distance z applying Gauss's law is given by

$$\oint \vec{E} \cdot \overrightarrow{ds} = \frac{q}{\varepsilon_0}$$

Here the Gaussian surface has cylindrical shape and hence

$$E2\pi zl = \frac{q}{\varepsilon_0}$$

where z is the radius and l is the length of the Gaussian surface. Let the linear charge density λ is given by the relation below

$$\lambda = \frac{dq}{dl}$$

Since we consider uniform charge density, $\lambda = \frac{q}{l}$. So we have

$$E = \frac{\lambda}{2\pi\epsilon_0 z}\hat{z}$$

Many students struggle to grasp the concept of an infinite line charge [6,7]. To address this, we start with a finite line charge and will show when a finite charge distribution can be effectively treated as infinite charge distribution. The top view of the field distribution is given in Figure2.

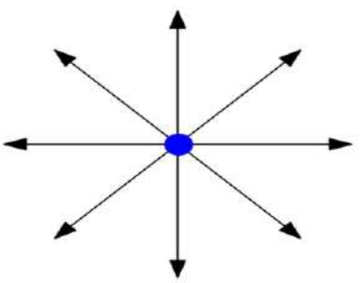

Figure 2: Electric field due to infinite charge distribution-Top view

3. Electric field due to finite line charge

The field due to a charge distribution with a finite length Lis as shown in Figure 3.

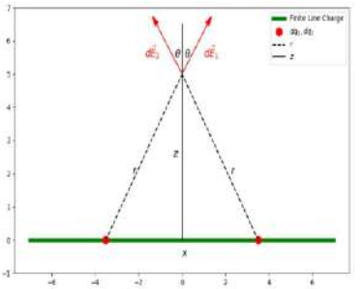

Figure 3: Electric field due to finite distribution

Let dq be an elemental charge. Now, if we look at dq with length dx placed at distance x from the center of the charge distribution, we can treat it as a point charge that creates a tiny electric field, $\overrightarrow{dE}$. As a result, we also know that all charges on the line will create small electric fields that will point to multipledirections.We know that due to symmetry of the line charge $\overrightarrow{dE}$ will havecomponents in the x and y-direction, but we can only focus on the $\overrightarrow{dE}$ components in the x-direction because all y components will add to zero.

$$dE_x = dE' \cos\theta$$

From Figure 3, we have

$$\cos\theta = \frac{z}{\sqrt{z^2 + x^2}}$$

Here dE' is the field due to charge dq. Then

$$dE' = \frac{1}{4\pi\varepsilon_0}\frac{dq}{r^2}$$

Here x runs from $\frac{-L}{2}$ to $\frac{L}{2}$. We have also

$$r^2 = z^2 + x^2$$

Since λ is the linear charge density, $dq = \lambda dx$. Using the formula for a point charge, electric field due to dq at a distance z is

$$dE_x = \frac{1}{4\pi\varepsilon_0}\frac{\lambda dx}{z^2 + x^2}\cos\theta$$

So the total electric field, considering such charge distribution on both sides

$$E = \frac{1}{4\pi\varepsilon_0}\int_{\frac{-L}{2}}^{\frac{L}{2}} \frac{2\lambda z}{(z^2+x^2)^{\frac{3}{2}}}dx$$

Integrating we get

$$E = \frac{\lambda z}{4\pi\varepsilon_0}\left[\frac{x}{z^2\sqrt{z^2+x^2}}\right]_{\frac{-L}{2}}^{\frac{L}{2}}$$

$$E = \frac{1}{4\pi\varepsilon_0}\frac{\lambda L}{z\sqrt{z^2+\left(\frac{L}{2}\right)^2}}$$

If L is very large we get

$$E = \frac{\lambda}{2\pi\varepsilon_0 z}$$

which is the field due to an infinite charge distribution. So to get an infinite charge distribution we must have $\frac{L}{2} >> z$, which means at least $z \approx \frac{L}{1000}$.

In NCERT plus two text book the electric field due to infinite conductor is discussed in chapter 1. The figure given in the book has the parameters $L \approx 7cm$ and $z \approx 1.1cm$, which does not agree with the infinite line charge condition given above. This may inculcate wrong notion among the students. The concept of infinite line charge and the conditions must be correctly pointed out to students while discussing this problem.

4. Does all diamagnets show temperature independent susceptibility ?

Magnetic susceptibility is a material's measure of how much it becomes magnetized in response to an applied magnetic field. Different types of materials-paramagnetic, diamagnetic, and ferromagnetic exhibit distinct temperature dependence of magnetic susceptibility, governed by their internal magnetic structures and interactions [8]. The dependence of diamagnetic susceptibility is given in many text books as temperature independent. But this not correct for all materials. To give a clarity in this we give the details about different types of magnetism, a brief account of the theory and the equations governing them. There are two types of diamagnetism- Langevin diamagnetism and Landau diamagnetism [9,10]

4.1 Langevin Diamagnetism

Langevin diamagnetism applies to insulating materials, dielectrics, and other substances where the electrons are not free to move throughout the material. Here are some examples of materials where Langevin diamagnetism is applicable:

1. Bismuth (Bi) – Known for exhibiting strong diamagnetic properties.
2. Water – A molecular substance that shows weak diamagnetism.
3. Diamond – A non-conductive carbon material where electrons are tightly bound in covalent bonds.
4. Sodium chloride (NaCl) – An ionic crystal where electrons are localized around ions, leading to a weak diamagnetic response.
5. Quartz – A dielectric material with bound electrons contributing to a weak diamagnetic behaviour.

The equation for the magnetic susceptibility of a diamagnetic substance for such substances are given by Langevin equation:

$$\chi = -\frac{\mu_0 n e^2}{6m}\langle r^2\rangle$$

which is temperature independent. Here n is the number density, e is the charge, mis the mass of electron, $\langle r^2\rangle$ is the mean radius of electrons. There are some materials where the reasons for diamagnetism is different, which is given below.

4.2 Landau diamagnetism

In metals like copper, gold, silver etc the theory related to magnetism is Landau's theory of magnetism. Landau diamagnetism specifically applies to materials that have a free electron gas, where the electrons can move relatively freely in response to an applied magnetic field. Landau diamagnetism can be observed in

1. Copper (Cu) – A good conductor with free electrons in its conduction band.
2. Silver (Ag) – It contributes to a weak diamagnetic behaviour
3. Gold (Au) – Exhibits Landau diamagnetism due to its highly conductive nature

4. Aluminium (Al) – Although it also exhibits paramagnetic effects, it shows weak Landau diamagnetism.

Landau's diamagnetism is temperature dependent and is given by

$$\chi = -\frac{n\mu^2}{3kT}$$

Where n is the number density, μ is the magnetic dipole moment of electron, k is the Boltzmann constant and T is the absolute temperature.

4.3. Curie's para magnetism

Curie paramagnetic materials are characterized by their positive magnetic susceptibility, which follows the Curie Law

$$\chi = \frac{n\mu^2}{3kT}$$

Itis typically observed in certain transition metals, rare earth elements, and compounds that contain these elements. Here are some examples of materials that exhibit Curie para magnetism:

1. Cobalt(II) Oxide – This compound displays Curie para magnetism due to the unpaired electrons in cobalt ions.
2. Nickel(II) Oxide – This compound also shows Curie para magnetism, attributed to the unpaired d-electrons in nickel ions.
3. Rare Earth Metals like Gadolinium (Gd)

4.4.Pauli Para magnetism

Pauli para magnetism occurs in materials where conduction electrons contribute to magnetic behaviour through their spin magnetic moments. This type of para magnetism is typically observed in metals that have partially filled electron bands, allowing for the presence of unpaired electrons. Here are some examples of materials that exhibit Pauli para magnetism:

1. Copper (Cu) –Copper shows weak Pauli para magnetism due to the presence of conduction electrons.
2. Silver (Ag) – It exhibits Pauli para magnetism because of its unpaired electrons in the conduction band.
3. Gold (Au) – Another noble metal that displays weak Pauli para magnetism, attributed to its conduction electrons.

Here susceptibility is given by equation

$$\chi = \frac{n\mu^2}{kT}$$

4.4. Ferromagnetism

For ferromagnetic materials, which shows spontaneous magnetisation below the Curie temperature magnetisation is given by

$$M = M_0\left(1 - \frac{T}{T_c}\right)^{\beta}$$

In this equation β=0.33. At $T = T_c$ spontaneous magnetisation becomes M=0 and the material looses ferromagnetic nature.

Above the Curie temperature the expression for susceptibility is given by

$$\chi = \frac{C}{T - T_c}$$

and ferromagnetic materials behave as para magnets, and the susceptibility can be described by the Curie-Weiss law. Inclusion of the concept of the critical temperature called Curie temperature above which ferromagnetism changes to para magnetism will give the student more insight to the classification.

5. Although the mathematical relationship differs, the electric and magnetic fields are depicted with equal amplitudes in the figures of an electromagnetic wave. Why?

In textbooks, an electromagnetic wave is often represented with equal electric and magnetic amplitudes of the waves, even though they are related by the equation

$$\frac{E_0}{B_0} = c = \frac{1}{\sqrt{\varepsilon_0\mu_0}}\,(1)$$

In electromagnetic theory, direct comparison of the magnitudes of electric and magnetic fields is not meaningful due to the fundamental differences in their units. For instance, comparing an electric field amplitude of 1 V/m with a magnetic field amplitude of 1 T is inappropriate because these quantities represent distinct physical phenomena. In the SI system, electric and magnetic fields are treated as independent physical quantities with separate

units, whereas, in the CGS system, the units of these fields are interrelated through the speed of light (c), which serves as a conversion factor between them.

This distinction arises because the dimensions of electric and magnetic fields differ between the SI and CGS unit systems [11,12]. The SI system clearly separates these fields, while the CGS (Gaussian) system intertwines them more closely, based on different assumptions regarding charge and force relationships. Notably, in the CGS system, a comparison of the amplitudes of the electric and magnetic fields in a plane wave is possible, and they are found to be exactly equal. However, in the SI system, no such direct comparison can be made.

Despite this, the relative energy stored in the electric and magnetic field oscillations remains correlated, regardless of the unit system used. Electric field energy is given by

$$\frac{1}{2}\varepsilon_0 E_0^2 \qquad (2)$$

Using (1) and (2) we get

$$\frac{1}{2}\varepsilon_0 E_0^2 = \frac{1}{2}\varepsilon_0 B_0^2 c^2$$

$$\frac{1}{2}\varepsilon_0 E_0^2 = \frac{1}{2}\varepsilon_0 B_0^2 \frac{1}{\varepsilon_0 \mu_0}$$

and we get

$$\frac{1}{2\mu_0} B_0^2$$

which is magnetic field energy. Here it's seen that regardless of the system of units both components, magnetic and electric, carry exactly equal amounts of energy. Hence we represent the amplitudes of them as same.

6. Conclusions

Many physics concepts are often inadequately represented in higher secondary textbooks, which can hinder students' ability to fully grasp them. This article has highlighted some of these issues and aimed to provide students with a deeper understanding of the underlying principles. To promote more effective learning, it is crucial to incorporate clearer and more comprehensive explanations of these concepts at the secondary level. We encourage readers to share any difficulties like these, they encounter, as we aim to address these type of problems in future discussions. In our next article, we will explore additional issues and continue this important dialogue.

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In Memory of Prof H C Pradhan

Subhas Samanta
Retired Professor of Physics, Midnapore College,
Paschim Medinipur, West Bengal

The news of the sudden demise of Prof H C Pradhan came to me as a cruel shock. Through this note, I express my deep regrets for his death; also convey my condolences to his bereaved family members.

We first met at the Jabalpur convention of IAPT. On that occasion, he narrated his experience of leading the first Indian team for International Physics Olympiad (IPO). In 2003, we had an in- depth discussion for the experimental QP for Indian Physics Olympiad in HBCSE. On his initiative, two experiments designed and developed at the CSC, Midnapore were included in it. Afterwards, we met on many occasions but his presence in CSC Midnapore College in 2014 and interaction with the school students there happens to be the most memorable.

In 2022, Midnapore College decided to publish a historical account of CSC, on the occasion of its 150 th year celebration. Prof Pradhan was requested to write the reminiscences of his visit to the CSC for this volume. Despite his severe illness, he readily complied with the request. His article in “An Historical Account of Midnapore College Centre for Scientific Culture” (pp 135-137), is reproduced below, with a slight change in its titles from **'Centre for Science Culture' to 'Centre for Science Culture and its role to “enculturate” students', in accordance with the theme reflected in his article.**

Centre for Science Culture and its role to “enculturate” students

The idea of setting up IAPT Centres for Science Culture (CSC) originated from the Late Dr D P Khandelwal. He was keen to have four or more CSCs across the country. Eventually, only one centre materialized, the one at Midnapore College. It was set up in 1993 for bringing to reality the vision of Dr Khandelwal.The Centre had now completed 21 years of dedicated service in the of science education in general and of physics education in particular. Midnapore College has consistently supported the Centre logistically and academically. I extend my compliments to the Principal of the college, Dr G C Bera and the present In-Charge of CSC Dr Rajib Kumar Pradhan. I also express appreciation of Dr Samanta and Smt Samanta for rendering timely financial help which helped create a corpus fund that has provided the Centre's running expenditure.

During my tenure as President of IAPT, I visited CSC on June 28,2014. On that day a course on practical was going on for students of Class XII from a school which had asked CSC's help. The students were so happy and enthusiastic about performing the experiments. I found the centre used novel, improvised, inexpensive material and equipment that brought physics closer to life for the students. In fact, the Centre has been conducting practical and theory courses for students and teachers at the secondary and tertiary level every year all these years. These courses are run in a genuine spirit of understanding and enjoying physics, inculcating in the students the culture of science which Dr Khandelwal has been happy to see.

In fact, it is my belief that one of the major roles of a teacher is to “enculturate” students. There is a way in which science works, a way in which a person thinks of science, a way in which facts and propositions are expressed in science.These ways of science are peculiar to science and very different, for example, from the ways of history or of languages. Such ways constitute the culture of a subject. Different disciplines differ not only in their content but also in their culture. Further even within science, Physics, Chemistry and Biology differ in content as well as in culture.

Learning a subject is not only mastering its content but also imbibing its culture. It is the interaction between the teachers and the students that leads the students to absorb the content of a subject. In this sense, a teacher transfers to the students both the content of the subject and its culture. The transfer of culture is 'enculturation'. At CSC the process of enculturation is enhanced and is primary, as it should be. This is what I believe, was Dr Khandelwal's vision and CSC lives it. I am really proud that IAPT has CSC as one of its institutions. There is no doubt our country needs many such centres.

Once again, I extend hearty compliments to CSC for its years of exemplary work and wish it many, even brighter, years of continuation and growth.

Prof H C Pradhan
Past President,
Former Senior Professor and Centre Director,
Homi Bhabha Centre for Science Education, TIFR,
Mankhurd, Mumbai 400088

Announcement

IAPT Central EC Election - 2024

Indian Association of Physics Teachers has conducted election through postal ballots for the following posts, for the team 1st January 2025 to 31st December 2027.

1 Vice President, South Zone

2 EC Member, RC-08, Maharashtra

The counting of Votes was conducted on 21st Dec. 2024 from 9.00 am to 5.00 pm at R. J. College,

Ghatkopar, Mumbai

Results of the Election for the above Posts :

1. Vice President, South Zone

Total Votes: 128

Candidate 1 : Prof. Rajeshwar Rao:	110
Candidate 2 : Prof. A. Anandavadivel:	003
Invalid Votes:	015

Prof. Rajeshwar Rao is declared elected.

2. EC Member, RC-08, Maharashtra

Total Votes : 1068

Candidate 1 : Prof. Shivanand A. Masti :	469
Candidate 2 : Prof. Ajay B. Lad:	443
Invalid Votes:	156

Prof. Shivanand A. Masti is declared elected.

P. D. Lele
Returning Officer
Email : pdlele@hotmail.com
Mob. : 9409288348

ABSTRACT/SUMMARY OF POSTER PRESENTATIONS AWARDEES

ID: P4 **Category: 1st Prize**

SYNTHESIS OF CONDUCTING CERAMIC $LiZr_2(PO_4)_3$ AND ASSESSMENT OF ITS ELECTRICAL PROPERTIES

Presented by
Himanshu Bhardwaj
Karan Upadhyay[12*], Himanshu Bhardwaj[1], Shivam Shukla, Anupama Prajapati[1], Abhisek Kumar Gupta[2] & Dinachandra Mayanglambam[1]
[1]SUREELA (StUdent REsearch Exposure LAb), Shiksha Sopan, Kanpur
[2]Department of Physics, School of basic and applied science, HBTU, Kanpur
[*]Email: karanupadhyay325@gmail.com

Energy storage technology has gained international attention in recent times. The search for alternative energy sources has consequently become necessary for human society. The electrolyte in energy storage devices is crucial in determining the ultimate properties of the batteries. Because of their great chemical stability, broad electrochemical stability window, and strong ionic conductivity, NASICON-type $LiZr_2(PO_4)_3$ (LZP) electrolytes have attracted a lot of interest in solid-state Lithium ion batteries. An introduction of Solid-state electrolytes along with information to synthesize Lithium based solid-state electrolyte. Synthesized material was characterized using X-ray Diffraction (XRD) to evaluate the shape and structure of the material, and hence we discussed the change in the conductivity of Synthesized material on different binder, pressure and Sintering temperature separately with the help of impedance spectroscopy. In this work we have found that the maximum ionic conductivity can be found to be at 3500 psi which is 2.0657×10^{-7} S/cm.

ID: P7 **Category:2nd Prize**

MORPHOLOGICAL ANALYSIS OF BIOSILICA DIATOMS FROM NORTH-EAST INDIA

Presented by
B Sophia Tao[*], Mekmadul Hassan Talukdar, and Nitu Borgohain
Department of Physics, University of Science &
Technology Meghalaya, Ri-Bhoi, 793101, India.
[*]E-mail of Corresponding Author: sophiatao2@gmail.com

This study presents preliminary findings on the morphology of various diatom species collected from diverse regions of North-East India. The investigation highlights the presence of distinct diatom forms, including pennate (elongated) and centric (circular) varieties, in the surrounding wetlands. Owing to their biosilica-based structure, primarily composed of silicon dioxide (SiO_2), diatoms exhibit strong potential for optoelectronic applications due to their resemblance to photonic crystals. Furthermore, these microorganisms play a critical ecological role, contributing approximately 20% of the global oxygen supply. We analyzed the structural properties of biosilica diatoms from water bodies across Assam, Meghalaya, and Manipur, emphasizing their morphological similarities with photonic crystal fibers (PCFs). The extracted diatom samples were examined using Light Microscopy, and SEM imaging, revealing a range of pennate and disc-shaped species.

The SEM images showcased the intricate arrangement and periodic distribution of nanoscale pores, resembling photonic crystal structures. This similarity suggests that diatoms

could serve as promising alternatives for PCF-based photonic systems. Given their natural abundance, cost-effectiveness, and structural properties, diatoms present a sustainable alternative to synthetic PCFs in optical applications. Their use could reduce the environmental impact of manufacturing conventional photonic components, aligning with the increasing demand for eco-friendly practices in the photonics industry.

Figure: Light Microscopy of a pennate diatom collected from USTM lake.

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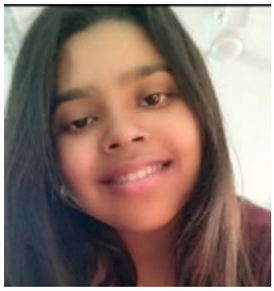
ID: P20

Category: 3rd Prize

NUCLEAR FUSION REACTORS: POWERING THE FUTURE OF CLEAN ENERGY

Presented by



Karan Kashyap **Shabnam Afroz** **Shatra Bhushan Sarmah**

Karan Kashyap*, Shabnam Afroz, Tridib Katowal*, Shatra Bhushan Sarmah*

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Nuclear fusion is the process by which atomic nuclei combine to form a heavier nucleus, releasing vast amounts of energy. It powers the sun and has the potential to be a clean, sustainable energy source for future generations. Unlike nuclear fission, which splits atoms and generates hazardous waste, fusion produces minimal long-lived radioactive materials and carries a lower risk of catastrophic failure. Key fuels for fusion include isotopes of hydrogen, such as deuterium and tritium, which can be sourced from seawater and lithium. Ongoing research, exemplified by projects like ITER, aims to achieve controlled fusion reactions that can produce more energy than consumed. Successful implementation of fusion technology could

significantly reduce reliance on fossil fuels, mitigate climate change, and provide a virtually limitless energy supply, paving the way for a more sustainable and environmentally friendly energy future.

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ID: P3 **Category: 3rd Prize**

FABRICATION OF VIBRATING SAMPLE MAGNETOMETER

Presented by

Himanshu Bhardwaj

Himanshu Bhardwaj*, Keshav Bhasin, Karan Upadhyay, Anupama Prajapati, Shivam Narayan Shukla, Palak, Tushar Sharma

SUREELA (StUdent REsearch Exposure LAb), Shiksha Sopan

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This research outlines the development and execution of a vibrating sample magnetometer (VSM) that employs two permanent magnets to create a uniform magnetic field. The VSM facilitates the assessment of the magnetic characteristics of various materials by measuring the magnetic moment as the sample oscillates within the magnetic field. The arrangement of the two permanent magnets provides stable and uniform magnetic environment to a good extent, thereby improving both sensitivity and precision. Woofer is used as vibrator and the plastic rod to hold the sample in magnetic environment. The signal detected using an operational amplifier circuit has been studied through SEELab 3.0. The design of the system is optimized to reduce stray fields and enhance the signal-to-noise ratio. Experimental findings illustrate the efficiency of this configuration in measuring hysteresis loops for various samples, highlighting its potential applications in material science and magnetic research.

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23rd Annual Convention of IAPT-Goa RC 21
4th January, 2025

The 23rd Annual Convention cum seminar of Goa Regional Council was held on Saturday, 4th January 2025 from 09.45 am to 06:00 pm. The convention was held at Conference hall of Goa Board of secondary and Higher secondary School Education Porvorim Goa. The seminar was attended by 82 participants including Physics teachers and students of College, university and HSS.

The Chief guest for the inaugural function was Shri. Shailesh Zingade, director directorate of education Govt. of Goa. The Saraswati invocation sung by Miss. Sakshi Desai captivated the audience, setting a serene and auspicious ambiance for the event. The convention was inaugurated by the Chief Guest and other dignitaries by watering the plant, which symbolize the growth and prosperity that accompanies knowledge. Prof. Satish Keluskar, President IAPT Goa RC delivered welcome address and introduced the Chief Guest. Dr. Reshma Raut Dessai, Secretary,RC-21, provided insight about the activities of IAPT and briefly outlined the sessions for the day. Chief Guest Shri Shailesh Zingade in his inaugural speech highlighted on the importance of amalgamation of English language with science. He shared his view on interdisciplinary connection of Physics with other subjects like Chemistry, Biology and mathematics. He encouraged and motivated the participants and congratulated EC for successfully conducting convention every year. The inaugural function concluded with the vote of thanks proposed by Shri Yatin Desai, Treasurer, Goa RC.

The first speaker in technical session was Prof. Vithal Tilvi, Professor at the Center for

Research Development & Innovation at the Goa State Higher Education. He explained the importance of basics in any subject in learning and understanding advanced topics.

Using the experimental setup showing formation of colors through prism he discussed the factors giving any body it's colour. Also elaborated about how do we see colors and the relation of energy to colours. In the second technical session Prof. Gajanan Honnawar, from MES University Bangalore delivered a comprehensive talk on “Battery Materials: A Physics Perspective”. He briefly explained why batteries are important and how Lithium battery works. He also explained why there is need to replace Lithium by a combination of sodium and aluminium for better efficiency. He also explained the work that they are doing in his lab and interacted with participants answering their questions.Participants had the opportunity to network and engage in discussions during the lunch and tea break fostering collaboration and knowledge sharing.

The annual general body meeting was held post lunch for all the life members in which the report of activities that were conducted throughout the year and the audited statement of accounts was presented. The future activities planned during the academic year 2024-25 were presented in the meeting.The announcement of National convention which will be beheld is Goa was made.

In the post lunch session by Prof. Y. K. Vijay on “Innovation in science teaching” demonstrated potential; distribution on a plane lattice of magnet and the dynamics of pendulum. He also demonstrated quantized states of electrons in atoms as circular orbits with integer multiple of wavelength associated with the electrons using the flexible strips mounted on a speaker.

The Chief guest for valedictory function was Shri. Bhushan Sawaikar, Director Directorate of Higher Education, Govt. of Goa.Participants shared their feedback about the entire days session and expressed their satisfaction about the programme. The toppers of M.Sc., B.Sc., in Physics and Electronics, HSSC topper in the subject of Physics and PhD awardees in Physics were felicitated

Two superannuated Physics Teachers ,Dr. Girish Kundaikar from PES College Farmagudi and Shri. Sandeep Burye from Dhempe College Mirramar were

felicitated for their contribution in teaching Physics.In his Speech the Chief Guest appreciated the work of IAPT and said this type of conventions are necessary in all subjects as they give a platform to all teachers especially to be in touch with current trends in the subject. Most difficult subject can be made easy if a teacher enjoys teaching. Director told about the importance of Mathematics and Physics in everyday life. He appreciated the felicitation of retired teachers and young students on one platform. He urged young teachers to come forward with new ideas and have their say in nation building. Gave best wishes for IAPT Goa to hold the National convention in Oct/ Nov 25 and assured full cooperation from DHE. Dr. Dessai proposed vote of thanks and expressed happiness over the success of the convention. She thanked resource persons, organizing members and the participantsof the convention.

She expressed her gratitude towards the management and the Chairman of Goa Board of Secondary and Higher secondary School Education for providing their facility and hosting the convention.

Photo1: Participants at the convention and the felicitation of retired Physics teachers

Photo2: Prof. Vithal Tilvi explaining formation of colours: Talk on battery material by Prof. Honnawar: Experimental demonstration by Prof. Y K Vijay

Reshma Raut Dessai

Secretary IAPT Goa RC 21

Report (RC-08E)

Recreational Maths Problems from Indian Knowledge System: From Pingal to Ramanujan

Date: 21st December 2024,

Platform: Zoom/ YouTube

Target Audience: Middle school students and teachers

Organized by: SRC 08E (Vidarbha) in association with Prof. .Rajendra Singh Science Exploratory, Nagpur (PRSSE) In celebration of National Mathematics Day, commemorating the birth anniversary of the renowned mathematician Shrinivasa Ramanujan, SRC08E (Vidarbha) organized a virtual talk titled **"Recreational Maths Problems from Indian Knowledge System: From Pingal to Ramanujan."** The event aimed to engage participants in the rich mathematical heritage of India and explore the contributions of historical figures in the field.The

session was conducted by Mr. Jay Thakkar from CCL, IIT Gandhinagar, who is known for his innovation in mathematics education. His engaging presentation provided insights into various recreational math problems and their historical context.

The event attracted approximately 100 participants, including middle school students and teachers, who actively engaged in the discussion and posed insightful questions.

Highlights of the Talk

- Historical Context: The talk began with an overview of the contributions of ancient Indian mathematicians, including Pingal and Ramanujan.
- Interactive Problems: Mr. Thakkar presented several recreational math problems, encouraging participants to think critically and creatively.
- Q&A Session: An interactive Q&A session allowed attendees to clarify doubts and deepen their understanding of the topics discussed.

The virtual session fostered a greater appreciation for mathematics and its historical roots among students and teachers. Prof. P.K. Ahluwalia, President, IAPT also addressed his views on this occasion. The session was conducted by Dr. G.V. Lakhotiya, Vice-President, SRC08E, Vote of thanks was proposed by Dr. Seema Ubale, Director, PRSSE.

Session can be revisited through weblink: https://shorturl.at/Pu1Av

G. V. Lakhotia
Event Coordinator

Report (RC-13)

Quizzard- Intercollegiate quiz contest

Quizzard - an intercollegiate quiz event for helping the students learn about Indian scientists and our current S&T was organised by the Department of Physics, Dwaraka Doss Goverdhan Doss Vaishnav College in association with IAPT RC-13(TN and Puducherry) on December 23, 2024. Students of UG and PG from 13 city colleges participated in the event.

Time has come that we talk more about our S&T contributions and where we are - time to build their passion for learning Science, to help teachers learn these facts, time to introduce about JC Bose, PC Ray, Tata, Anna Mani, Kamala Sohoni, Mahalanobis, and many more. Based on the theme for National Science day, 2024 titled "Indigenous technologies for Viksit Bharat" which reflects a strategic focus on promoting public appreciation for Scientific accomplishments of Indian Scientists to address challenges through home-grown technologies for over-all well-being,.The quiz was conceptualized on –Founders of Modern Science in India.

Mr. Gopalakrishnan Karthikeyan, the quiz master made it very interactive and educative to every participant and audience. The quiz had preliminary writing test and the final 5 teams were selected from 13 teams. Each team had 3 students. There were many interesting rounds, viz, photons and phonons, rapid-fire, audio-visual rounds that excited the participants.

The prize winners were awarded with certificates and medals. The enthusiastic audience was also given special prizes. Students learnt more about Indian scientists, their works and institutes of national importance. It was a wonderful experience for students creating an experiential learning platform.

V Renganayaki
Organising Secretary

"How To Do Science" – Prof. N. Gautham

11 Sept 2024 (Online Talk)

The IAPT Regional Council – 13 (Tamil Nadu and Pondicherry) in association with the Department of Physics, Madras Christian College, Chennai had organized an online seminar by Prof. N. Gautham, Professor (Retd), Centre for Advance Study in Crystallography and Biophysics, University of Madras, on 11 Sept 2024. Prof. N. Gautham's research interests span in many areas of biophysics - DNA Crystallography, protein structure prediction and molecular docking. Prof. N. Gautham delivered an online talk entitled "How To Do Science". The talk was an exposition of the basic tenets of the scientific method and through the talk Prof. N. Gautham impressed upon the audience the need to inculcate scientific temper and inquiring mindset, especially in the younger generation.

The head of the department, Prof. P. Samuel Asirvatham, welcomed the gathering and the speaker. The coordinator of the event, Dr. N. Nirmal Thyagu, introduced the speaker and his contributions in the field of biophysics. During the talk Prof. N. Gautham spoke about the scientific method and the merits of scientific inquiry. Prof. Guatham gave a brief outline of what constitute the scientific method and identified some steps, which are: i) identification of a phenomenon, ii) investigation of the phenomenon, iii) Explanation of it in terms of the known theory, iv) If not explainable, devise a new explanation or theory, v) making a prediction based on theory, vi) Check to see if the prediction is correct, vii) Report the results.

Prof. Gautham highlighted the features that are built into the scientific method that help us not only discover new phenomenon with the existing theories but also to come up with a new theory when the existing theory(-ies) cannot explain the new phenomenon. He pointed out that the real power of scientific method is in the clause of "falsifiability" which gives scope for a new theory to supersede and replace the established old theory (-ies). He gave a few examples of such instances from the history of science. Notably, he explained as to how the theory of relativity of Einstein came to be an overarching theory which superseded the classical theory of Newton that ruled the reign for centuries.

Prof. Gautham encouraged the student participants to read widely to inculcate the spirit of inquiry. He cited several important books that a student should read, for instance: George Gamow's "One, Two, Three, … Infinity". The national president of the IAPT, Prof. P. K. Ahluwalia too graced the occasion and actively engaged in lively conversation with the guest. Prof. P. K. Ahluwalia too added that a student should read widely and cited a famous book "The Chemical Life of a Candle" by Michael Faraday as a book that should not be missed by anyone.

The number of participants was around 30.

NOTE: The Youtube recordings will be uploaded in the RC-13 and IAPT websites shortly.

Dr. N. Nirmal Thyagu

Report (RC-12A)

Workshop on Quantum Computing – An emerging field of Physics

A half day online workshop was conducted on **Quantum Computing –An emerging field of Physics** by Department of Physics, Dayananda Sagar College of Engineering, Bengaluru in association with RC 12 (A) on 13-01-2025 from 6.15 PM to 7.45 PM through Google meet. An industry expert Dr. Jayakumar Vaithiyashankar, CEO, Anuthantra conducted the session. The workshop was coordinated by Dr. Meera R Gumaste (EC Member RC 12 (A) of IAPT), Assistant Professor Department of Physics, Dayananda Sagar College of Engineering, Bengaluru Dr. C M Joseph, Head Department of Physics welcomed Dr. Jayakumar. Dr.Meera introduced the resource person Dr. Jayakumar Vaithiyashankar.

Dr. Jayakumar started his session with the useful information about the quantum computing program by IBM.

He also talked about the opportunities as a Quantum Educator to the faculty. Later he expounded the basics of quantum computing and the applications of physics theory in quantum computing. He also explained simple quantum gates like Hadmard gate with illustrative examples.

He concluded the session with the online courses available for the faculty as well as for the students based on quantum computing. All faculty members of Department of Physics attended the workshop. Few students interested in quantum computing also attended the workshop.

As concluding remarks Dr. Meera R Gumaste delivered vote of thanks. She thanked Management of DSCE, Principal Dr. B G Prasad for their constant support in conducting this online workshop.

Meera

Announcement

International Conference on Physics Education 2025 to be held in India

IIT Ropar, IISER Mohali and IAPT to Cohost

Photo Courtesy: Prof. Pratibha Jolly

This year India is hosting for sure IUPAP International Conference of Physics Education 2025. The regional Councils must help in participation of members from their regions by submitting papers under various themes. It will also provide an opportunity to network with leaders in Physics Education from across the world. From 1st January Prof. Sunil Gupta has taken over as President of IUPAP. He is second Indian to have this honour after Homi J Bhabha. Prof. Arun Grover, former Vice Chancellor Panjab University Chandigarh is a member of C14 group of IUPAP on Physics Education and he has been instrumental in bringing this event to India. Chairperson of C14 Prof. Manjula Sharma who is a Prof. of Physics Education and a PER expert in University of Sydney is also from India. In 2005 when last ICPE in India was held was conducted by then General Secretary of IAPT Prof. Pratibha Jolly. Prof. R Chidambaram helped a lot in the conduct of that conference. It was inaugurated by Dr. APJ Kalam in Vigyan Bhavan. Prof. Zillenger who got Nobel Prize for quantum Entanglement was one of the keynote speakers.

To view all the IAPT Feeds of IAPT Community, visit:

https://www.indapt.org.in/f/international-conference-on-physics-education-2025-to-be-held-in-india-37232

Announcement

IAPT Sub Regional Council SRC-08B Mumbai

EXECUTIVE COUNCIL (Jan 01, 2025 to Dec 31, 2027)

The following office bearers and executive members are hereby declared duly elected, unopposed, to the respective positions as they were the only nominees for these posts.

Sr. No.	Post	Membership No.	Name of the Candidate	Contact No.	Email
1	President	L2503	Krishna Girdhar Bhole	9820551156	kgbhole@gmail.com
2	Vice President	L5895	Vivek Vasant Bhide	7738458185	vivekbhidestar@gmail.com
3	Secretary	As no nominations are received, the decision will be taken by the new EC.			
4	Treasurer	L3528	Shyamala Prajapati Bodhane	9869336624	spbodhane@gmail.com
5	Member	L5840	Sushmita Meta	9867498395	homesushmitameta@gmail.com

Kiran M. Kolwankar, Returning Officer (RO)
Professor, Department of Physics,
Ramniranjan Jhunjhunwala College, Ghatkopar (W), Mumbai 400 086
Mobile: 9920381051, Email: Kiran.Kolwankar@rjcollege.edu.in

Announcement

The New Office Bearers of Sub RC- 04 A [Kanpur] for the Term 1st January 2025 –31st December 2027

S. No.	Designation	Name	Life Member ship Number	• Address • E – Mail • Mobile Number
1	President	Dr. Manoj Bhushan Pandey	L6625	• 132/B2, Gomti Nagar, Makadi Kheda, Kanpur 208002 • mbpandey@gmail.com • 9451052040
2	Vice-President	Mr. Sanjeev Kumar	L3510	• 117/H-2/124,Flat T2 Guru Astha Apartment, Pandu Nagar,Kanpur • sanjeevanveshika@gmail.com • 9935104021

3	Secretary	Dr. Manish Nigam	L4948	• 117/Q/15, Flat No 04, First Floor, Vishnudham Apartment, Sharda Nagar, Kanpur 208025 • mnigam26@gmail.com • 8318140314
4	Treasurer	Mr. Ravish Chandra Pandey	L3321	• 3/31 Pashupati Nagar, Naubasta Kanpur 208021 • rcpandey603@gmail.com • 9452832762
MEMBERS				
1	Member	Dr. Aprna Dixit	L8397	• 128/65 E Kidwai Nagar, Kanpur, 208011 • DRAPARNADIXIT1@GMAIL.COM • 9450770545
2	Member	Mr. Bankey Bihari Agarwal	L9277	• 11-A, Dadanagar, Industrial Area, Kanpur • bankeygrwl@gmail.com • 8299433668
3	Member	Mr. Yogesh Kumar Jha	L9278	• 116/505 Keshav nagar, Rawatpur Gaon, Kanpur • yogeshjhakanpur@gmail.com • 8887811168
4	Member	Mr. Mohit Singh	L8589	• Village and Post Bhikhepur, District Auraiya, Pin206129 • mo.sin2k2@gmail.com • 9761170250
5	Member	Ms. Seema Kumari	L9276	• 1596 Kashyap Nagar Jagatpuri, Kalyanpur, Kanpur 208017 • Seemakumari7489@gmail.com • 9794649022
Co-Opted Member				
1	Coopted Member	Dr. Anurag Tripathi	L 9269	• Chemical Department IIT Kanpur 208016 • anuragt@iitk.ac.in • 7619080000
2	Coopted Member	Dr. Niraj Mohan Chawake	L 9268	• Department of Materials Science and Engg IIT Kanpur 208016 • nchawake@iitk.ac.in • 9884681712
Ex-Officio Member				
1	NANI Coordinator	Dr. H. C. Verma	L0081	• 12/1-3, Nankari, IIT Kanpur • hcverma@iitk.ac.in • 9935271481
2	Treasurer IAPT	Dr. D. C. Gupta	L3153	• 117/@/555 Indrapuri Sharda Nagar, Kanpur 208025 • guptadeepchandra117@gmail.com • 9839035685
3	EC Member RC – 04 (U.P.)	Dr. Sunder Singh	L 5287	• 28 Ashish Royal Park, Phase-1, Bareilly • Ssg01bcb@gmail.com • 9411469145

Amit Kumar Bajpai [L6073,
Returning Officer
Email: sopanbajpai@gmail.com ,
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Election: IAPT RC – 20 Jharkhand

S.No	Post	Name	Address	LM No.	Mobile	Email
1.	President	Dr. Shambhu Nath Paul	Retd. Associate Prof. Dept. of Physics, Marwari College, Ranchi	L-1490	9934134068	paulphysics2010@gmail.com
2.	Vice President	Dr. Shreeman Narayan Tiwary	Assistant Professor, Dept. of Physics, St. Xavier's College, Ranchi	L-0575	9431577946	shreemantiwary@yahoo.com
3.	Secretary	Mr. Santosh Rajwar	Assistant Prof., Dept. of Physics, Marwari College, Ranchi	L-8568	7762924600	santosh.raj020@gmail.com
4.	Treasurer	Dr. Anupam Kumar	Assistant Prof., Dept. of Physics, DSPMU, Ranchi	L-9497	9430735008	anupamiitd@gmail.com
5.	Member	Dr. Sunil Kr. Singh	Associate Prof., University Dept. of Physics, Ranchi University, Ranchi	L-9646	9470522177	singh.kr18sunil@gmail.com
6.	Member	Dr. Dilip Kumar Giri	Assistant Prof., University Dept. of Physics, BBMKU, Dhanbad	L-5754	9470365859	dilipkumargiri@gmail.com
7.	Member	Dr. Raj Kumar Singh	Assistant Prof., University Dept. of Physics, Ranchi University, Ranchi	L-5092	7070476268	rajkrsingh08@gmail.com
8.	Member	Dr. Tushar Mohanta	Assistant Prof., Dept. of Physics, St. Columbus College, Hazaribagh	L-9499	8603793861	tmohanta427@gmail.com
9.	Co-opted member	Dr. Preety Minz	Assistant Prof., Dept. of Physics, Ranchi Women's College, Ranchi	L-9649	9134320685	praisethelord.minz8@gmail.com
10.	Co-opted member	Mr. Santosh Kumar Singh	Assistant Prof., Yogoda Satsanga Mahavidyalaya, Ranchi	L-9648	9471718022	singhsantosh2065@gmail.com

As no other nomination forms were received, the above listed members are hereby declared elected unopposed by the members of the general body/EC meeting of RC 20 Jharkhand of IAPT in the conference hall of Marwari College, Ranchi, a constituent and autonomous college of Ranchi University, Ranchi.

Returning Officer :
Raj Kumar Singh
Mobile: 7070476268 Email: rajkrsingh08@gmail.com
University Department of Physics, Ranchi University, Ranchi

Bearers of IAPT RC-23 (Himachal Pradesh) for the Term 2025 – 27

S. No.	Designation	Name	Life Membership Number	Address	E-Mail	Mobile Number
1.	President	Dr. Kuldeep Kumar Sharma	L8078	Associate Professor Department of Physics & Photonics Science, National Institute of Technology Hamirpur (H.P) - 177 005	kks@nith.ac.in kknitham@gmail.com	9418780275
2.	Vice-President	Dr. Chhavi Kashyap	L3723	Principal, Rainbow International School, Nagrota Bagwan District Kangra, Himachal Pradesh-176047	chhavikashyap22@gmail.com	9418052977
3.	Secretary	Dr. Sapna Sharma	L1616	Associate Professor, Department of Physics, St. Bede's College Shimla - 171002	sapnasharma228@yahoo.com	9418495919
4.	Treasurer	Dr. Ram Murti Sharma	L8041	Lecturer, GSSS Bangana, Vill Samlara, P. O. Jasana Teh. Bangana, Distt. Una (H. P.) - 174307	rammurtisharma07@gmail.com	9418230891

Members:

1	Member	Dr. Satinder Sharma	L9614	Professor, School of Computing & Electrical engineering, IIT Mandi (H.P.) 175075	satinder@iitmandi.ac.in	9459190073
2	Member	Dr. Anil Thakur	L5567	Associate Professor Department of Physics Govt. College Solan	anilt2001t@gmail.com	9418054082
3.	Member	Dr. Amarjeet Sharma	L8623	Professor, Department of Physics Himachal Pradesh University, Shimla 171005,	amarjeet.sirohi@gmail.com	7018466932
4.	Member	Dr. Sapna Verma	L7467	Assistant Professor, SE Residence, I & Ph. Near field Hostel Sarvari, Kullu H.P	sapnaverma2792@gmail.com	7018834732
5.	Member	Dr. Arun Kumar	L7910	Assistant Professor Deptt. of Physics, Govt. College Bilaspur, Himachal Pradesh.	arunphy@gmail.com	9418110563

Ex – Officio Members:

1. President [IAPT]: Prof. P. K. Ahluwalia [Shimla]
2. Vice President [North Zone]: Prof. Meenakshi Sayal [Jalandhar]
3. IAPT EC Member [RC – 23]: Sh. Dinesh Sharma [Kangra]

Co – Opted Members:

1. Prof. O. S. K. S Sastri [Professor, CUHP Dharamshala (H.P.)]
2. Dr. Pawan Kumar Sharma [Principal, GDC Dadahu, Solan (H.P.)]
3. Prof. Raman Sharma [Professor, HPU Shimla]
4. Dr. Arvind Kumar Gathania [Associate Professor, NIT Hamirpur]

It is certified that all the above Office-Bearers were elected unanimously, in the General Body Meeting of Life Members from Himachal RC-23 held on Sunday 25 Aug. 2024.

Pawan Kumar Sharma, (Returning Officer, L6218,
IAPT RC 23 (H.P.)
Manukulam, Near Government Degree College
Solan, Distt. Solan, HP-173 212
Pawankumarsolan@gmail.com, Mob: 9418465066

List of the New Office Bearers of RC – 21 Goa for the Term 2025 – 2027

S. No.	Designation	Name	Life Membership Number	• Address • E – Mail • Mobile Number
1	President	Prof. Satish H. P. Keluskar	L2394	PES'S RSN College of Arts and science Farmagudi Ponda Goa Shpk964@gmail.com 9422447504
2	Vice-President	Mr. Manoj B. Sawaikar	L3423	D4/101, Nova Cidad Residency Porvorim Goa msawaikar@gmail.com 9404454324
3	Secretary	Dr. Reshma Raut Dessai	L3462	Faculty Block A, SPAS, Goa University Taleigao Plateau Goa 403206 reshma@unigoa.ac.in 9423317344
4	Treasurer	Mr. Roger Cajetan Andrew Fernandes	L 2516	Block A, F-2, Graceland , Nr. Corporation bank Alto Porvorim Goa rogerferrao@gmail.com 9860323817
	MEMBERS			
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2	Member	Mr. Pradeep V Morajkar	L9284	H. No. 110/4 Lobo vaddo Parra, Bardez Goa pvmorajkar@gmail.com 9822139319
3	Member	Dr. Sudipta Kanungo	L9628	Academic Block B, IIT Goa, sudipta@iitgoa.ac.in 8335813769
4	Member	Mr. Atul Achut Naik	L2866	H.No.111,Nr.Bandeshwar Temple,Dandos wada,Mandrem-Goa.403527
5	Member	Mr. Amey Shirodkar	L9373	Shivshakti Kunj, H. No 379, New Mahalaxmi Nagar, Talaulim, Ponda Goa 403 401 ameyka007@gmail.com

Returning Officer: Mr. Pradeep V Morajkar
Email: pvmorajkar@gmail.com
Ph. No: 9822139319

Elected office bearers for the period January 1, 2025 to December 31, 2027- Regional Council-11, Andhra Pradesh

S.No	Designation	Name	Life membership No.	WhatsApp Number/Ph.	College Name and address/ email
1	President	Dr. G. Sahaya Baskaran	L5066	9490658088 7989963625	Andhra Loyola College, Vijayawada - 8sbalc@rediffmail.com
2	Vice President	Mr Kondamudi Ravindra Kumar	L5041	9924805001 5652276666	Sri Chaitanya College, Gosala Boys zone, Gosala, Vijayawada physicsravindra@gmail.com
3	Secretary	Dr J Chandrasekhar Rao	L5824	9390421450 8919528952	Govt Degree College-Rajam, Srikakulam chandujoga1@gmail.com
4	Treasurer	Dr P.B.Sandhya Sri	L7657	9494051548 8074203008	Government Degree College, Avanigadda, Krishna Dt., Andhra Pradesh sandhyasri.prathipati@gmail.com

Members of Executive Committee

1	E.C. Member	Dr. Seelam Rajyalakshmi	L7377	9290402635 9603566777	Adikavi Nannaya University, Rajamahendravaram srajyalakshmi768@gmail.com
2	E.C. Member	Mr. Upadrasta Lakshmana Suri.	L4500	9490336958	Sri Chaitanya medical academy gosala phylakshman@gmail.com
3	E.C. Member	Mr. Srinivasa Rao Varanasi	L7024	9440963553 7013580677	A.P. Model school, Tamada, Laveru Mandal, Srikakulam Dist. contactvsr@gmail.com
4	E.C. Member	Sri. Anand Bhaskar Reddy		9441823923 8639092816	MPUP School, Pothulanage palli, Dharmavaram mandal, Ananthpur dist. Kabhaskar2@gmail.com
5	E.C. Member	Dr Prem Pankaj	L9262	9418805533	Dept of Humanities and Sciences, Ashoka Women's Engineering College, Kurnool, 518218 prem9ajo@gmail.com
	National EC Member	Prof. M. Krishnaiah	L1973	9502988833	profkrishnaiah.m@gmail.com	Science Coordinator, Padmavathi Mahila University, Tirupathi. profkrishnaiah.m@gmail.com

M. Krishnaiah , Returning Officer
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National Standard Examination - 2024

State-wise **Enrolment** and the number of students shortlisted for the **Indian National Olympiad - 2025** in respective subjects

SR	State	No. of Centre	NSEP - 2024				NSEC - 2024				NSEB - 2024				NSEA - 2024				NSEJS - 2024		
			Enl	Present	Shortlisted for INO - 2025		Enl	Present	Shortlisted for INO - 2025		Enl	Present	Shortlisted for INO - 2025		Enl	Present	Shortlisted for INO - 2025		Enl	Present	Short listed for INO
					Group A	Group B			Group A	Group B			Group A	Group B			Group A	Group B			
1	ANDAMAN & NICOBAR	5	51	38			33	28			54	45	1		5	2			123	100	
2	ANDHRA PRADESH	59	2212	2011	9	10	2082	1903	23	8	565	465	8	1	491	440	8	3	2576	2149	19
3	ARUNACHAL PRADESH	14	95	72			84	75			167	149			27	24			388	348	
4	ASSAM	42	1078	864		1	860	684	5	1	1081	891	4	3	209	171	4	1	1231	1117	1
5	BIHAR	38	1499	1139	7	10	1112	899	20	12	865	696	7	5	423	295	5	18	1377	1082	20
6	CHHATTISGARH	42	819	717	5		769	687	6	5	616	535	5	1	304	260	6	5	831	738	5
7	CHANDIGARH	6	806	656	7	5	701	568	14	4	207	162	4	4	336	282	7	8	125	91	5
8	D & N HAVELI and D & DIU	3	87	74			82	66	1		82	66			42	34			52	45	1
9	DELHI	22	3293	2164	34	16	2764	1902	53	13	968	622	56	23	1235	825	31	22	1306	871	13
10	GOA	10	220	154			329	245	4		228	139	4		38	27	3		96	74	
11	GUJRAT	63	2955	2450	9	11	2962	2530	15	9	2585	2074	9	9	964	849	11	16	1795	1552	13
12	HIMACHAL PRADESH	31	488	392	2		405	349	4		408	333	4		96	85	4		581	503	
13	HARYANA	67	3106	2388	12	7	2887	2237	20	7	1606	1200	5	5	1057	837	11	9	2390	1868	15
14	JHARKHAND	32	1375	1059	4	3	1072	829	5	2	540	374	4	4	425	331	5	5	996	805	5
15	JAMMU & KASHMIR	32	573	436	1	2	440	341	4		518	411	4	4	154	112	3	1	837	643	4
16	KARNATAKA	106	4025	3286	10	10	3805	3110	18	9	3091	2461	11	9	1209	975	15	14	3551	3059	14
17	KERALA	37	1392	1037	6	1	1228	889	6		980	706	6	4	402	288	5		739	491	2
18	LADDAKH	2	26	18			32	25			33	26			11	11			51	41	
19	LAKSHADWEEP	1	6	5			6	5			6	5			0	0			3	3	
20	MAHARASHTRA	121	7212	5746	24	19	6499	5195	37	21	4100	3075	20	20	2341	1844	26	28	3449	2835	30
21	MEGHALAYA	12	64	55			68	58			110	96			26	26			364	325	
22	MANIPUR	12	132	115			104	99			194	190			33	32			262	244	2
23	MADHYA PRADESH	85	2756	2299	14	9	2384	1990	13	10	2195	1821	15	15	932	778	16	10	1696	1452	13
24	MIZORAM	9	6	6			9	7			76	63			0	0			138	113	
25	NAGALAND	9	25	23			46	46			78	75			2	1			189	171	
26	ODISHA	72	1349	1124	6	4	966	800	7	8	1069	899	7	7	396	336	8	6	1471	1238	10
27	OVERSEAS	2	18	15			18	15			8	6		2	1	1		2	9	7	
28	PUNJAB	41	1394	1119	5	4	1511	1237	5	6	924	742	5	5	515	434	7	7	914	767	7
29	PUDUCHERRY	6	200	165			229	196	4		250	209	4	2	73	67	1	1	190	162	3
30	RAJASTHAN	88	5140	4045	19	22	4313	3451	38	12	2694	2087	12	12	1642	1310	18	18	2790	2366	19
31	SIKKIM	5	50	24			25	19			45	36			14	11			117	99	
32	TELANGANA	78	2708	2329	13	31	2747	2376	45	6	854	675	7	6	1153	1020	11	17	4546	3918	15
33	TAMIL NADU	96	4814	3939	12	5	4280	3505	16	13	3256	2595	12	12	1535	1317	16	15	3253	2614	17
34	TRIPURA	9	228	188			169	138	5	1	159	143	1	3	61	48	2	2	225	193	
35	UTTARAKHAND	28	729	567	2		581	461	4	2	403	319	3	2	320	244	4		403	328	3
36	UTTAR PRADESH	140	5124	3855	35	22	4211	3292	35	36	2934	2173	34	31	1641	1269	43	41	3327	2722	52
37	WEST BENGAL	52	2347	1810	15	9	1834	1399	14	15	1246	903	14	12	805	612	18	18	1280	1007	22
	Total	**1477**	**58402**	**46384**	**251**	**201**	**51647**	**41656**	**421**	**200**	**35195**	**27467**	**266**	**201**	**18918**	**15198**	**288**	**267**	**43671**	**36141**	**310**

MAS : Minimum Admissible Score is 50% of Top Ten Scores **MI** : Merit Index is 80% of the average of Top Ten Scores. All students scoring equal to and above MI are shortlisted for INO - 2025

Prof B P Tyagi
Chief Coordinator (Examination)

National Standard Examination - 2024

held on

November 23 & 24, 2024 and December 21 & 22, 2024 in NCR

SUMMARY

Examination	Enrolment				Present	Percentage of Present Students	Groups		Average of Top Ten Scores	MAS	MI	Students above MAS	Students above MI	Students shortlisted for INO - 2025
	Total	Male	Female	Other										
NSEP	58402	42318	16083	1	46384	79.42	A	Rest of India	166.6	83	133	664	52	251
								NCR	188.9	94	151	314	51	
							B	Rest of India	146.0	73	116	252	23	201
								NCR	153.3	76	122	169	17	
NSEC	51647	34027	17617	3	41656	80.65	A	Rest of India	178.1	89	142	2749	233	421
								NCR	177.3	88	141	418	70	
							B	Rest of India	153.0	76	122	572	32	200
								NCR	123.3	61	98	188	21	
NSEB	35195	13739	21453	3	27467	78.04	A	Rest of India	149.5	74	119	1011	70	266
								NCR	140.7	70	112	220	59	
							B	Rest of India	149.7	74	119	351	38	201
								NCR	125.6	62	100	87	18	
NSEA	18918	14196	4720	2	15198	80.33	A	Rest of India	160.8	80	128	791	62	288
								NCR	140.5	70	112	298	42	
							B	Rest of India	148.7	74	118	367	32	267
								NCR	121.7	60	97	222	29	
NSEJS	43671	25245	18425	1	36141	80.75	Rest of India		152.9	76	122	692	96	310
							NCR		126.2	63	100	132	24	
Total	**207833**	**129525**	**78298**	**10**	**166846**	**80.27**						**9497**	**969**	**2405**

MAS : Minimum Admissible Score, MI : Merit Index, INO : Indian National Olympiad

All students above MI have been shortlisted for INO - 2025

Shortlisting of the students above MAS and below MI depends upon their respective states.

Prof B P Tyagi
Chief Coordinator (Examination)
Indian Association of Physics Teachers

INVITATION

National Photo Essay Competition in Physics

Celebrating: International Year of Quantum Science and Technology and National Science Day 2025

Organized By

Indian Association of Physics Teachers (IAPT)
SRC08E (Vidarbha)

In Association With

Department of Physics
Dharampeth M.P. Deo Memorial Science College, Nagpur (DMPDSVM)

Who can Participate

Category 1: Undergraduate Student/Post Graduate Student
Category 2: Research Scholar/Faculty/ School Teachers/ Any Postgraduate From Indian Universities and Colleges

Theme: Quantum Mechanics and Technologies of 20th and 21st Century

INCENTIVES

- The top three participants in two categories will be awarded cash prizes of :
  Rs. 5000 for the first place
  Rs. 3000 for the second place
  Rs. 2000 for the third place
- Toppers will be invited to present their photo essays in the Annual IAPT convention.
- Each participant will get the e-certificate duly signed by the organizers.

Scan Here to Know

- About Photo Essay
- About Participation Guidelines
- About Helplines
- About Registration process

https://tinyurl.com/n63w3e38

No Registration Fee

Registration Begins
1st February 2025

Last Date of Submission
28th February 2025

Event Convener

Dr. Prashant Ambekar
HOD, Physics, DMPDSVM

National Coordinator

Dr. Govinda Lakhotiya
Vice President, IAPT SRC08E
Asst. Prof. , DMPDSVM

Patrons

- Prof. PK Ahluwalia, President, IAPT
- Prof. Rekha Ghorpade, Secretary, IAPT
- Prof. Shyamkant Anwane, President, SRC08E (Vidarbha), IAPT
- Dr. Akhilesh Peshwe, Principal, DMPDSVM

Event Coordinators

- Dr. Pranita Deshpande
  Asst. Prof., DMPDSVM
- Dr. Shraddha Joshi
  Asst. Prof., DMPDSVM
- Mrs. Payasvini Dhoke
  Lecturer, DMPDSVM

About the Organisers

IAPT: https://www.indapt.org.in
Dharampeth M.P. Deo Memorial Science College: https://www.dharampethscience.com/

Concept Inventories - Introduction to some popular examples

In this column we continue the discussion on concept inventories. We discuss some of the popular examples.

Test of Understanding Graphs in Kinematics (TUG-K)

Beichner, R. J. (1994). Testing student interpretation of kinematics graphs. Am. J. of Phys., 62(8), 750-762.

TUG-K was developed by Beichner to probe student difficulties in interpreting graphs in linear kinematics. The inventory comprises of a set of 21 multiple choice questions. The sub-topics covered by the questions include position-time graph, velocity-time graph, acceleration-time graph and textual motion description. A number of difficulties related to these topics were uncovered. Students tend to mistake graphs as pictures rather than as abstract representations. They believe that the graphs for distance, velocity and acceleration of motion under consideration will be identical to each other in appearance. Confusion between slope and height were also found. Value on the axis for height were thought to be the value of the slope. Students who correctly identified the slope of a line found the same difficult when the line was not passing through the origin. In terms of methodology, the paper presented a model for the construction of inventories.

Force and Motion Conceptual Evaluation (FMCE)

Thornton, R. K., & Sokoloff, D. R. (1998). 'Assessing student learning of Newtons laws: The force and motion conceptual evaluation and the evaluation of active learning laboratory and lecture curricula. Am. J. of Phys., 66(4), 338-352.

FMCE comprising of 43 questions evaluates student understanding of basic Newtonian mechanics. More specifically the test covers one-dimensional kinematics and Newton's laws. The content covered is narrower than Force Concept Inventory (FCI). FCI includes two-dimensional motion with constant acceleration, vector addition, identification of forces etc, but FMCE does not. Both inventories also differ in terms of the representational format employed in the items. Verbal and graphical representation dominates FMCE. In contrast FCI relies more on verbal and pictorial representation. The construction of FMCE was accompanied by the development of a microcomputer based laboratory (MBL) curricula. The aim of this curricula was to help students develop a functional understanding of Newton's first and second laws.

Student Understanding of Rotational and Rolling Motion Concepts

Rimoldini, L. G. & Singh, C. (2005). Student understanding of rotational and rolling motion concepts. PRPER, 1(1), 010102.

This inventory consists of 30 items investigating student difficulties with regard to concepts in rotational and rolling motion. The concepts covered include moment of inertia, angular velocity, angular acceleration, torque, rotational kinetic energy, motion on an inclined plane and rolling motion. Some of the difficulties were related to the intricate nature of rotational motion. For example students considered force and torque to be equivalent as they were not clear about the concept of lever arm. They tend to think that two equal and opposite forces always imply a zero net torque. Some other difficulties could be traced back to related difficulties in linear motion. An illustration is the misconception in linear motion that 'constant net force implies a constant velocity'. Rotational analog of this namely that a 'constant net torque implies a constant angular velocity 'was observed. The notion that friction always slows down motion is another example.

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