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Are stars better appreciated for their art after they die? Actually, stars usually create their most artistic displays as they die. In the case of low-mass stars like our Sun and M2-9 pictured here, the stars transform themselves from normal stars to white dwarfs by casting off their outer gaseous envelopes. The expended gas frequently forms an impressive display called a planetary nebula that fades gradually over thousands of years. M2-9, a butterfly planetary nebula 2100 light-years away shown in representative colors, has wings that tell a strange but incomplete tale. In the center, two stars orbit inside a gaseous disk 10 times the orbit of Pluto. The expelled envelope of the dying star breaks out from the disk creating the bipolar appearance. Much remains unknown about the physical processes that cause and shape planetary nebulae. https://apod.nasa.gov/apod/ap200913.html

PHYSICS NEWS

Inducing plasma in biomass could make biogas easier to produce

Producing biogas from the bacterial breakdown of biomass presents options for a greener energy future, but the complex composition of biomass comes with a long list of challenges. Cellulose and woody lignocellulose in biomass are especially hard for bacteria to digest, making the process inefficient. Chemical, physical, or mechanical processes, or several of them combined, can be used for pretreatment to make biomass easier to digest, but many of the current solutions are expensive or inefficient or rely on corrosive chemicals. In research supported by the European Regional Development Fund, published in *AIP Advances*, researchers at the Leibniz Institute of Plasma Science and Technology are testing plasma formation in biomass and finding a promising method for pretreatment of biomass. "The plasma can be seen as a reactive gas, which contains populations of particles that contain several electron volts of kinetic energy. This energy can be used to break the bond of the chemicals and break the bonds of molecules with which they interact," author Bruno Honnorat said.

Read more at : https://phys.org/news/2020-09-plasma-biomass-biogas-easier.html

Original paper : *AIP Advances*, aip.scitation.org/doi/10.1063/5.0018626

Researchers identify new type of superconductor

Until now, the history of superconducting materials has been a tale of two types: s-wave and d-wave. Now, Cornell researchers - led by Brad Ramshaw, the Dick & Dale Reis Johnson Assistant Professor in the College of Arts and Sciences - have discovered a possible third type: g-wave. Physicists have theorized the existence of a third type of superconductor between these two so-called "singlet" states: a p-wave superconductor, with one quanta of angular momentum and the electrons pairing with parallel rather than antiparallel spins. This spin-triplet superconductor would be a major breakthrough for quantum computing because it can be used to create Majorana fermions, a unique particle which is its own antiparticle.Their paper, "Thermodynamic Evidence for a Two-Component Superconducting Order Parameter in Sr_2RuO_4," published Sept. 21 in *Nature Physics*.

Read more at : https://phys.org/news/2020-09-superconductor.html

Original paper: Nature Physics. DOI: 10.1038/s41567-020-1032-4

Aberrant electronic and structural alterations in pressure-tuned perovskite

The perovskite $NaOsO_3$ has a complicated but interesting temperature-dependent metal-insulator transition (MIT). A team led by Drs. Raimundas Sereika and Yang Ding from the Center for High Pressure Science and Technology Advanced Research (HPSTAR) showed that the insulating ground state in $NaOsO_3$ can be preserved up to at least 35 GPa with a sluggish MIT reduction from 410 K to a near room temperature and possible transformation to a polar phase. The work has been published in *npj Quantum Materials*.$NaOsO_3$ perovskite undergoes a metal-insulator transition concomitant with the onset of an antiferromagnetic long-range ordering at a Neel temperature of about 410 K, which is accompanied by a magnetic ordering without any lattice distortion.

Read more at : https://phys.org/news/2020-09-aberrant-electronic-pressure-tuned-perovskite.html

Original paper: Nature Physics. DOI: 10.1038/s41567-020-1032-4

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BULLETIN OF INDIAN ASSOCIATION OF PHYSICS TEACHERS (ISSN 2277-8950)

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Feedback from a participant of NAEST

"This wonderful experiment made me realize that becoming a physicist requires patience and resilience and this is not easy. Physics is way beyond solving numerical problems for JEE. But it makes me even more motivated to take up a career in physics- it so challenging, that's what makes physics so beautiful!"

H C Verma

IAPT DSM Award 2020

Dr. Suchetana Chatterjee, Department of Physics, Presidency University Kolkata (WB) has been selected to receive the prestigious IAPT DSM Award (Dinabandhu Sahu Memorial Award) of this year – 2020, in recognition of her contributions to UG Physics teaching, and to the noble cause of Physics education in general.

We in the IAPT fraternity are all happy to congratulate her on this achievement and we do hope that it will motivate her to devote to Physics education with renewed zeal and zest. It is also a pleasure to thank the members of jury Prof. P. K. Ahluwalia (Himachal Pradesh University, Shimla) and Prof. Y. K. Mohapatra (IIT – Kanpur), for rendering their valuable services in the selection process for this Award. The Award presentation ceremony is expected to be held in the annual Convention of the IAPT, for which an announcement will be made in the due course of time.

K N Joshipura
- General Secretary, IAPT

An elusive light beam

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Abstract
A light box is often used to demonstrate various phenomena related to geometrical optics. Light coming out from the box makes an illuminated line on a white paper which is used as "incident light beam" for further experiments. We examine in this article the validity of this assumption.

1. A light box
A light box is widely used by physics teachers to demonstrate phenomena like reflection, refraction, prism action etc. In this, a light source is placed inside the box and the light comes out of it through a slit or slits at the end of the box. Often a cylindrical lens is fitted inside the box to make the beam parallel. Figure-1 shows the structure of a light box used at SGM-IAPT Anveshika, Kanpur.

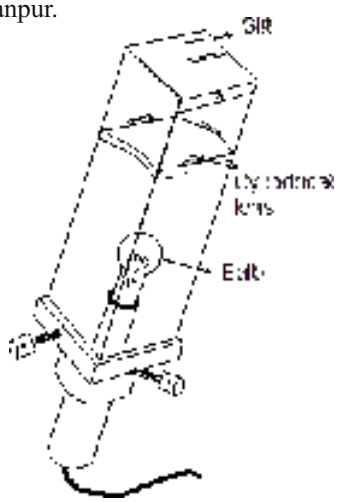

Figure-1 : Structure of the Light box used at SGM-IAPT Anveshika

The light comes out of the box from a slit or slits made at the end of the box. The box is placed on the working table with the slit in vertical orientation. A white sheet is fixed on the table and a narrow, long area of the paper gets illuminated. This illuminated area is treated as a beam of light for the experiments.

2. Using the light box for experiments
Figure-2 Shows the phenomena of reflection from a plane mirror using the light box. One can see that the angle of incidence is equal to the angle of reflection as expected from the law of reflection. A number of phenomena like lateral shift by a rectangular glass slab, image formation by spherical mirrors and lenses, bending of light beam by a prism etc. are demonstrated using the "light beam" on the white sheet.

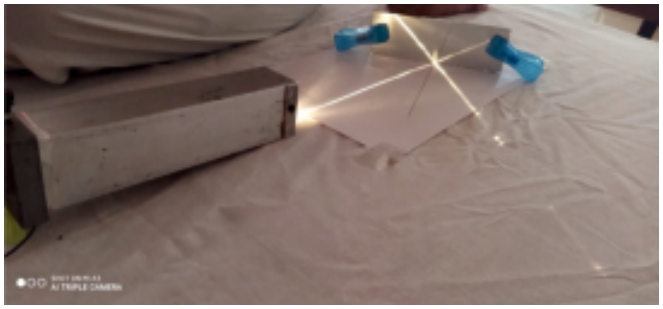

Figure-2 : Light beam falls on a plane mirror kept vertically using two clips. Normal to the mirror is drawn with a pencil.

It is indeed a good educational tool and students get a feel of the laws of geometrical optics. They can also do quantitative analysis to check that it is working according to the expectations.
But is the light beam on the paper really a light beam?

3. How does light makes the apparent beam on the paper?
To keep things simple, we made another version of light box without using the lens. Figure-3 shows the arrangement where light from a mobile phone torch is passed through a vertical slit kept at an appropriate distance. We get a very similar so called beam of light on the paper. We did all the experiments of geometrical optics and it works as good as the light box with lens between the source and the slit. Figure-3a shows the arrangement and the light beam so obtained, while Figure-3b shows reflection of light from a plane mirror using this light beam. Similarly other experiments are easily done with this light source.

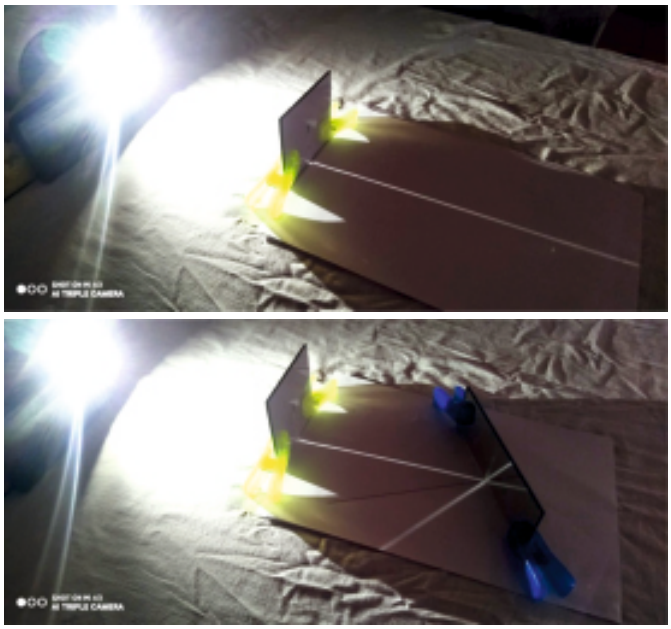

Figure-3 : (a) Light beam from a mobile phone torch (at left) and a slit and (b) reflection from a plane mirror

Now let us explore how light reaches the paper to give this beam-like structure. Figure-4 shows a schematic diagram showing paths of light from the mobile torch to the paper. As the width of the slit is of the order of a millimetre, the diffraction effects are negligible. Light from the source S goes in different directions and that going through the slit falls on the paper to illuminate it. Light falling at point A of the paper must have started from S in the direction SA. After falling at A, the light would have scattered in different directions due to which the point A is seen as an illuminated point by all persons in the vicinity. Similar is the story with the point B and with all other points. No way light falling on A moves towards B making the line AB as the path of light. Light from the source in the direction SA and in the direction SB are independent of each other and hence there is no connection between A and B through light. AB is not a light beam at all!

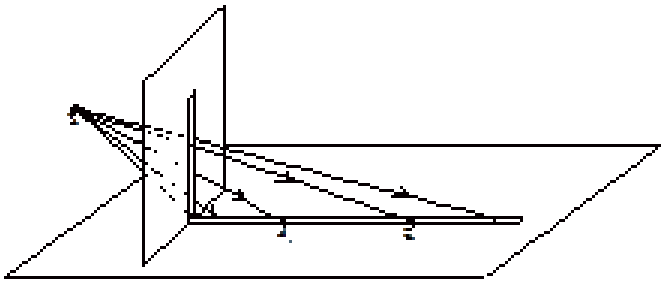

Figure-4 : Light coming from the source and illuminating the paper like a beam

But interestingly it does follow the same rules of reflection and refraction as a real light beam does, at least visibly. It will be interesting to work the mathematics and relate the behaviour of such an illuminated strip to the actual light beam.

Resilience in Corona Pandemic: Online Examination in Experimental Skill the NGPE-2020 Part C

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Abstract
This is the first time , that an experimental examination is conducted in online mode due to the Corona Pandemic & under strict precautionary instructions and advisories issued time to time by Government of India, New Delhi and other State Governments in the country. With all limitations in unlock down such as poor traffic movements, a large number of containment zones and poor internet connectivity; the experiments are designed, developed and the apparatus are multiplied and packed. The packets containing the complete apparatus are posted to the individual examinee by courier and speed post to set it up on their own desk. Instructions are passed in a Google class room to each examinee. The experiments have been performed by each examinee on his/her own desk under strict online proctoring / invigilation by IAPT faculty members in NGPE 2020 Part C (an examination in experimental skill) on August 23, 2020. The answer scripts have been submitted in google class room and have been thoroughly examined by the working team of teachers. Five recipients of NGPE-2020 Gold medal have been declared in an online meeting of all students and teachers on 25.8.2020.

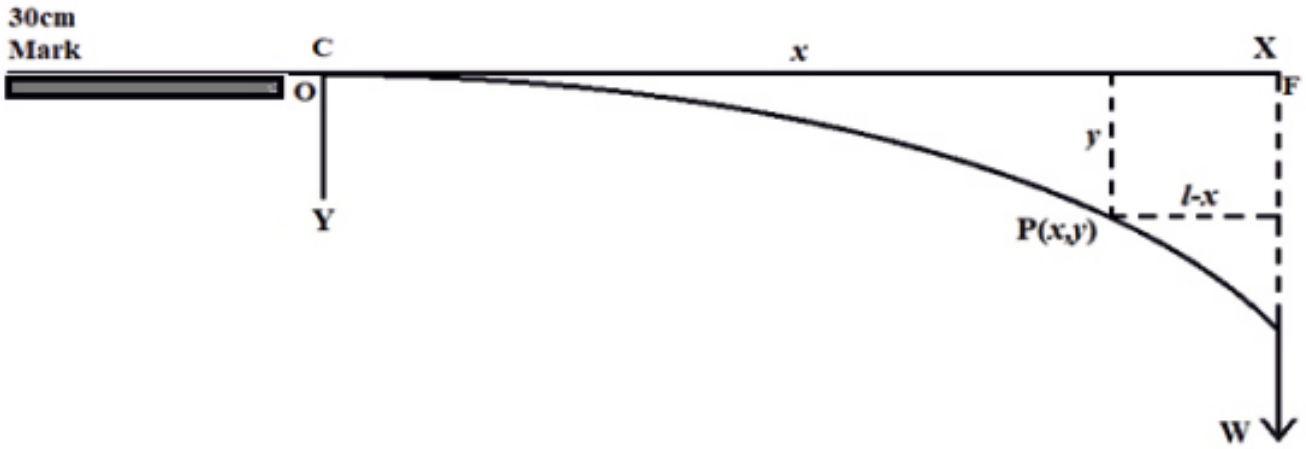
1. Introduction

National Graduate Physics Examination (NGPE) is conducted for Physics Graduate students in the month of January every year by the voluntary organization Indian Association of Physics Teaches (IAPT). This year NGPE - 2020 was conducted for 11637 students on January 19, 2020. On the basis of the performance of the students in theory examination 118 National Toppers and 127 state toppers have been declared(lists have been published in IAPT Bulletin). Top 27 of them were shortlisted to appear for NGPE - 2020 Part-C (An Examination in experimental skill). Because of Covid-19 Pandemic, it could not be possible to call these students in some university / college for the experimental Test. IAPT therefore we decided to hold an online examination on 23.8.20 to test the experimental skill. Three experiments were designed and developed at P K College Contai (WB). In all 27 sets of the whole apparatus were made and packed. One packet was sent to each student by speed post/courier. The students were instructed through the Google class room to set up the complete apparatus on his/her own desk. On the day of experimental examination, the students were first instructed to set the apparatus by showing relevant videos. The students were then asked to perform the experiment, keeping their camera on and the invigilating teachers had a close vigil on each student. All the examinee were properly proctored by invigilators. The examination was conducted on 23.8.2020 from 8.30 AM to 3.30 PM under complete vigil.

2. Experiments

Out of the four proposed experiments, the following three experiments were selected for final examination. All the experiments are based on the basic concepts and involve understanding of Physics at graduate level. The experiments are as follows-

[A] **Determination of Young's modulus (*Y*) of the material of a thin beam**. Students have to arrange meter Scale of 30cm as a cantilever beam whose one end is to be clamped and the other end left free. A wooden block of a fixed mass is provided for the purpose of loading. Basically students have to measure the depressions of the cantilever under different situations.



Task 1

i) Set up the experiment as shown.

(ii) Suspend the load from F and measure the corresponding depression. Taking C as the origin of our coordinate system i.e., $x = 0$ at C, place the load at positions corresponding to x = 8, 10, 12, 14, 16, 18, 20 cm and find the depressions at F using the needle. Tabulate the data in a table.

(iii) Now place the needle at points having the above mentioned values of x keeping the load fixed at F and find the depression (y) in each case. Record the data in table which are consistent with the reciprocity theorem.

(v) From the two tables T_1 and T_2 construct another table T_3 where students note the mean value of the depressions(y) with respect to the corresponding x value for the load (W) and the protruding length L (= CF) of 22 cm. Find the value of the constant $C' = \frac{YAk^2}{W} = \left(\frac{Lx^2}{2} - \frac{x^3}{6}\right)\frac{1}{y}$ for all the pairs of (x,y).

Task2:

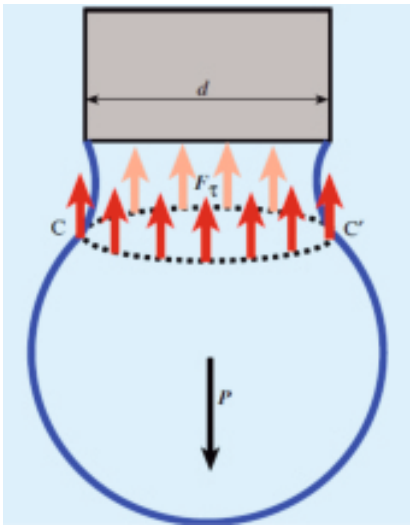
(vi) The length of the protruding part (CF) of the beam is 22 cm and it is loaded with a mass of M gm. Excite it to oscillate transversely. Find the mean time period T after measuring it five times for this given length and mass. Use the relation,

$T = 2\pi\sqrt{\frac{ML^3}{4YAk^2}}$ to find Y.

[B] **Measurement of surface tension by the dripping from a needle:**

Take a disposable injection syringe (provided in the packet) fitted with corresponding needle without the tapered portion. The needle diameter is usually written on the pack. Immerse the needle inside water in a bottle at room temperature and suck some water inside the syringe by drawing out the piston up to a certain division mark. Volume of water (V) sucked in can be found from this mark. Now push in the piston very slowly. A water droplet will form at the tip of the needle and will gradually grow in size until it falls off. At that moment

$\pi T d = mg$ where d is the external diameter of the needle, m is the mass of the droplet and T *is* the surface tension of water.

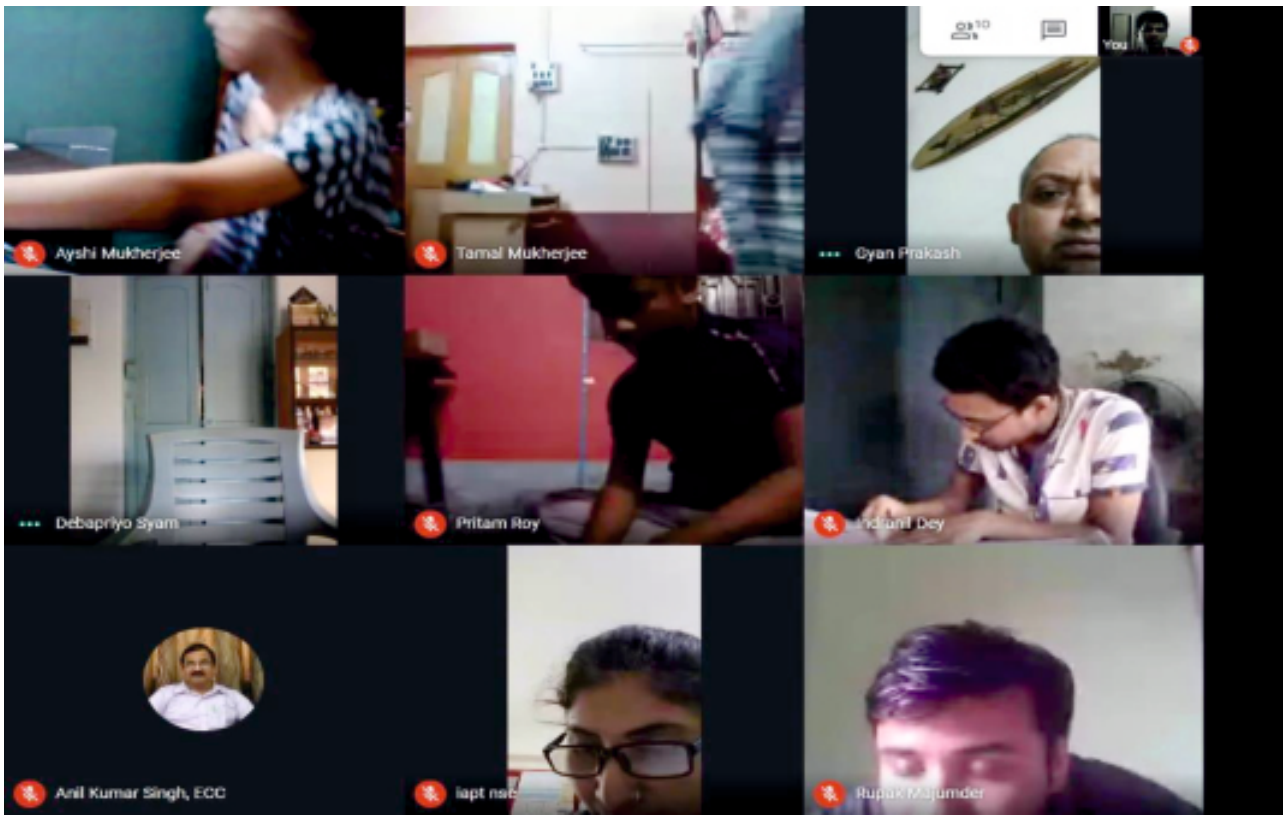


(i) Take a syringe of a definite capacity (say 2 ml) with the needle of a fixed diameter (d). Do the experiment three times as stated above. To

know the average value of m, find the number of droplets (N) required to be dropped to exhaust the volume (choose volume V judiciously for better accuracy) of water in the syringe.
Then $m = V/N$. (Density of water = 1 gm/cc).
(ii) You are provided with 20 ml, 10 ml, and 5 ml syringes of different needle diameters (d) also with corresponding needles. Repeat the experiment as in (i) for other syringes.
(iii) Plot the d - m graph.
(iv) Find T from the graph.
(v) Prepare a saturated aqueous solution of table salt.

(vi) Do the same experiment [as in (i)] with the 5 ml syringe for this solution. Take the density of the solution (ρ) = 1.36 gm/ml. Find T using the same formula.

[C] **To determine the coefficient of restitution and acceleration due to gravity**
A ball is allowed to fall vertically from a height h_0 (around 1 – 1.5 m) in time t_0. Let us consider h_1, h_2, …., h_n to be the subsequent heights to which the ball rises after its collisions with the floor, as well as the corresponding rise times t_1, t_2, ...t_n, respectively. If the ball falls freely from rest to the floor, it bounces back and forth several times before coming to rest. Here, t_{total} is the total time in which the ball remains in motion.
Setup the experimental arrangement.Capture videos (keeping audio on) for one steel ball and one ping-pong ball (at least two times).Find the average value of e(from either height or time calculation) using the videorecordings for bouncing motions of these two balls. Find t_{total} for four different initial heights, h_0 for each ball. Record the (h_0 - t_{total}) data.Draw the straight line graphs between t_{total}versus $h_0^{1/2}$ and find the slope$S$ for each ball.
For both the steel and ping-pong balls find the value of the acceleration due to gravity (g) using the values of e (already measured) and the slopes S, using the expression $g = \frac{2(e^2)^{1/2}-1}{2(e^2)^{1/2}+1}$.



Experimental Kit

The following experimental kits along with the smart phone for time measurement and imaging are required for the online examination on the students own desk:

S. No.	Experiment	Item	Specifications
1.	Cantilever	Steel & Plastic Scales; Tailor & Adhesive tape; wooden block	30cm each; 5ft; 5Pc each of 50gm
2.	Surface Tension	Medical syringes with needles of different dia; Table salt; water; cups	2,5,10,20 ml; 100gm;100ml,1
3.	Coefficient of Restitution	Cycle bearing Balls; bouncing Ball	5;3

3. Planning a web experiment

Setting up & conducting web experiment for the first time means an invention. It should be noted that conducting internet supported experiments requires knowledge and familiarity with methodological and technological particularities that relate to the networked structure of internet. Not only is it necessary to understand the basic of Google desk specially Google Form & Google Class and the working of the various facilities in it. At least five issues are critical in the online plate-form especially free version software like Google Meet, Jio.meet, Cisco Webex meeting, Say Namaste and Zoom. These are

1. Cues transmitted
2. Bandwidth
3. Cost Constraints
4. Level and type of anonymity
5. Synchronicity of data

In comparison to the laboratory situation and depending on the exact internet service used , Internet based experiment may thus primarily differ on these dimensions, and suffer from their impact on the information transmission and the condition of the students because of the performing the experiments of the online transmission of the video and results to the proctoring / monitoring persons.

After the technical issues, the training to human resources for the task like online examination is also a big question. To explain each and every steps through the concise & precise instructions in various online meeting with the students as well as the teachers . We have prepared the following instructions:

4. Instructions for the Examinees for NGPE- 2020 Part 'C' (An examination in experimental skill)

(i) The packet carrying the accessories for experiments will be delivered at least two days before the date of examination.

(ii) The Google Classroom Code will be sent by email to the examinees. Examinees are requested to register on it.

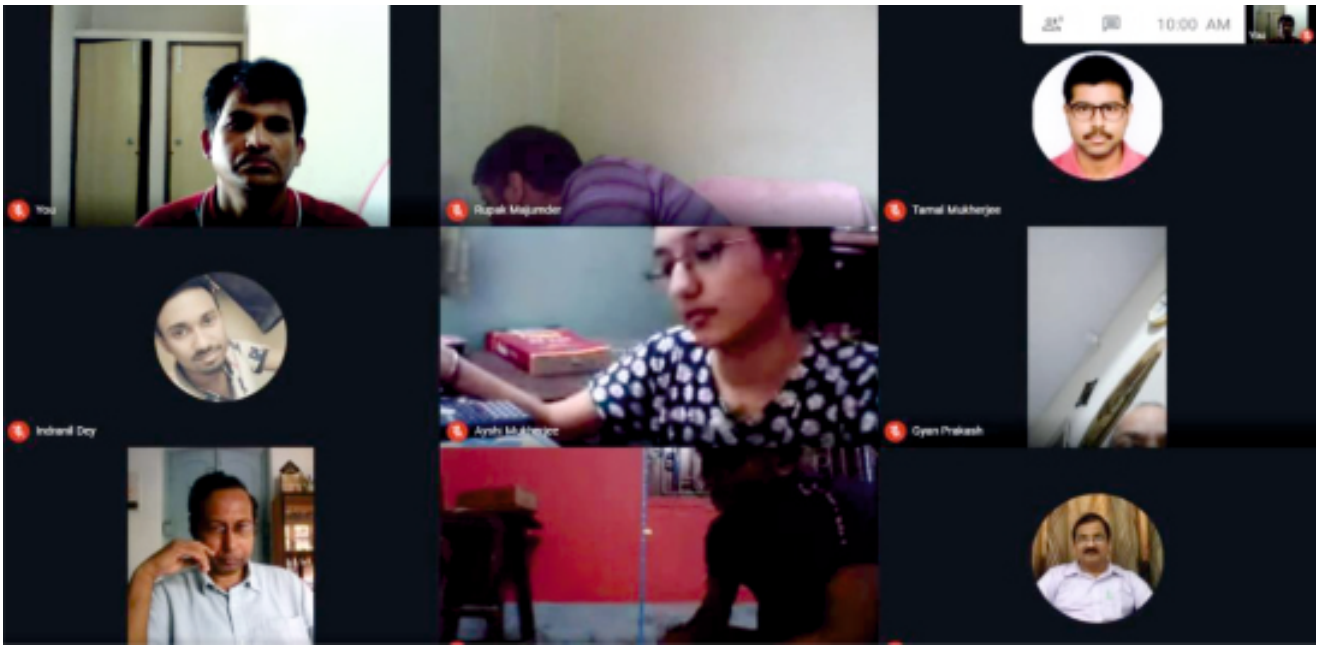
(iii) A mock test will be held via Google Classroom on August 21, 2020 (09.30 – 11.00 am) to get the examinees accustomed.

(iv) Each examinee is requested to recharge with 5 GB data for the day of final examination (23.08.2020).During the examination he/she may switch to a new device for any technical glitches occurring in data usage though the previous device with a prior approval from his/her invigilator group.

(v) *The final examination will commence from 08.30 am and continue up to 03.30 pm. Total duration of the examination is 7 hours for completing three experiments of 50 marks each.*

(vi) Question paper with the demonstration videos will be available in the Google Classroom at least 45 min. before the commencement of the examination. After accessing the Classroom, each examinee will download the question paper and promptly acknowledge the receipt by email. Each examinee can utilize the time span up to 08.30 am in studying the question paper and watching the demonstration videos

which will help in setting up experiments. A short demonstration session of nearly 10 min. May be arranged within 08.00 – 08.30 am on behalf of the organizers.
(vii) After going through the questions each examinee will prepare the experimental set-ups one by one and take data. While setting up experiments they also can take help of the videos as and when required. During recording of data for the separate parts in a particular experiment an examinee must shoot a video of 30 sec – 90 sec, as deemed appropriate for the corresponding part.
(viii) *An examinee must take snapshots / scan the TOTAL write up for an experiment and convert it to a single pdf file. Then he /she will build three separate pdf files for the three experiments and submit those to the Google Classroom.*
(ix) Another half an hour (*over and above the span of 7 hours*) *is allotted to complete all the tasks.*
(x) After the stipulated period of time the Classroom will not allow submission of the files.



5. Mock, pre-testing, online experiments:

The students were divided in four groups. Each group consist of three teachers for proctoring / monitoring / invigilating and seven students along with one specific link for them apart from the central link **https://meet.google.com/war-badx-kkn.** In all 21 students reported for the examination. The structure of the four groups are given as –

S. No.	Teachers	Students
1.	Dr Devesh Tyagi Dr Akhilesh Tiwari Dr Anand singh Rana	Mr. Harsh Jain, Mr. Manav Beniwal, Mr.Sonu Kaswan, Mr.Kirshan Joshi, Mr.Shivaye Modi, Mr. Siddharth Jain **https://meet.google.com/hxe-svbq-gom**
2.	Prof. Y K Vijay Dr(Mrs) Arundhati Mishra Dr Tushar Pandya	Mr.Kshitij Vijay Sharma, Mr.Abijit Soumen Ghosh, Mr.Johann Fernandes, Mr. Ashvin Panchal, Mr. Varghese Reji Mr.Shinmaya Kumar Sahoo https://meet.google.com/est-ukwq-knx

3.	Dr Makhan Lal Nanda Goswami, Dr Pradipta Panchadhyayee, Dr Rajib Pradhan	Mr. Sandipan Manna, Mr. Debsubhra Chakraborty, Mr. Sayan Bhakta, Mr. Sudip Chakrabarty, Mr. Sayak Datta, Mr. Bikram Pain, Mr. Niladri Ghorui, Mr. Aditya Kumar Mandal **https://meet.google.com/joc-czwz-sdk**
4.	Prof. D. Syam, Dr Gyan Prakash Dr Pramod Kumar	Mr. Rupak Majumder, Mr. Souvik Kumar Naskar, Mr. Indranil Dey, Miss. Ayshi Mukherjee, Mr. Abhijit Haldar, Mr. Pritam Roy, Tamal Mukherjee, **https://meet.google.com/knu-mmem-kgk**

The students were directed for a mock test as a preliminary performance and were asked to arrange for the following things for the mock test.

1. A rubber ball/potato/onion/lemon or any spherical shaped object of diameter 3-5 cm and mass ~50 gm., 2. Thread-~2.0 m, 3.Measuring scale of 30 cm or long, 4. Smart phone for time measurement, 5. Graph sheet /pencil etc, 6. Scotch tape/glue/safety pin etc.
In the Mock test, the students were asked to take observations of a self made simple pendulum and they were asked to plot Time period against the length of pendulum to obtain a parabola and to find g using given formula and the properties of the parabola.

6. Advantages of online Examination

The main advantages in online examination are more cost-effective in administration, time, space and labour in comparison with laboratory experiments. Detectability of confounding with motivational aspects of the participation and better generalizability of the finding as result. The simultaneous participation of large number of participants is possible. Greater external validity through greater technical variance. Polite and careful communication with participants and intermediaries are very much in practice.

7. Result

In this pandemic situation, the examination was conducted well and smoothly. Dr S M Hossain from Kolkata managed Google classroom very nicely and trained the students to use it comfortable. All the examinee submitted their observations on the Google class room and sent the answer books to the chief coordinator (examination).. Based on the overall performance of the students in NGPE 2020 (Part A, B and C) five participants are short listed to be the recipient of NGPE 2020 Gold Medal. Each of them will be awarded a gold medal and cash prize of Rs 20,000.00 with a certificate of merit at the inaugural session of the 35th Annual IAPT Convention held from November 1 to 3, 2020 at Sri Vaishnav Vidyapath University in Indore. The names of the award winners are:

1. Manav Beniwal, Kirorimal College DU Delhi
2. Johann M Fernandes, IISER Pune
3. Ayshi Mukherjee, St Xavier's College Kolkata
4. Debsubhra Chakarborty, R K Mission College, Belur Math, Howrah (WB)from Kolkata
5. Sudip Chakaraborty, Burdwan Raj College, Burdwan (WB)

8 Acknowledgment:

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Dr. Pradipta Panchadhyayee (Co-ordinator, Examination Centre), Dr. Rajib Pradhan, and Mr Anirban Samanta (A PG student of electronics). The following professors have extended their full cooperation for the successful completion of the test: Professor Yogesh K Vijay from Jaipur, Dr. Akhilesh Tiwari from Prayagraj, Dr. Tushar C. Pandiya from Ahmadabad , Dr. Devesh Kumar Tyagi from Muzaffarnagar (UP), Dr. Gyan Prakash, Dr. Pramod Kumar both from Pryagraj, Dr. Anand Singh Rana from Dehradun and Dr. Arundhati Mishra from Bhubneshwar .

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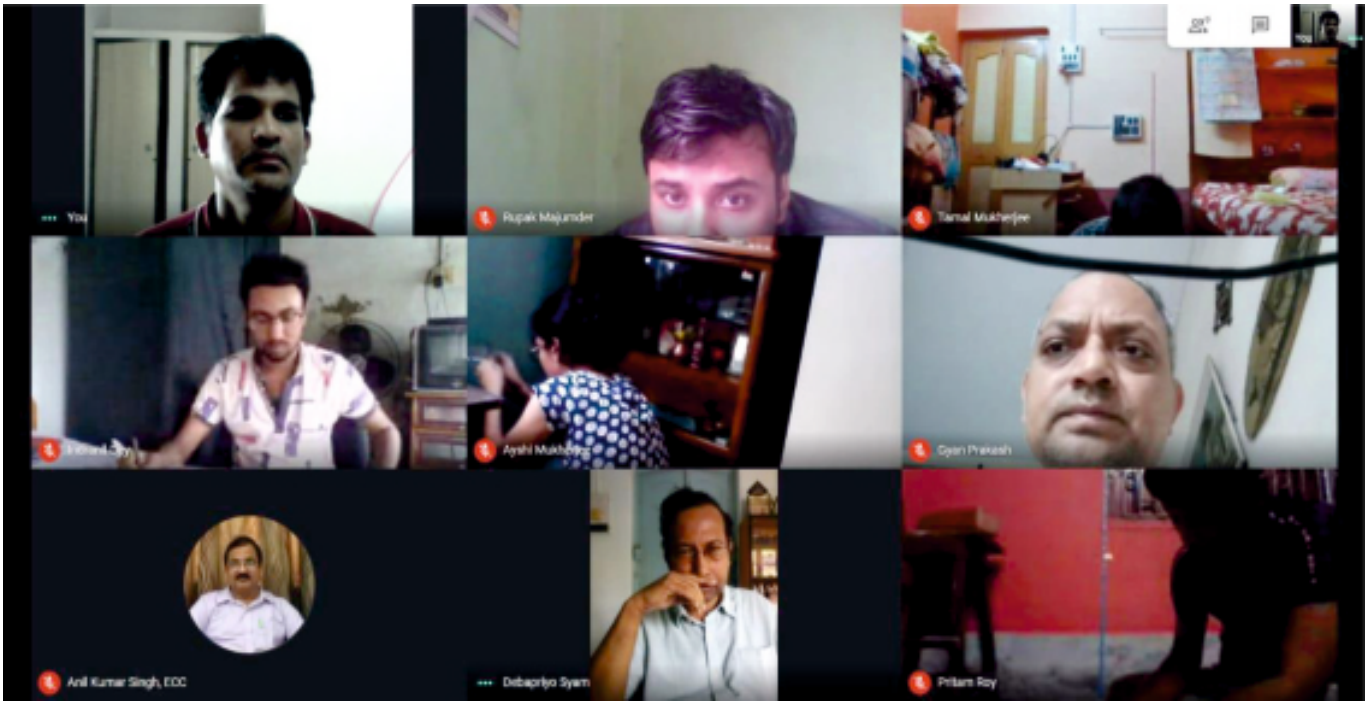

A Tribute to Prof Govind Swarup

M. L. Ogalapurkar
ogalapurkar@yahoo.com

One of the great Indian scientists of 20th century, Prof. Govind Swarup, known as the father of Indian Radio Astronomy, passed away on 7th September 2020 in Pune.

He was an eminent scholar well recognized for his frontline research work in radio astronomy using entirely indigenous teams. He was an internationally renowned astronomer responsible for making India one of the leading countries in radio astronomy research. Under his leadership a strong group in the field of radio astronomy has been set up at TIFR, that is comparable to the best in the world. Apart from physics, Prof. Swarup had deep understanding in electronics, mechanical engineering, civil engineering as well as computer science

STUDENT LIFE

Govind Swarup was born on 23rd March 1929 in a small town in Moradabad district, UP. He belonged to a rich landlord family. In 1944, he matriculated with distinction from Coronation Hindu High School, Moradabad. In his school days, Swarup was deeply impressed by the inspiring speeches of Mahatma Gandhi. In consequence, a patriotic spark was lighted in his heart, which he carried throughout his life. In 1948, Swarup graduated in physics from Allahabad University, and then continued for M.Sc. physics course. During his post graduate studies, 36th Science Congress was held in Allahabad in 1949. It was attended by Nobel Laureate Prof. C. V. Raman. Swarup invited him for a lecture and then dinner in the hostel of Allahabad University. Prof. Raman spent more than three hours with the physics students, discussing the future developments in science and technology in India.

CAREER

After completing M.Sc. in 1950, Swarup joined the National Physical Laboratory (NPL), New Delhi as a Project Assistant. In this period Radio Astronomy evolved and established as a new branch of Physics in western Countries. Swarup was attracted to this branch and studied several research papers on it. In 1953, the director of NPL sent Prof. Swarup to Australia for two years advanced studies in radio astronomy. In 1955 he returned to India and continued to work in NPL. In 1957, Swarup left NPL and went to USA for a more exhaustive research in the field of radio astronomy. For some time, he worked in Fort Davis field station of Harvard University and then in Stanford University for doctoral research. He obtained Ph.D degree from Stanford University in 1961. He planned to launch radio astronomy program in India. For this, in 1963, he joined Tata Institute of Fundamental Research (TIFR), Mumbai, when the director Dr. Homi Bhabha had just started the department of radio astronomy.

OUTSTANDING WORK IN RADIO ASTRONOMY

(a) India's first radio telescope was installed by Prof. Swarup and his colleagues in 1965 at Kalyan near Mumbai. This experimental project consisted of an array of 32 dish antennas each 1.8 m in diameter. For next three years he used the Kalyan Radio Telescope for study of sun spots and solar corona. This was the start of India's attempt to place its name on the world stage as an able radio astronomical nation.

(b) In order to study distant weak radio sources, Prof. Swarup designed an ambitious high resolution radio telescope at Ooty in Nilgiri Hills. Prime Minister Pandit Nehru funded for this project and Tamil Nadu State Government provided the land. Installation of Ooty Radio Telescope (ORT) was completed in 1969. As shown in fig. 2, this consists of 530 m long and 30 m wide cylindrical parabolic antenna. The unique feature of ORT is that its long axis is aligned with the north-south direction along a hill with a natural slope 11.3 degrees which is equal to latitude of the location of Ooty. With a total collecting area 8700 sq. meters, the ORT was one of the largest steerable radio telescopes in the world at that time. It was an outstanding achievement in building ingenious, innovative and powerful radio telescope. This ORT is very effective as a useful research

Fig 2

instrument, even today. Several valuable contributions were made in the field of pulsar astronomy, giving a world recognition to Indian radio astronomy.

(c) The greatest and brightest achievement of Prof. Swarup and his team is the design and installation of the world famous Giant Meter Wave Radio Telescope (GMRT).This project was approved by prime minister Rajiv Gandhi in 1987. For this, Prof. Swarup moved from Mumbai to Pune, established the National Centre for Radio Astrophysics (NCRA) in Pune university campus, of course under the umbrella of TIFR. The location selected for this ambitious project was the village Khodad, about 80 km north of Pune. The erection process of GMRT started in early 1990's and was completed by 2001. At the time it was built, GMRT was the world's largest and most powerful interferometric array. It consists of thirty parabolic dishes, each 45 m in diameter, spread in an approximate Y shaped configuration across a region of about 25 km. Fourteen of these antennas are arranged in a compact central array in a region of about one square kilometer as shown in fig. 3. GMRT is one of the most challenging experimental programs in basic sciences undertaken by Indian scientists and engineers. It is a versatile instrument for investigating a variety of radio astrophysical problems ranging from our nearby solar system to the edge of the observable universe. GMRT is popular among radio astronomers all over the world. In the first 15 years, about 1800 successful research proposals were submitted by scientists from 30 different countries, about 50 percent of these from India. This project was the peak in the leadership of Prof. Govind Swarup.

CONTRIBUTION TO EDUCATIONAL FIELD

From about 1980 onward, most of the talented college students were getting attracted to the fields of Engineering, Management, Computer Science and IT, only few were coming to pure science. Prof. Swarup was unhappy with the trend. In an attempt to attract good students to develop a career in pure science he planned an autonomous course where the students would learn modeling and computer simulation of concepts in science. On an experimental basis an " Inter Collegiate Diploma in Scientific Computing " was started in the year 1998-99 for B.Sc. students in Pune. I was the convener of this programme. Experts from computer industries were requested to help. Throughout the year, Prof. Swarup, Ex- VC of Pune University, Prof. V.G.Bhide and IAPT President Prof. Y.R.Waghmare guided the entire team. Thus, I was very fortunate to get advice and guidance from Prof. Govind Swarup for more than a year.

Fig 3

Prof. Govind Swarup and Prof. V. G. Bhide thought of setting up a nationwide organization similar to IITs (or something like a super IIT ?) but wholly dedicated to research in pure science. Proposals were sent to central government and were discussed with high level authorities. Finally these efforts were successful in 2005 in the form of Indian Institute of Science Education and Research (IISER) set up in Pune and Kolkata. Later on more IISERs were established at other places in the country.

In order to encourage rural students to study science with the help of hands-on-activities, Prof. Swarup set up the " Khodad Rural Science Centre " in the premises of GMRT project.

Prof. G. Swarup has guided 42 students for Ph. D and post-doctoral research.

HONOURS AND AWARDS

Some of the national and international honours received by Prof. Govind Swarup are –

1) 1972 Shanti Swarup Bhatnagar Prize
2) 1973 Padmashri Award from Govt. of India
3) 1984 P.C. Mahalanobis Medal
4) 1987 Doctor of Engineering from University of Roorkee
5) 1987 Vainu Bappu Memorial Award
6) 1987 Megnad Saha Medal
7) 1987 Tskolovosky Medal
8) 1988 TWAS Prize
9) 1990 John Howard Delinger Gold Medal
10) 1990 R.D.Birla Award
11) 1991 FIE Foundation Award
12) 1991 Elected as a Fellow of Royal Society, London (FRS)
13) 1993 C.V.Raman Medal
14) 1995 M.P.Birla Award
15) 1996 D.Sc. from Banaras Hindu University
16) 1999 Khwarizmi International Award
17) 2001 H.K. Firodia Award
18) 2009 Homi Bhabha Award

By the sad demise of Prof. Govind Swarup, India has lost a world class scientist and the pioneer of radio astronomy in the country. He was not only a great scientist, but also an efficient administrator and an ideal teacher too.

My respectful homage to this adorable unforgettable personality.

Online Lecture Series

Regional Council (Delhi & Haryana)

A series of Lectures on Topics of interest to School and college Physics Teachers was organised online by the Regional Council (Delhi & Haryana) during the pandemic. All programmes except the first one were organised in association with the Delhi State Science Teacher's Forum (DSSTF) .Each programme started at 11 am and consisted of one hour lecture followed by thirty minutes of Question & Answer session.

Each day started with an introduction of IAPT and its activities by Dr M S Bhandari , Secretary, RC-01; followed by (from second lecture onwards) introduction about the DSSTF and its activities by its Gen. Secretary, Ms. Pragya Kiran. Thereafter the distinguished speaker was introduced by Prof. V.P. Srivastava, President , IAPT(RC1). During 18th July programme, Prof. Vijay Singh, chief guest, introduced the speaker, Prof. H.S.Mani. The Q & A session was coordinated by Dr. Yogesh Kumar. Every lecture ended with a vote of thanks by Shri R. K. Tiwari, Vice President of the RC. During 11th July event, the vote of thanks was proposed by Dr. O. P. Sharma, Immediate Past President of the RC-01 and currently EC member of the IAPT,

Each programme was hosted via zoom platform. Dr. S.K.Singhal, Treasurer of the RC01copered the programme, technical support was provided by Webinar team comprising Ms. Vandana Banga, Dr. Yogesh Kumar , Dr Poonam Jain and Dr. S.K.Singhal. The programme was live- streamed through YouTube and Facebook for participants who could not enter the zoom room. After the programme, video of each event was uploaded on YouTube for benefit of students and teachers to access it anytime after the event. As the event was conducted online, each programme was attended by teachers and students of Schools, Colleges, Universities/ Institutions from all over India, with even some participants from abroad. **All the lectures can be accessed on YouTube under account, "iaptrc1"**. On the demand of the participants, some speakers also shared the ppts of their lectures.

Lecture 1: June 20, 2020

Venue : Zoom Platform

No. of Participants (Registered): 835

Topic: LIGHT & EINSTEIN'S $E = mc^2$

YouTube link:

https://www.youtube.com/watch?v=2_2Im5iTuRw

Speaker: Prof. Ajoy K.Ghatak

Meghnad Saha Professor, The National Academy of Sciences of India, Prayagraj (Allahabad) (Formerly Professor @ IIT Delhi)

Prof. Ghatak started by recalling late Prof. D.P.Khandewal's visit to IIT Delhi and how he motivated him and others to become member of the IAPT. Then he mentioned about four famous books on Relativity, namely,(1) Relativity by Albert Einstein, (2) Introduction to Special Relativity by Robert Resnick, (3) Newton to Einstein-the trail of light by Ralph Baierlein and last (4) E=mc2 : A Biography of the World's Most famous Equation by David Bodanis.

He also mentioned about three books on this topic written by him, namely,(1) Optics , published by McGraw Hill Education, New Delhi, which has a chapter on Special Theory of Relativity, (2) Einstein's Year of Miracles published by Viva Books, New Delhi and (3)Albert Einstein: The Story of a Genius, Viva Books, New Delhi.

Prof Ghatak said that " Ever since man could see, he wanted to know, What light is?, who created light ?". He also mentioned that we all worship the light from the Sun. Then he briefly discussed the significance of Einstein's famous equation $E = mc^2$ which he derived in his Year of Miracles (1905). Prof. Ghatak explained with couple of examples the significance of this equation. He also presented a very simple derivation of $E = mc^2$.

Lecture 2: June 27, 2020
Venue : Zoom Platform
No. of Participants (Registered): 1247
Topic: Wave Optics I: Interference & Diffraction
YouTube link: https://youtu.be/VBiyREIJ8f8

Speaker: Prof. Rajaram Nityananda
Azim Premji University, Bengaluru
(Formerly Director, NCRA, TIFR, Pune and TIFR Centre for Interdisciplinary Sciences, Hyderabad

CHIEF-GUEST: **Prof. J.S. Rajput, Former Director, NCERT and Chairman, NCTE.**

Prof Rajput , in his address, recalled his association with Late Prof. D.P. Khandelwal and noted the contribution and dedication of Prof. Khandelwal and Prof. Babulal Saraf, in giving strong academic foundation to the IAPT. He noted, with gratitude that these two eminent physicists created his interest in popularisation of science and he was inspired to set up Science Parks in Regional Institute of Education (NCERT),Bhopal, National Bal Bhavan , Delhi and NCERT Campus ,New Delhi. He highlighted that the students in many countries including India focus on rote memorization and not on application of knowledge -which is so well emphasised in education systems of countries like USA and UK. In this context he mentioned the experience of Prof. Feynman during his visit to Brazil. In the context of 'Bombing of Hiroshima' during 1945, he recalled what great Philosopher Bertrand Russell had said, " **Knowledge alone will not serve the Society**". Appropriate use of knowledge is important. One needs, "Buddhi" along with " Vivek" for the service of the mankind.

Prof. Rajaram Nityananda started his talk by recalling his experience of contributing to NCERT Textbook of Physics. Coming to the topic, he contrasted the contributions of Huygens(1629-1695) and Newton(1643-1727) to the field of Optics. In the process he explained the Huygens construction with help of diagrams and explained how it can be used to explain the phenomenon of Mirage. Then he proceeded to explain Young's double slit experiment, Moire pattern and Diffraction by a single slit. Prof. Nityananda also explained the subtle difference between Interference, diffraction and scattering. He gave examples of use of diffraction phenomena in defence science and radio astronomy. Prof. Nityananda also discussed about resolving power of a microscope and a telescope, providing simple arguments.

Lecture 3: July 11, 2020
Venue: Zoom Platform
No. of Participants (Registered): 1261
Topic: Wave Optics II: Polarization
YouTube link: https://youtu.be/senqD8e068E

Speaker: Prof. Rajaram Nityananda

Prof. Nityananda started with an observation that this topic is considered one of the most difficult topics by both students and teachers. He said that a dipole (oscillating) is a physical source of electromagnetic (EM) waves, both in theory as well as in practice. Mobile Tower is an example of such a source. He then explained, with help of diagrams and simple equations plane monochromatic polarised em wave. Then he discussed polarisation by scattering and by reflection and double refractions. He explained, in detail about Optical rotation and mirror symmetry, the history of Optical rotation and the Faraday effect or Faraday rotation - a magneto-optical phenomenon, with the help of well drawn diagrams and simulations, In a simple way he further explained that as a circular polarised wave is a result of combination of two linearly polarised waves, similarly we can obtain a linearly polarised wave by a combination of two circularly polarised waves. Finally he described the use of tools based on the principle of polarisation in the field of chemistry, biology/medicine and astronomy.

Lecture 4: July 18, 2020
Venue: Zoom Platform
No. of Participants (Registered): 1255
Topic: Electrostatics I
YouTube link: https://youtu.be/NwmnGS2gp5U

Speaker: Prof. H.S.Mani
Adjunct Professor, Chennai Mathematical Institute,

Kelambakkam
(Formerly Professor of Physics @ IIT Kanpur and Director, Harish- Chandra
Research Institute, Prayagraj (Allahabad))

Prof. Vijay A. Singh while introducing Prof. Mani, said that it is a singular honour, privilege and pleasure to introduce the speaker of day's talk, Prof. Mani whom he knew since 1984 when he joined IIT Kanpur as a junior faculty where Prof. Mani was a senior faculty. Prof Singh noted about the clarity of his presentations, the rigor of his talk, the systematic way he proceeded in his lectures, the empathy he had for students, and his sense of fairness. He summed up by describing Prof. Mani as a gentle man and a scholar.

Prof. Mani, in his first part of the talk on Electrostatics, discussed Coulomb's law in vector form, Electric field and electric field lines and flux. He explained the linearity of electrostatic fields. Then Prof. Mani introduced the concept of Electric Potential and its relation with electric field. He explained in a lucid way with help of diagrams the electrostatics of conductors using concept of filed lines. Next he talked about Gauss's Theorem, its application to the case of a plane surface, infinite conductor of finite thickness and Farday's Cage. Finally he explained Earnshaw theorem and its use in solving problems in electrostatics. After the lecture, Prof. Mani answered a good number of questions from participants.

Lecture 5: July 25, 2020
Venue : Zoom Platform
No. of Participants (Registered): 1029
Topic: Electrostatics II
YouTube link: https://youtu.be/_tJn48nE3wA

Speaker: Prof. H.S. Mani

Prof Mani started with the Method of Images, its concept and explained in detail its application in case of a point charge held at a distance d from an infinite plane conductor which is earthed (at zero potential). He obtained expressions for the electric field, the induced surface charge and the force on the conductor. He then mentioned a number of cases where this method can be used to solve problems in electrostatics; for example, (i) a point charge placed at a distance from a grounded conducting sphere, (ii) Two semi-infinite grounded conducting planes meet at right angle and a point charge is held in the region between them and (iii)a line charge in front of a conducting right circular cylinder, the axis of the cylinder in the same direction as the line charge. He mentioned that the method of images allows us to solve many more interesting problems; of course some may require use of more advanced method of complex variables. He then discussed electric field due to a dipole using vector method, in a general case and emphasized the use of vector methods. He explained that the concept of electric dipoles helps us to understand the electric behaviour of insulators. He then introduced the concept of Atomic Polarizability and obtained an expression for it in a simple case. Prof. Mani also discussed the behaviour of dielectrics in presence of an electric field and also explained the specific case of a parallel plate capacitor filled with a dielectric. He discussed how Gauss's law is modified in the presence of a dielectric. After the talk, he answered questions from the participants.

Lecture 6: August 01, 2020
Venue: Zoom Platform
No. of Participants (Registered): 985
Topic: Magnetism & Matter
YouTube link: https://youtu.be/XUaE80tuUM8

Speaker: Prof. Dipan Ghosh
Guest Professor, CEBS, Mumbai
(Formerly Professor of Physics @ IIT Bombay)

During his talk, Prof. Ghosh discussed the topics of a bar magnet as a dipole, Gauss's law and magnetism, Earth's magnetic field, definition of magnetic vectors, **M**, **H** and their relationship with **B**. He explained the phenomenon of diamagnetism, paramagnetism and ferromagnetism. He explained that as the concept of electric dipole helps us to understand the behaviour of dielectric in an electric field, similarly the concept of magnetic dipole helps us to understand magnetic properties of materials. He further noted that though magnetic field is not a conservative field like an electric field, still it is possible to associate a

scalar potential with a magnetic field .Talking about existence of magnetic monopoles, Prof. Ghosh said that in 1931, Dirac had suggested that if magnetic monopole existed , electric charges would be quantised Recent theories suggest that a magnetic monopole, if it existed, would have a mass nearly 10^{16} times the mass of a proton and might have existed in hot dense plasma in early universe. After his talk, Prof. Ghosh answered a number of questions posted by the participants.

7. Lecture 7: August 06, 2020

Venue: Zoom Platform

No. of Participants (Registered): 1046

Topic: Surprises in Elementary Physics: Examples from Mechanics, Optics & Thermodynamics

YouTube link: https://youtu.be/1No5-HhBnVE

Speaker: Prof. Vijay A. Singh

Visiting Professor, CEBS, Mumbai

(Formerly Professor, IIT Kanpur and HBCSE (Tata Institute of Fundamental Research, Mumbai))

Prof. Singh discussed three interesting cases of chain events in physics, first one from mechanics, second from Optics and the third from Thermodynamics. A chain event consists of a succession of similar events leading to a cumulative result. He explained that he chose these examples because of three characteristics; namely, (i) these cases are simple and are of high school/higher secondary level, (ii) they are unifying, that is, a common thread runs through them and (iii) the results obtained will surprise, if not most of us, then perhaps some of us.

First case he discussed was that of one dimensional collision of two masses. He considered a collision of a body A of mass M moving with velocity V with a stationary body B of mass m. Let V' and v be the velocity of A and B respectively after collision. The Law of conservation of momentum and the Law of conservation of kinetic energy gives us V'= V+ v. Then he introduced two ratios: one the *velocity transfer ratio*, r_v =v/V and second *kinetic energy transfer ratio*, r_k (=kinetic energy transferred to B /Initial kinetic energy of A). He showed that for the case when m=M/3, and the collision is perfectly elastic then, 75% energy is transferred. If we introduce a body of mass 0.58 M between these two bodies, then the energy transferred is 86%. Further if we introduce two bodies of mass 0.69 M and 0.48 M, then energy transferred is 90%. So by introducing a number of bodies of suitable masses between A and B, energy transfer of 100% can be achieved. This is surprising because for a two body completely elastic collision maximum transfer is 75%. Prof Singh also mentioned that in the process of chain events, velocity amplification also occurs and showed the result of velocity amplification in some specific cases. But in real life situations, there is energy loss in collisions because of friction, etc.

Next he revisited the above cases of chain events in case of inelastic collisions. He said that we can codify the energy dissipation by a parameter e, known as coefficient of restitution. The parameter e is equal to the ration of relative velocity after collision and relative velocity before collision. For e=1, we have perfectly elastic collision. Then he showed the dependence of kinetic energy transfer on value of e and number, n of intermediate collisions. He showed that for e less than 1.00, the energy transfer first increases and then decreases with increase in the value of n. For a given value of e, we get a value of n which gives maximum energy transfer. Thus we can find the optimum number of collisions for maximum kinetic energy transfer.

Then Prof. Singh discussed analogous situations in Optics and Thermodynamics. For detail, interested readers may visit the YouTube link for his talk given above and for complete mathematical treatment, his paper co-authored with two undergraduate students, R R Saha and R Nain, titled, “On the Optimization of dissipative chain events” published in Am. J. Phys. 88(2), February 2020.

Thereafter Prof. Singh replied to questions posted by the participants.

Prof. Ghatak, in his concluding remarks, talked on “Development of Science in India - A brief historical perspective”. His talk is available in YouTube link mentioned above.

At the end Dr Poonam Jain proposed the vote of thanks.

V P Srivastava

President

Report (RC-02)

Celebration of Akshay Urja Diwas 2020

Regional Council (Punjab & Jammu and Kashmir)

To mark the importance of development of renewable energy sources and to promote awareness about renewable resources among students, IAPT (RC-02) in collaboration with HMV Collegiate Sr. Sec. School in the campus of Hans Raj Mahila Maha Vidyalaya, Jalandhar celebrated Akshay Urja Diwas 2020 on 22nd August, on virtual platform. The event began with traditional lamp lighting ceremony followed by Gayatri Mantra. In her inaugural address, school coordinator Ms. Meenakshi Sayal sensitized students about 3 R's- Reduce, Reuse and Recycle and advised the students to use renewable energy, like solar energy, wind energy, geothermal energy and biofuels, etc. as it helps to reduce air & water pollution and global warming

The competitions received overwhelming response from different parts of India. A total of 473 students from 49 institutions of Varanasi, Haridwar, Kolkata, Nepal, Chandigarh, Himachal Pradesh and Punjab participated in the various competitions like Slogan Writing, Role Play and Quiz Competition

Mr. Rajiv Joshi, Deputy District Education Officer was the Chief Guest of the event. Prof. Sushil Kumar, and Prof (Mrs) Simmi Garg, performed the tedious task of judgement. The competition was held at two levels i.e. school level and college level. Srishti of SSC II Arts recited the poem on Energy Conservation. A video of posters made by participants about energy conservation and renewable energy sources was displayed.Trophies and Certificates were distributed to prize winners on virtual platform.

Principal, Dr. (Mrs) Ajay Sareen, emphasized the importance of renewable energy as it remains non- exhaustible and does not deplete with usage. The Chief Guest Mr. Rajiv Joshi asked the students to spread awareness about the use of renewable resources and the need to conserve energy for future generations. Dr. Major Singh, President IAPT RC-2 and Mr. Jaswinder Singh EC member IAPT congratulated the organizers on the success of the event.

Meenakshi Sayal
EC Member

To our readers

For change of address and non-receipt of the Bulletin, please write (only) to:
our New Address :

The Managing Editor

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Kalyanpur, Kanpur-208017
Email : iaptknp@rediffmail.com
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Online Lecture Series -II

After an overwhelming response to 1st Lecture series of June 11 to July 9, 2nd lecture series consisting of 6 lectures from 23rd July to 27th August was organized. K J Somaiya College of Science and Commerce, Vidyavihar, Mumbai came forward to co-host it on Zoom platform and Dept of Physics provided active support in organizing and conducting the programme. Simultaneously, series was also broadcasted on You Tube and recording is available on You Tube.

Lecture 1: July 23, 2020

Title: The Enduring Mystery of Ettore Majorana and his Elusive Particles

Speaker: Samuel Joseph, Raman Research Institute Bangalore.

The life and work of Ettore Majorana and his mysterious disappearance were talked about. His work and legacy in Physics was especially covered keeping undergraduate students' interest in mind.

Lecture 2 : July 30, 2020

Title: Chandrayan Mission :

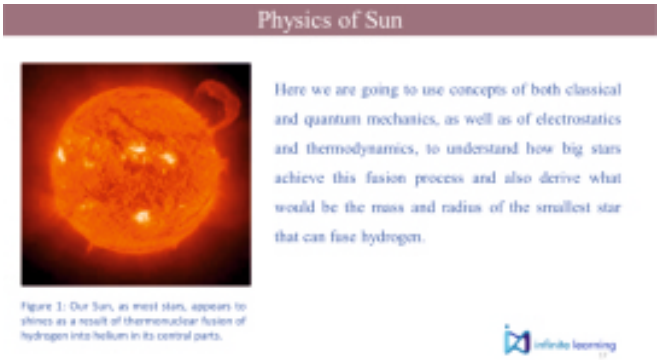
Speaker: Prof. S. M. Ahmed, University of Hyderabad.

In this lecture Chandrayan missions were discussed. All the details from launching to equipments were covered. The excitement of Chandrayan II and especially the Vikram lander were also covered.

Lecture 3: August 06, 2020

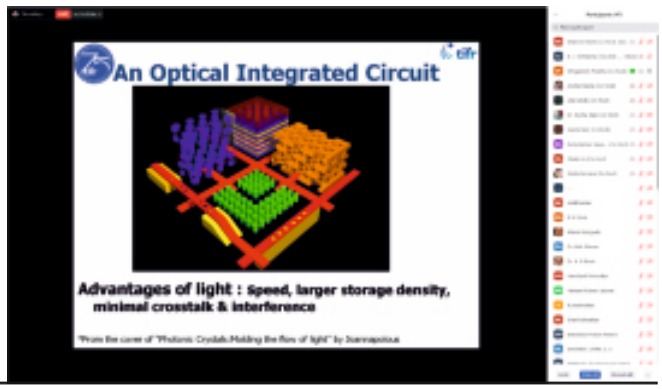
Topic: Physics of Sun

Speaker: Dr. Atul Mody, IAPT, Mumbai Sub RC



In this lecture, simple model of Sun based on simple observations and basic Physics was discussed. Simple criteria for a gas cloud to be eligible to be a star was also covered.

Lecture 4: August 13, 2020

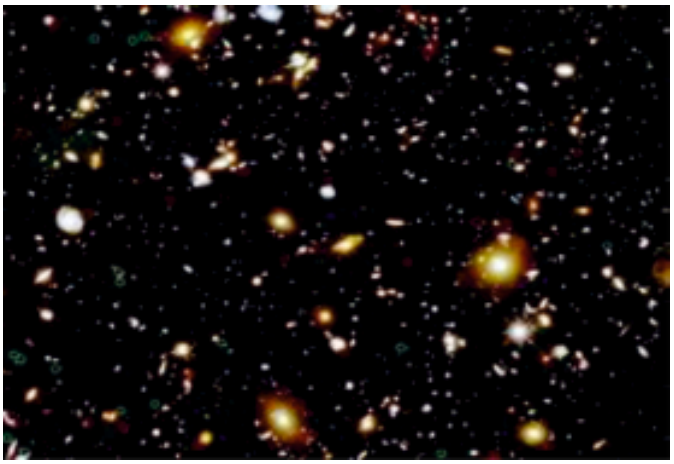


Topic: Photonics: 21st Century for Photons
Speaker: Dr. Shriganesh Prabhu, TIFR,Mumbai.

In this lecture, role of photonics in 21st century as similar to that of electronics were discussed especially covering the ongoing work and excitement of designing photonic materials.

Lecture 5: August 20, 2020

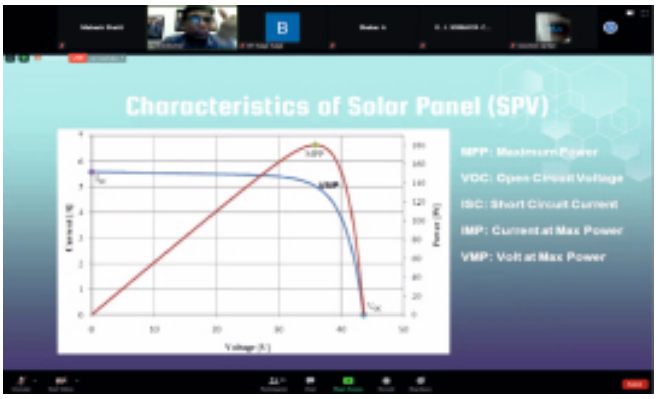
Topic: The Universe, Elementary Particles, Dark Energy : Speaker Prof. Ajit Mohan Srivastava from Institute of Physics, Bhubaneshwar



In this lecture evolution of universe and especially role of dark energy and its interpretation in Einsteins's General Relativity was discussed.

Lecture 6: August 27, 2020

Topic:Harnessing of Solar Energy for Photovoltaics
Speaker Mr. Shivkumar, Partner, MG Solar Powertronics LLP, Mumbai.



This lecture covered Manufacturing process, characteristics and working of solar cells, working of off grid and on grid and hybrid solar invertors and management systems.

Atul Mody
President, Mumbai Sub- RC

Guidelines for the contributors

The IAPT Bulletin recommends for publication:

- Articles, reviews and short notes on subject matter related to physics content and physics teaching at secondary, undergraduate and postgraduate levels. The write-up must offer some new insight into the topic under discussion. Mere reproduction of information available on the internet be avoided.
- Letters and comments on matter published in the Bulletin.
- Reports, news and announcements about important physics related IAPT activities/events in the country.

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NATIONAL GRADUATE PHYSICS EXAMINATION (NGPE-2021)

Conducted by

INDIAN ASSOCIATION OF PHYSICS TEACHERS

Registered Office : 206, Adarsh Complex, OPR 4, Awas Vikas-1, Keshavpuram, Kalyanpur, Kanpur - 208017
Web: www.iapt.org.in ; www.indapt.org (Regd. No. K 1448)

Day, Date & Time of Examination SUNDAY, January 24, 2021
TIME : 10.00 AM to 1.00 PM

Last Date for Enrolment : 17th November 2020

Eligibility for Appearing in NGPE-2021 : Students of BSc I, II and III (Pass, Hons. or Integrated) are eligible. (Any one who has already passed B.Sc. is NOT eligible)

Exam Information :

Registration Fee - ₹ 150 (Rupees One Hundred & Fifty Only)

Language for NGPE - English, Hindi, Gujarati, Tamil, Telugu or any other language if 100 or more Students opt for it.

Format for NGPE :

Part A : 25 MCQs with any number of options (1,2,3 or all 4) may be correct.
Credit is given only if all the correct options are marked (6 marks each; Total 150 marks)

Part B1 : 10 Short Answer (5 to 6 Lines) Questions (5 marks each ; Total 50 marks)

Part B2 : Ten Problems (10 marks each ; Total 100 marks)

Unique Features of this Examination :

- ★ Fully voluntary examination in a stress free environment.
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- ★ Solutions in printed form are provided to Centre In-Charge for each participant.
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(Cash Award will be released only if the candidate continues higher studies in Physics)

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TOP 1% at State Level	:	State Topper Merit Certificate
TOP 1% at National Level	:	National Topper Merit Certificate + Book Prize
Top 5 Students in India	:	Merit Certificate + GOLD MEDAL + ₹ 20,000/- Cash Award

- ★ Top 25 will be eligible for appearing in NGPE Part-C Examination - 2021 (an examination in experimental skill) for final selection for GOLD MEDAL and one time Scholarship (Max. 5 in Number) worth ₹ 20,000/- for pursuing higher studies in Physics. TA is paid and free lodging arranged.
- ★ Top 25 will have eligiblity for an interview for Admission in Post - B.Sc. Integrated Ph.D. Programme in Physical Sciences 2021 of S N BOSE NATIONAL CENTRE FOR BASIC SCIENCES. KOLKATA, (Only BSc III year students with more than 60% Marks)
  For more details must see website - http://bose.res.in/admission.htm or write email to admission@bose.res.in
- ★ May get opportunity to attend one week EXPERIMENTAL PHYSICS WORKSHOP organized by IAPT AT KOLKATA (Regional Council - 15). TA is paid.
- ★ Top 5 to 10 students of B.Sc. First year (of University 3Yr System) shall be eligible to participate in prestigious NATIONAL INITIATIVE FOR UNDERGRADUATE SCIENCE [NIUS] program of Homi Bhabha Cener for Science Education, TIFR, Mumbai. [This is A Govt. of India, DAE Program organized at Mumbai].
- ★ Top 20 students of B.Sc. I appearing in NGPE-2021 may get an opportunity for two weeks Academic Workshop on Basic Physics at IIT Guwahati (Preferably for those from University 3-yr B.Sc. System)
- ★ Some more programmes for toppers may be decalared later.

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If underlivered please return to :
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