State Council of Educational Research and Training
Varun Marg, Defence Colony, New Delhi 110024

CAPACITY BUILDING PROGRAM
AT
INDIAN INSTITUTE OF TECHNOLOGY, MANDI

For PGT Physics Teachers

Details Of Program

Name of program : Five Days Capacity Building Program for Physics Teachers at IIT Mandi
Duration : 3rd Nov to 9th Nov 2024
Venue : Indian Institute of Technology, Mandi
No. of Proposed Participant: 35
No. of participant Attended: 35
Stakeholder: PGT Physics
Name of Program Incharge: Dr. Dinesh Kumar (N.O INSET)
Coordinator: Sonam Yadav (BRP), INSET Cell
Report By: Sonam Yadav (BRP) INSET Cell

Objectives of Training Program

- To observe and understand the practical applications of physics in action.
- To stimulate curiosity, critical thinking, and sense of scientific inquiry.
- To foster teamwork and deepen bonds within group, enhancing the learning experience.
- To incluculate the skills for classroom implementation of the activities conducted during the training.

DAY 1

Inaugrartion Session

The day began with a brief and impactful inaugural function in Hall A, North Campus, where participants were warmly welcomed by the organizers and coordinators. The session outlined the objectives of the program, emphasizing the importance of continuous professional development for educators. The speakers highlighted how this program would bridge the gap between advanced research in Physics and classroom teaching practices.

Key Highlights:

- Participants were introduced to the schedule and key resource persons.
- A strong emphasis was laid on active participation and collaborative learning.

Session -1

Physical World and Measurement

By: Dr. Suman K Pal

1. The first session on Physical World and measurement was taken by Dr. Suman K. Pal. A unique technique for visualizing units was explained by him using activities or pictures. For instance, the distance can be estimated using fingers, mass can be gauged with different sizes of cakes, and temperature can be sensed by touching and estimating different vessels filled with water at various temperatures. Additionally, time can be measured by orally counting seconds.
2. Significant figures, error, accuracy, and precision were also discussed by him using pictures and examples from daily life. Through these relatable examples, participants were able to grasp complex concepts in an intuitive and accessible manner.

Session 2

Simple Harmonic Oscillation & Beyond

By: Dr. Pradeep Kumar

- The second session on "Simple Harmonic Oscillation and Beyond" was delivered in an innovative, exciting, and efficient manner by Dr. Pradeep Kumar. Simple Harmonic Oscillation was explained with a demonstration of chaotic problems. The application of this effect in weather forecasting was also discussed in detail.
- Starting from the SHM of the spring mass system, and complex potential problems of the simple pendulum were explained mathematically using Lagrangian mechanics.
- The information was based on an advanced level as the time of the simple pendulum is given by.

$$T \approx T_{\circ}\left(1 + \theta^2/16\right) \text{ as } T_{\circ} \text{ is } 2\pi\sqrt{l/g}$$

Session 3

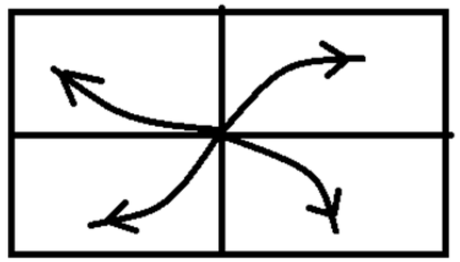
Real Effect of Pseudo Forces-I

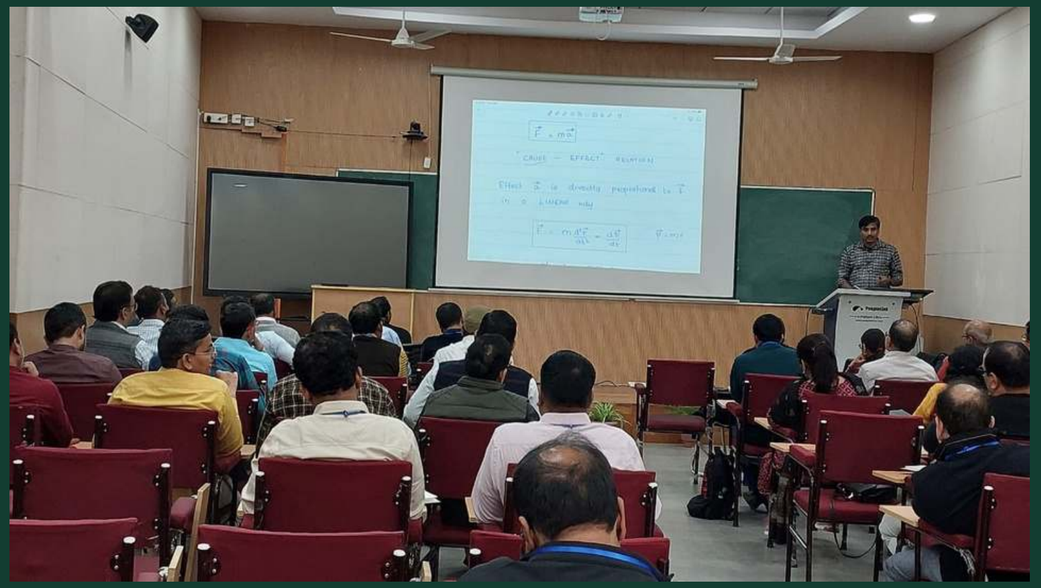
By: Dr. Hari Varma

1. The Real effect of Pseudo forces was focused on in the next session taken by Dr. Hari Verma. Pseudo forces in inertial and non-inertial frames were theoretically explained by him.
2. Concepts of coriolis and centrifugal forces in pseudo forces using examples were also focused on in the session, which was explained in detail.
3. Real force and pseudo force were learnt by the participants.
4. The importance of inertial and non-inertial frames was emphasized.

$$\frac{dv_x}{dt} = 2w\text{Sin}\,\lambda$$

$$\frac{d\theta x}{dt} = 2w\text{Sin}\,\lambda$$





Session 4

Gravitation

By: Dr. Krishna Mohan Parattu

1. The session on Gravitation, which included the explanation of the New theory of gravitation (General theory of relativity) using pictures and videos, was conducted by Dr. Krishna Mohan Partattu.
2. Different kinds of assessment techniques, which were discussed in detail, were also the focus of the session.
3. The professor was asked by the participants to share their pedagogies, especially those used with children who are from Socio-Economically Disadvantaged Group.

DAY 2

Glimpse of the Day

Session 1 & 2

Tinkering Lab

By: Prof. Rahul Vaish

1. Practical's on day two were taken by Prof. Rahul Vaish. Firstly, a session was conducted in the hall while some experiments that can be conducted in the classroom for students by using basic things like Pencils were explained. Some of the pedagogy techniques for creating a lab in the classroom were also discussed such as Demonstration, Project Based Learning, and Learning by Doing.
2. Demonstrations were then conducted for explaining how series combinations, parallel combinations of resistances, ohm's law (approx), and wheatstone bridge can be designed using graphite pencils(2 HB, 8B etc.) by just drawing the circuit using a pencil on paper and measuring the required parameters.
3. The formation of an in-plane capacitor (nF range) was also explained, and its working was demonstrated using diagrams drawn with a pencil and a multimeter.
4. The application of resistors and capacitors in sensors (temperature sensor, Capacitive or inductive sensors) were discussed and demonstrated well.
5. A book titled "Lab on Book for Science" by Prof. Rahul Vaish was presented to all the teachers, in which all the actual circuits were pasted.

Session 1 & 2

Tinkering Lab

By: Prof. Rahul Vaish

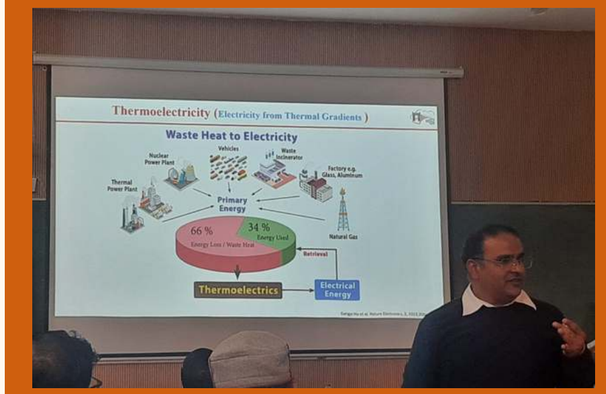
1. The session was conducted by Prof. Rahul Vaish, who was taken all the participants to do some practicals in the tinkering lab where LDR circuit using copper deposition technique was shown to all and process of electroplating was shown with the help of a recorded video.
2. Interdisciplinary aspects of knowledge regarding graphene were focused by the Prof. Rahul Vaish.
3. The refrigeration effect was demonstrated by a working model (balloon and thermal imaging camera) and the latest research in nano refrigerator was discussed.
4. The explanation of the center of mass was provided using some DIY (do it yourself) activities for finding the stability of anybody (Matchbox) using inclinometer app and daily life examples of ships, warships, double decker buses were discussed.
5. The concepts of Hydrophobic, Hydrophilic, and thermocouple were discussed and demonstrated well.
6. The meaning of plasma was explained using a plasma ball.
7. Different kinds of models were displayed in the Tinkering lab.

Session 3 & 4

Thermodynamics-I & II

By: Dr. Ajay Soni

1. Dr. Ajay Soni conducted the third Session on Thermodynamics in which Concepts of Heat, Temperature, and Thermodynamics laws and Black Body Radiation were discussed and demonstrated with the help of activity-cum-demonstration.
2. Participants were shared information regarding Latest research conducted in IIT Mandi for exploring the applications of Temperature gradient in thermodynamics and it was explained in details.
3. In the session, discussions about the Seebeck Effect, Peltier Effect, Thomson Effect were carried out by Dr. Ajay Soni using diagrams and their daily life usage (Geyser).
4. An apparatus of Radioisotope Thermoelectric Generator (RTG) was used to demonstrate how our body temperature can be converted to voltage (mV range).



DAY 3

Parashar Lake

The highlight of the day was a serene and scenic excursion to Parashar Lake, nestled amidst the mountains. This trip served as a perfect blend of education and recreation.

Key Experiences:

- Participants explored the natural flora and fauna around the lake, connecting it to ecological concepts discussed during the program.
- •The unique floating island within the lake sparked conversations about its formation and ecological significance.
- A visit to the ancient temple dedicated to Sage Parashar provided cultural and spiritual enrichment.
- The trip fostered camaraderie among participants and faculty, enhancing informal interactions and creating memorable experiences.

Session 1

OPTICS- I

By: Dr. Ravindra Kumar Yadav

- Dr. Ravinder Kumar Yadav took the session-1 focused on Optics. In-depth analysis of concepts of light as an electromagnetic wave was shared by him as well as Step-by-step Mathematical analysis for the laws of reflection and refraction was explained in a very impressive and excellent manner.
- Some information about Meta-material, which can be used to make something invisible, was also shared. Additionally, in the session, Resolution limit and diffraction limit were discussed briefly.
- The practical session, which was very interesting, informative, and based on research, was presented by the research scholars focusing on the needs of students.
- Participants are helped in learning how to inculcate the ability of thinking and asking questions among students by this session.

Session -2

PHYSICS LAB-I
(Mechanics, Electricity and Magnetism)

By. Dr. Kaustav Mukharj

On Day 3, a session was conducted by Dr. Kaustav Mukherjee in the Physics Lab. During this session, various experiments were performed by all the teachers, who were divided into small groups. These groups received assistance from research scholars as well as Dr. Mukherjee himself. The session was specifically designed to help participants clear their conceptual doubts through hands-on experiments, which facilitated a deeper understanding of the topics covered.

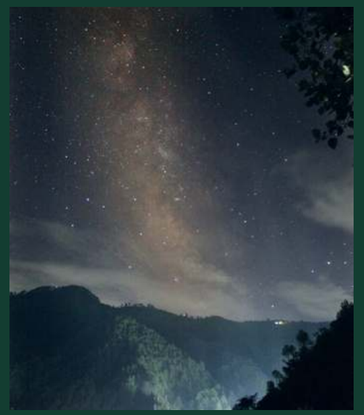
Among the experiments conducted were those involving the magnetic field along the axis of a single coil and the measurement of the variation of conductivity of a semiconductor with temperature using a four-probe setup. These experiments took place in the Physics Laboratory and were orchestrated by Dr. Kaustav Mukherjee. The interactive nature of these experiments provided participants with valuable practical experience, enhancing their comprehension of complex physical concepts.

STAR GAZING Using TELESCOPE

1 The Moon, Saturn, the planet Jupiter, star clusters, the Pleiades, and the Andromeda Constellation were observed using the telescope, which provided an enthralling experience. The celestial bodies became the focus of an evening's attentive observation, capturing the beauty and complexity of space. The telescope served as a gateway to the universe, allowing observers to witness these distant entities in intricate detail.

2. Hands-on experiences with telescope operation were offered, allowing participants to engage directly with the technology. These experiences included setting up the telescope, calibrating it to focus on specific celestial objects, and learning how to adjust for Earth's rotation to keep these objects in the field of view. Such practical involvement deepened the understanding and appreciation of the astronomical observation process.

3. An enhanced understanding of astronomy was achieved as a result. Participants were able to connect theoretical knowledge with real-world application, gaining insights into the structure and dynamics of the universe. The experience awakened curiosity and inspired further exploration into the fields of astrophysics and cosmology, fostering a deeper appreciation for the night sky and the science that explains it.



DAY 4

Glimpses of the Day

Session -1

PHYSICS LAB-I I
(Heat, Optics & Modern Physics)

By. Dr. Kaustav Mukharj

- On Day 4, a session was conducted by Dr. Kaustav Mukherjee in the Physics Lab. Participants were assisted by him in performing various experiments, such as the Frank-Hertz experiment, Helmholtz coil, Stefan's constant, etc.
- All the experiments available in the Physics Lab were observed and performed by the participants. Although the experiments were at the B.Sc. and M.Sc. level, they were found to be quite informative.
- In further detail, during this session, emphasis was placed on understanding fundamental concepts underlying each experiment. For example, the Frank-Hertz experiment, a pivotal experiment for demonstrating the quantized nature of energy levels in atoms, was explored comprehensively. Participants were guided to meticulously record observations and interpret results. The Helmholtz coil experiment allowed them to delve into the properties of magnetic fields and their applications. Participants also had the opportunity to calculate Stefan's constant, which is vital for understanding blackbody radiation.
- Through these experiments, participants were not only able to hone their practical skills but also gain insights into the real-world applications of theoretical physics principles. The session fostered a collaborative learning environment, encouraging discussions and inquiries, and Dr. Mukherjee's guidance was instrumental in enriching the participants' overall experience.

Session 2

OPTICS-II

By: Dr. Srikanth Sugavanam

The theories of light, interference, coherent sources, and wavefronts were impressively and effectively covered by Dr. Srikant Sugavanam during Session 2, which focused on Optics. This session aimed to deepen the participants' understanding of fundamental optical concepts. Participants were introduced to the historical and theoretical development of the theories of light, exploring how these concepts have evolved over time. The session also emphasized the practical applications of these theories, particularly in modern technology and scientific research."

"The activity of pattern formation from a single pinhole (diffraction) and two pinholes (interference) was conducted by all participants using laser lights. This hands-on exercise was designed to provide a practical understanding of diffraction and interference, which are critical phenomena in the field of optics. Participants observed the resultant patterns formed on a screen, witnessing firsthand the wave nature of light. The use of laser lights allowed for a clear and vivid demonstration of these effects, reinforcing the theoretical concepts discussed during the session.

Session 3

QUANTUM & CLASSICAL PICTURE of a PARTICLE

By: Dr. Sudhir Pandey

The lecture on the Classical and Quantum picture of particles, delivered by Dr. Sudhir Kumar Pandey, was thoroughly engaging. Notably, Dr. Pandey employed a storytelling approach to elucidate the historical events surrounding the resolution of Wave-particle duality. This innovative method required participants to set aside our preconceived notions and assume the role of researchers, logically proving each concept from scratch.

Session 4

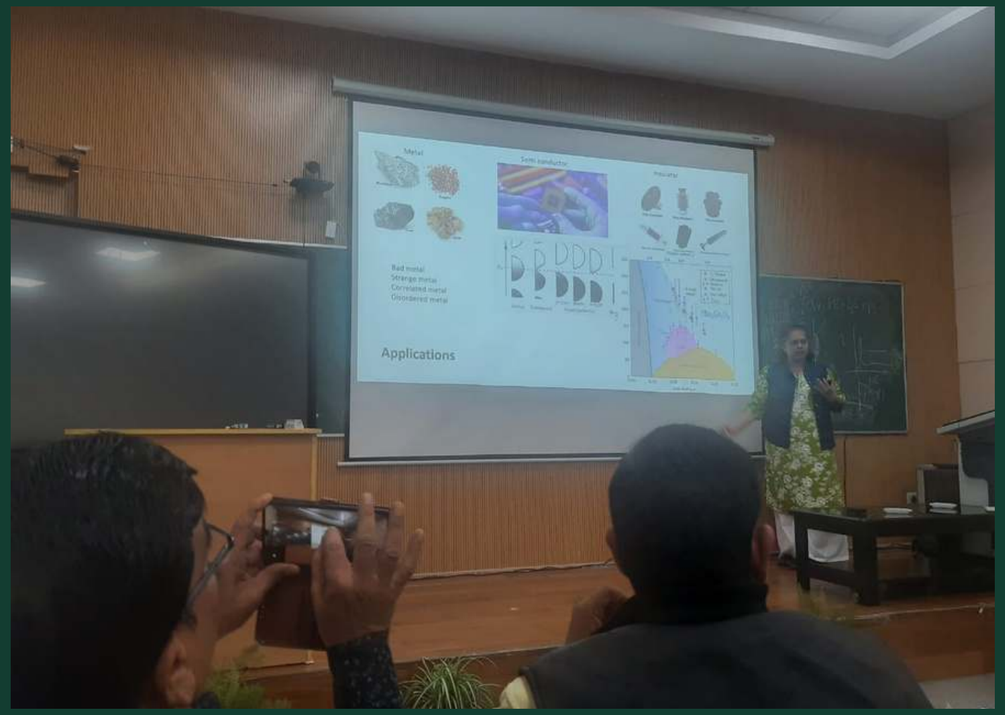
Photoelectric Effect & Dual Nature of Light

By: Dr. Bindu Radhamany

The lecture on the Classical and Quantum picture of particles, delivered by Dr. Sudhir Kumar Pandey, was found to be extremely interesting by the Participants

A storytelling technique was employed by Dr. Pandey to explain the historical events that led to the resolution of the dilemma of Wave-particle duality.
The participants were required to set aside all their preconceived notions and previously learned concepts, and instead, think like researchers, making assumptions and attempting to prove them logically.
The storytelling approach adopted by Dr. Pandey was instrumental in facilitating a deeper understanding of the subject matter, as it enabled the participants to engage with the material in a more immersive and interactive manner.

Through this innovative teaching method, Dr. Pandey successfully conveyed the complexities of Wave-particle duality, making the lecture a truly enriching experience for all who attended.



DAY 5

Glimpses of the Day

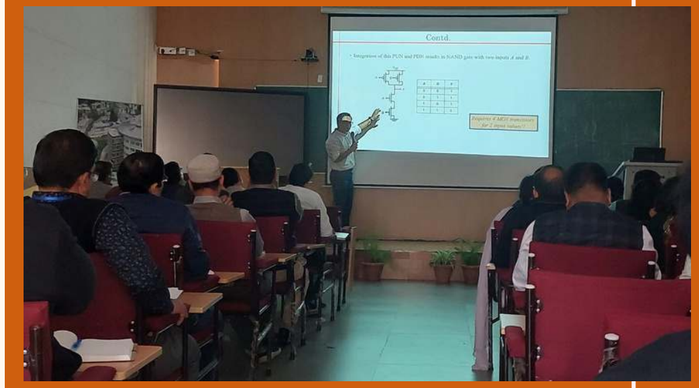
Session 1

ELECTRONICS

By: Dr. Rahul Shrestha

An innovative and realistic presentation of the lecture on Electronics was conducted by Dr. Rahul Shreshtha. The fundamentals of chip designing were explained by him with great precision. The participants were taught about integrated circuits (IC) and their development, as well as the importance of MOSFET, PMOS, NMOS, CMOS, and their roles in NAND gate formation and various applications.

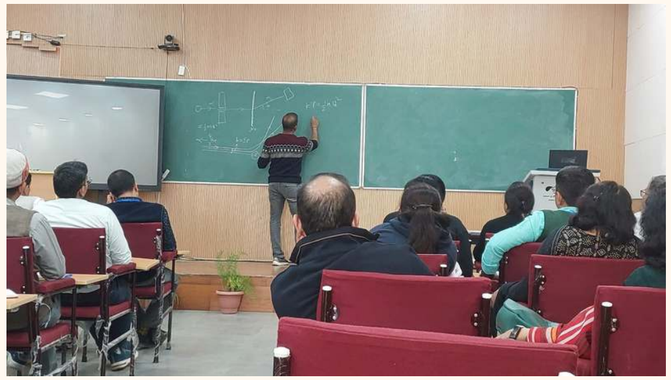
2. A very innovative and interesting lecture on integrated circuits, MOSFET, logic gates, MOS, PMOS, NMOS, and CMOS was delivered by Dr. Rahul Shreshtha.



Session -2

ATOMS & NUCLEI

By: Dr. Prabhakar Palni



- The content ranged from NCERT topics to research-level material. Mathematical analysis was efficiently used by Prabhakar Sir to deliver the entire content, highlighting formulas related to the number of scattering particles in Rutherford's experiment.
- A brief overview of all fundamental elements beyond electrons, protons, and neutrons was presented in a tabulated form. Under the guidance of Prabhakar Sir, a beautiful experiment demonstrating alpha decay was performed by research scholars. This observation allowed the abstract equation of alpha decay to be visualized in a concrete form.
- The participants were motivated and inspired by the demonstration presented by Dr. Palni's researchers. An innovative and effective lecture on nuclear forces and alpha, beta, and gamma decay was introduced by Dr. Prabhakar Palni. Furthermore, experiments to detect cosmic rays and alpha particles were performed by research scholars under the guidance of Dr. Prabhakar Palni, showcasing significant innovation.
- The detailed exploration of these advanced topics not only enhanced the participants' understanding but also sparked a deeper interest in the realm of electronics and nuclear physics. The lectures and experiments provided a comprehensive blend of theory and practical application, making the sessions both informative and engaging for all attendees.

Valedictory and Feedback Session

- The program concluded with a Valedictory Session, where participants reflected on their learning journey. Key highlights included.
- Participants shared their experiences, appreciated the program's structure, and offered suggestions for improvement.
- **Certificate Distribution:** Each participant received a certificate of completion, acknowledging their active participation.
- **Closing Remarks:** Coordinators and faculty members expressed gratitude to the participants for their enthusiasm and engagement. They reiterated the importance of applying the acquired knowledge and skills in their teaching practices.
- The session ended on a high note, with participants expressing their gratitude to the organizers, resource persons, and the institution for providing such a transformative experience.