

NAEST : 2020-21

(An unparalleled National experimental skills competition)

The annually held competition National experimental skills test - NAEST under the leadership of the National Anveshika network of India - NANI co-ordinator Dr. H.C. Verma with help from the 26 Anveshika co-ordinators all over the country, is a much awaited competition by the entire physics community in India. This year it was a challenge to conduct the competition amidst the Covid Pandemic. But the NANI co-ordinator and his team of resource persons accepted this challenge and decided to conduct the competition in a remote mode with great zeal and enthusiasm.

The competition commenced in July 2020 with the registration of over 48000 students on the MOOKIT portal of IIT Kanpur, specially opened for the purpose and culminated in February 2021 with the declaration of four national winners along with a summer camp in Sopan Ashram, Kanpur with Dr. H. C. Verma for the ten top position holders in the competition.

The competition was held in three stages:

Screening round:

The first stage consisted of a screening round which was taken by around 11500 students. To accommodate such a huge number, five quizzes in five different time slots were floated on the MOOKIT portal of IIT Kanpur. Each quiz had 9 videos which were made by keen observations of our day to day life activities from a scientific perspective and around 18-20 questions were based on these videos. The beautiful videos and the ingenious questions created by Dr. H.C. Verma and his team, helped the students in relating the concepts they had learned in textbooks with the actual phenomenon they observed around them. Later the analysis of the videos and the questions was also done at length on the MOOKIT portal which strengthened the physics concepts of the students. Around 1000 students were selected from the screening round on the basis of their scores and Anveshikas for the next stage which was the NAEST prelim round.

Prelim round:

This second stage called the NAEST prelim round was again planned very ingeniously by Dr. H. C. Verma and his team. For this round, the students were expected to perform experiments at their homes. Three experimental write-ups were prepared and the students were sent these write ups one by one in a period of around one month. The experiments were designed in such a manner that they had all the elements of scientific method which involved observations, calculations and analysis. But apart from this, another exclusive element was the experimental set up which the students had to design on their own with the help of only the materials available at home. This brought out the creativity of the students and it was a great learning for them. The reports and videos sent by the students were evaluated by a team of around 120 evaluators who were subject experts and physics teachers volunteering for it. The students attempting the prelims were spread over 34 centres all over the states of India. On the basis of the quality of the reports, 36 students from the 34 allocated centres were selected for the final round of the competition.

Final round:

The third and final stage of the competition was another historical chapter in the field of experimental physics. For this round it was planned that the students should be given a taste of doing experiments which were a little more structured with a set of a well defined apparatus. So a box "Nani ka Dibba" containing the apparatus required for doing the experiments was assembled at Kanpur and sent to all the thirty six finalists of the competition. The materials inside Nani ka dibba catered to three experiments which were based on mechanics, electricity and magnetism. The write up of all the three experiments was released on 25th December, 2020 and the students were expected to send their reports by 2nd January, 2021. These experiments looked very regular and simple but each of them had some intricate factor which required a deeper thinking, analysis and very good experimental skills.

Experiment I:

The first experiment was based on the observation of the motion of simple pendulum. A metallic pendulum bob and a string was provided in the Nani ka dibba as an apparatus for the doing the experiment. The rigid support was expected to be some kind of a nail dug into the wall at home. This experiment is done at the school level by the students where this motion is observed only for very small amplitude of the pendulum. But in the given experiment students were also required to study its motion at very large amplitudes and see the variation of the time period with amplitude. They were to compare the theoretically predicted variation with the one obtained experimentally and analyse the results. Also the damping per oscillation was to be observed and analysed.

Experiment II:

The second experiment was based on the charging and discharging of a capacitor through a resistor. Two 100 microfarad capacitors, two 1 Mega ohm resistors, a breadboard, a multimeter, jumper wires and an ingeniously designed connector for giving power through the 5V mobile adapter of the student was provided in the Nani ka dibba as an apparatus for doing the experiment. Again it was a seemingly regular experiment. But the interesting part was the fact that the capacitor was to discharge through the multimeter which was to be connected in series with the capacitor. So the resistance of the RC circuit included the resistance of the multimeter when it was kept in the voltage mode. So the multimeter was measuring the voltage drop across its own resistance. This clause baffled the students and they had to think out of box to make and analyse the circuit.

Experiment III:

The third experiment was based on calculating and comparing the magnetic moments of two bar magnets using a compass. Two bar magnets of different strengths and a compass was provided in the Nani ka dibba for doing the experiment. The deflection of the compass in the influence of the earth's magnetic field and the magnetic field of the magnet was to be noted when the magnet was kept at various distances from the compass. The magnet was to be kept such that its field and the earth's magnetic field were perpendicular to each other where the compass was kept. For such an arrangement, the magnetic moment can be found using the expression for the magnetic field of a dipole on its axis and at a point on its equatorial plane. But interestingly there are deviations

observed when the experiment is done. Analysis of these deviations is an interesting exercise and shows how the theory does not take into account the length of the compass.

Evaluation process:

The evaluation process was quite vigorous. A three member evaluation team comprising of Mr. BasuSahu, Mr. Jitendra Singh and Ms. Smita Fangaria was constituted to evaluate the reports of the students. All the members of the evaluation team also received the Nani ka dibba. As a preparation for a fair evaluation, each member of the team performed all these three experiments using the apparatus in Nani ka Dibba. Then there were long meetings and discussions based on the observations and results of the experiments in which Dr. Verma also gave his inputs. A tentative marking scheme was also made to do the evaluation.

33 out of 36 finalists submitted their reports on 2nd January. Mr. Jitender Singh, Ms. Smita Fangaria and Mr. BasuSahu evaluated all the reports of exp I, II and III respectively. It took more than 15 days to evaluate the reports. Each evaluator found the six best reports. These six best reports of each evaluator was again evaluated by the other two evaluators. So for each student there were nine scores three for each experiment. Re-evaluation of the reports took another week. The top ten positions were decided by the total of these nine scores of each student. The entire evaluation process was almost a month long process.

Results:

The first position was bagged by Harshpratap Singh (B.Sc student), second position went to Abhishek Saidarsan(Class 12) and third position went to Bijoy Biju Varghese(Class 10) while a special Nani prize was given to Ashwat Jain (Class 12).

Also the students who were among the top ten scorers have been invited to a four day summer camp in Kanpur where they will work under the guidance of Dr. H.C. Verma

As an evaluator I can say that it was a great learning. It was a sheer pleasure to go through the reports. Most of the students took meticulous observations and carefully analysed them to make beautiful reports. Some reports stretched to more than 100 pages. The dedication and creativity of the students seen in the reports was remarkable. Each report was unique. But there were some mistakes also which were quite commonly noticed. Most of the students do not understand that they cannot report their results to as many significant digits as they find in their calculators while doing calculations with it. They need to understand that the precision of a reported result by calculation cannot exceed the precision of the measured parameter.

The entire competition of NAEST was a very enjoyable eight month long feast for the entire physics community. I would like to take this opportunity to thank all the teachers who motivated their students to participate in the competition and all the evaluators who made this competition successful. And most of all I would like to thank Dr. H.C. Verma for giving life to the competition with his innovative ideas and his in-depth knowledge.

- Smita Fangaria