



Kanoria PG Mahila  
Mahavidyalaya, Jaipur



An MoE Govt of India Initiative

Report on  
5-Day Inter-College Online Workshop

May 10-14, 2023

On

“Fundamentals of Scanning Electron  
Microscope (SEM)”

Organised by

Kanoria PG Mahila  
Mahavidyalaya, Jaipur

Report by

Dr. Sunita Shekhawat, Convenor

Dr. Rekha Prajapat, Nodal Coordinator



**Kanoria PG  
Mahila Mahavidyalaya,  
Jaipur**

is organizing  
Five Day Inter Collegiate  
Workshop  
on

**Fundamentals of  
Scanning Electron  
Microscope (SEM)**

For Science PG  
Students  
From

**MAY 10-14, 2023**

**2:00 PM -4:00 PM**

**On Google Meet**

For any query, Contact  
Virtual Lab Coordinator

**Dr. Rekha Prajapat**  
**Contact Number- 8955591779**



In  
**Collaboration  
with  
Virtual Labs Team,  
IIT Delhi**

**Principal**  
Dr. Seema Agrawal  
**Vice Principal**  
Dr. Ratna Saxena  
**Convener**  
Dr. Sunita Shekhawat

**Eminent Speakers**  
Mr. Prateek Sharma  
Sr. Field Engineer  
Virtual Labs Team, IIT  
Delhi  
Mr. Chandan Kumar  
Field Engineer, Virtual  
Labs Team, IIT Delhi  
**Dr. Rekha Prajapat**  
Assistant Professor,  
Department of Physics,  
Kanoria College, Jaipur  
**Dr. Harsha Sharma**  
Assistant Professor,  
Department of Physics,  
Kanoria College, Jaipur



## Introduction

Virtual Labs is an initiative of the Ministry of Human Resource and Development, Govt. of India under the National Mission on Education through Information and Communications Technology (NME-ICT). This initiative provides an opportunity for all students to use virtual labs free of cost. The aim to provide high quality remote laboratory access in Science and Engineering disciplines for students and teachers of the country and is applicable to undergraduate (B.Sc., B.Tech, B.E.) and post-graduate (M.Sc., M.Tech, M.E.) students including Physical Sciences, Biological Sciences, Chemical Sciences, Computer Science and Electronics and Mechanical Engineering. Virtual Labs are being developed by consortia of 12 institutes which include Amrita Vishwa Vidyapeetham, IIT Delhi, IIT Bombay, IIT Kanpur, IIT Kharagpur, IIT Madras, IIT Roorkee, IIT Guwahati, IIT Hyderabad, Dayalbagh Educational Institute, NIT Surathkal and College of Engineering, Pune.

Main website: <https://www.vlab.co.in/>

University website: <http://vlab.amrita.edu/>

Virtual Labs are new immersive e-learning environments that provide a media-rich, interactive user interface that teachers can use to supplement their curriculum. These labs are located on an open webpage that can be accessed by anyone through a web browser, on any Internet-connected computer in the world. A variety of laboratory experiments can be conducted virtually using animation, simulation or remotely triggered hardware. Laboratory experiments are modeled very close to real-life experiments and when used as a learning tool by students it allows them to learn the material more efficiently and can make doing the practical experiments easier.

One of the challenges in science and engineering education in our country is that access to costly lab equipment is constrained by lack of resources and geographical distances. Virtual Labs can provide an alternative to traditional hands-on labs where labs are not present or augment existing access to labs and experiments. Thus, Virtual Labs can extend the use of scarce or costly equipment.

The workshop offered an opportunity for all students of PG stream to learn more about Virtual Labs.

## AIM

The aim is to provide a complete Learning Management System for laboratory education where the teaching and learning experience is enriched through simulations, additional web resources, video lectures, animated demonstrations, and tools for self-evaluation quizzes.

## OBJECTIVES

- Creating awareness about Virtual Lab project.
- Using Virtual Labs for performing laboratory experimentations.
- Integrating Virtual labs into teaching and learning practices.

## PARTICIPANTS

Many participants ( 40 Students) from various colleges in Jaipur attended the online workshop.

## METHODOLOGY

The workshop was conducted online through the virtual platform Google Meet. The methodology used was live demonstration of Virtual Lab experiments from main website: <https://www.vlab.co.in/>

The main virtual lab website (vlab.co.in) followed by hands-on practice by participants.



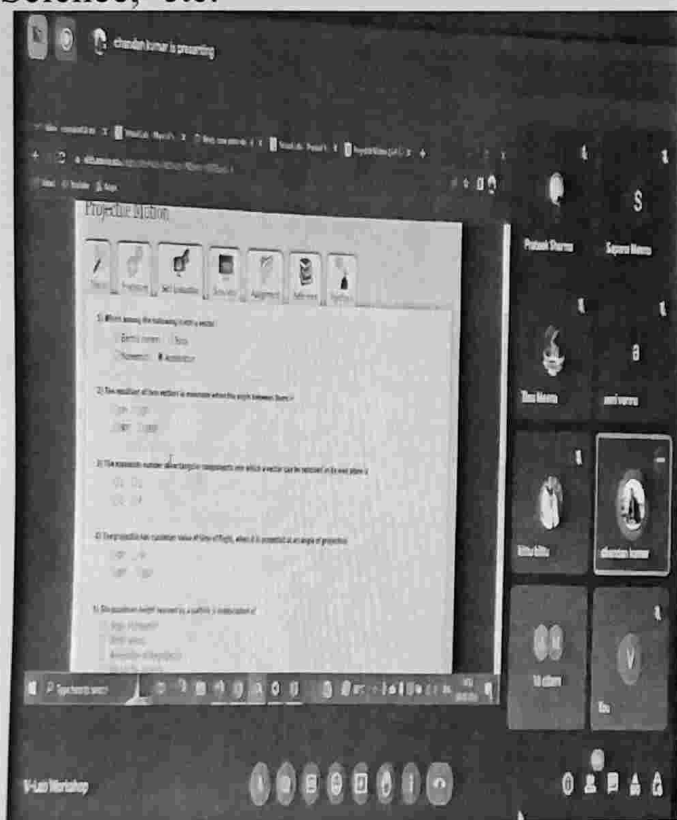
## Workshop Schedule

<b>Day</b>	<b>Time</b>	<b>Activity Session</b>	<b>Key Person</b>
<b>May 10, 2023</b>	<b>2:00 PM – 4:00PM</b>	<b>Introduction to Virtual Labs</b>	<b>Mr. Prateek Sharma, Mr. Chandan Kumar</b>
<b>May 11, 2023</b>	<b>2:00 PM – 4:00PM</b>	<b>Fundamentals of SEM</b>	<b>Dr. Harsha Sharma</b>
<b>May 12, 2023</b>	<b>2:00 PM – 4:00PM</b>	<b>Virtual Lab Demonstration on “Basics of Scanning Electron Microscopy: Secondary Electron and BSE Imaging Mode”</b>	<b>Dr. Rekha Prajapat</b>
<b>May 13, 2023</b>	<b>2:00 PM – 4:00PM</b>	<b>Virtual Lab Demonstration on “Feature Size Measurement: Porosity, Grain and Reinforcement”</b>	<b>Dr. Rekha Prajapat</b>
<b>May 14, 2023</b>	<b>2:00 PM – 4:00PM</b>	<b>Virtual Lab Demonstration on “Effect of Beam Voltage on Conducting and Insulating Samples”</b>	<b>Dr. Rekha Prajapat</b>

## Day- 01. Introduction to Virtual Labs

The inauguration was graced by the presence of Mr. Prateek Sharma, Sr. Field Engineer, Virtual Labs Team, IIT Delhi and Mr. Chandan Kumar Field Engineer, Virtual Labs Team, IIT Delhi. Dr. Rekha Prajapat welcomed all the participants and gave an overview of the program. She mentioned the need for virtual labs so that all students have equal access to quality practical and hands on experiment-based learning. The need to bring virtual labs to students was emphasized.

Mr. Prateek Sharma presented the project background, development phase and implementation phase of the virtual labs. Mr. Chandan Kumar demonstrated various experiments on Virtual Lab of different subjects like Physical science, Chemical Science, etc.





## Day- 02 Fundamentals of SEM

Dr. Harsha Sharma, Assistant Professor, Department of Physics delivered a talk on “Fundamentals of Scanning Electron Microscope”. She gave perspectives of Scanning Electron Microscope Technique. Starting from the introduction, she explained about the experiment set-up, SEM instrument Components like Electron Gun, Condenser Lens, Aperture, Objective Lens, Detector along with working of SEM.

SEM introduction.mp4

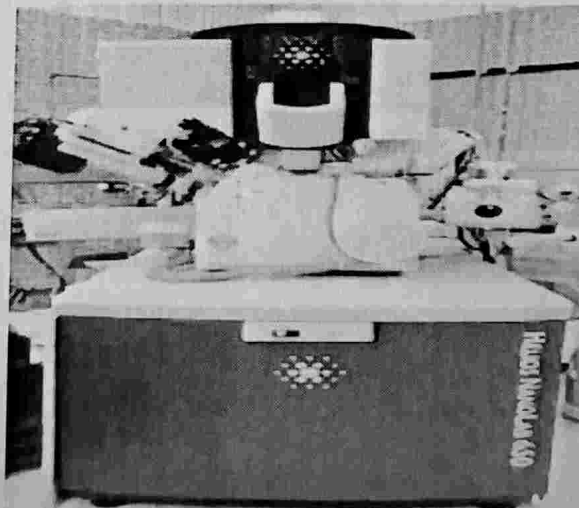
### Introduction of Scanning Electron Microscopy (SEM)



Dr. Harsha Sharma  
Assistant Professor  
Department of Physics  
Kanoria PG Mahila  
Mahavidyalaya, Jaipur

SEM introduction.mp4

### Practical setup of SEM



## Day- 03 Virtual Lab Demonstration on “Basics of Scanning Electron Microscopy: Secondary Electron and BSE Imaging Mode”

In this session Dr. Rekha Prajapat explained about the basics of Scanning Electron Microscopy: Secondary Electron and BSE imaging mode. The basic requirements for operating of SEM and the importance of Vacuum, Filament and high voltage was explained. Through this session students were able to perform the secondary electron (SE) imaging and also to perform back-scattered electron (BSE) imaging.

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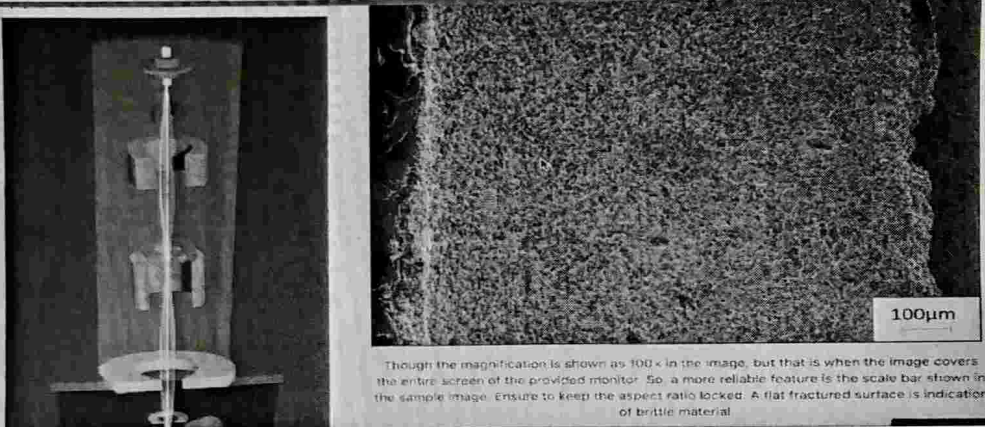
### Basics of Scanning Electron Microscopy: Secondary Electron

Now you can set magnification, accelerating voltage and other controls to set the image.

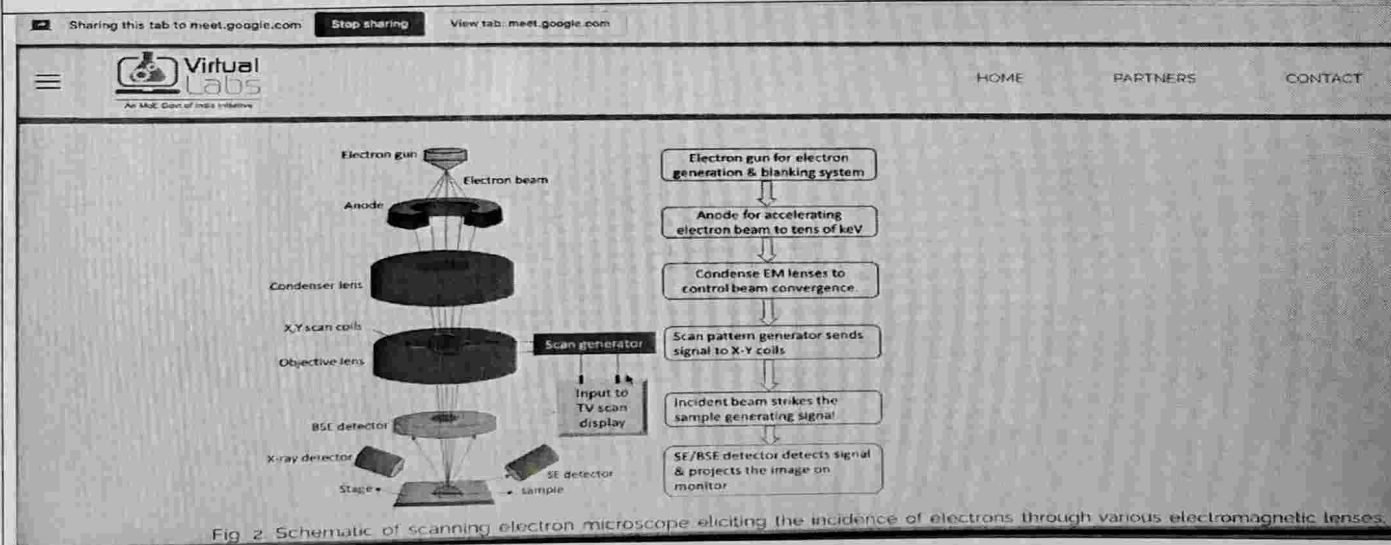
Available Materials:  
 Metal  Powder  Hair  Ceramic Sample

Vacuum: LV

Accelerating voltage: 10kV



Though the magnification is shown as 100x in the image, but that is when the image covers the entire screen of the provided monitor. So, a more reliable feature is the scale bar shown in the sample image. Ensure to keep the aspect ratio locked. A flat fractured surface is indication of brittle material.





# Day- 04 Virtual Lab Demonstration on “Feature Size Measurement: Porosity, Grain and Reinforcement”

In this session, the talk was delivered on microstructure of material comprising various phases like secondary phase, matrix, reinforcement, porosity and impurity or inclusions. The importance of scale bar was highlighted as this is important feature than image magnification and it was shown how to calibrate the scale bar.

The screenshot shows a web browser window with the URL `emb-litk.vlabs.ac.in/exp/feature-size-measurement/theory.html`. The page header includes the Virtual Labs logo and navigation links for HOME, PARTNERS, and CONTACT. The breadcrumb trail reads: Mechanical Engineering > Electron Microscopy For Beginners > Experiments. The main heading is "Feature Size measurement: Porosity, Grain, and Reinforcement".

<b>Aim</b>	
<b>Theory</b>	
<b>Pretest</b>	Microstructure of a material comprises of various phases, which can be matrix, secondary phase, reinforcement, porosity and impurity or inclusions. Microstructural features may also show the type of fracture (i.e. brittle or ductile), formation of facets, dimples, valleys, or even depict the shape (for powders it can be spherical, acicular, faceted, irregular, etc.) So, if we understand how to estimate the grain size, the same concept can be used for estimating the size of powders as well.
<b>Procedure</b>	It may be noted that the size, content and distribution of the microstructural features decide the emanating properties of the bulk material. Thus it is very important to be able to observe the feature shape, and estimate the feature size, and also be able to estimate the content of the second phase (which can be reinforcement or even porosity).
<b>Simulation</b>	
<b>Posttest</b>	
<b>References</b>	
<b>Feedback</b>	

On the right side of the page, there is a video player with the title "Feature Size measurement: Porosity, Grain, and Reinforcement" and a duration of 0:00 / 18:06. Below the video player, the text reads: "Video on Feature Size measurement: Porosity, Grain, and Reinforcement".

The screenshot shows the simulation interface of the Virtual Labs website. The URL is the same as the previous screenshot. The main heading is "Feature Size measurement: Porosity, Grain, and...".

**Instructions**

1. Choose the mode
2. Load the sample
3. Set Focus and Saturation
4. Calibrate the image
5. Click on the points according to mode selected
6. Verify your answer.

**Choose the mode:**

Focus:

Contrast:

Calibrate the image

Click on the buttons below corresponding to the points where you identify porosity on

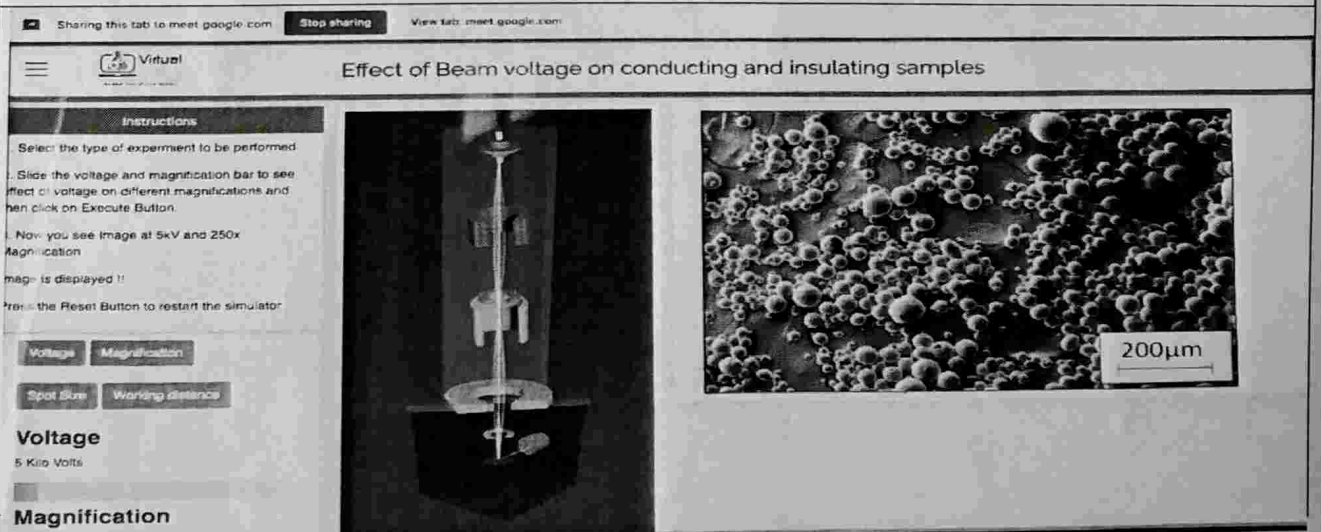
The interface includes a central image of a microscope stage with a sample, and a large image on the right showing a microstructure of a material with a scale bar labeled "10 μm".

## Day- 05 Virtual Lab Demonstration on “Effect of Beam Voltage on Conducting and Insulating Samples”

This session was taken by Dr. Rekha Prajapat. In this session the importance of Beam Voltage was explained and demonstrated that how it affects the imaging of Conducting and Insulating Samples. The clarity of image was visualized under scanning electron microscope after gold-coating of the sample. It was also visualized to the students via practical session on Virtual lab that sharpness of feature and that saturation of surface no more hinders the observation of features on the sample.



Fig 2. The beam damage in the rectangular portion shows the area in which the beam scanning was performed (at higher magnification), and when zoomed down the beam-damage area appears quite evident.





## Feedback of the Workshop

Participants were requested to fill up the feedback form using Google Form. Feedback link was shared via Google Meet chat-box at the end of the session.

### Inter-College Online Workshop On "Fundamentals of Electron Microscope"

May 10-14, 2023

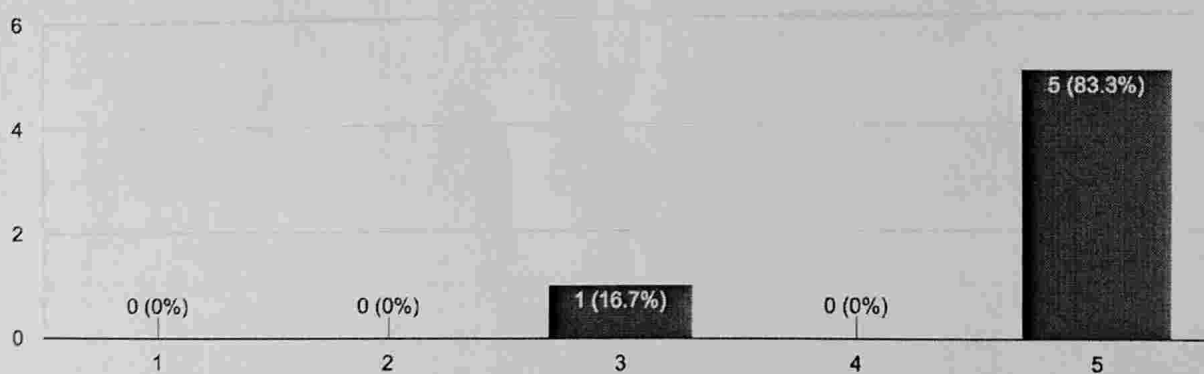
Dear Participants,

We want to thank you for participating in the Virtual Labs workshop. We would like to request a few minutes of your time to take this detailed survey to allow us use this information in enhancing the experience of using virtual labs for other faculty members and students.

This form is automatically collecting emails from all respondents. [Change settings](#)

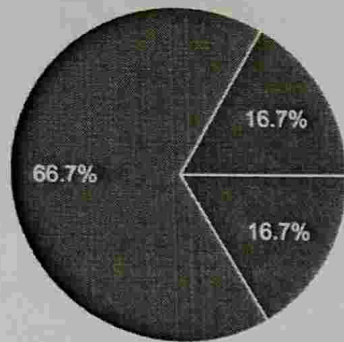
How would you rate the workshop?

6 responses



### Age Group of the Participants.

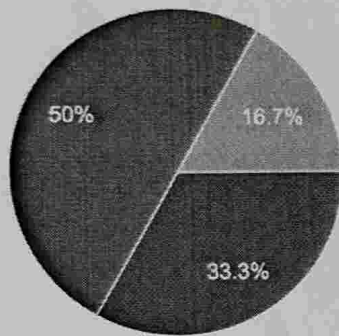
6 responses



- <=20
- 21-30
- 31-40
- 41-50

### What are the challenges that you are facing in the laboratory teaching?

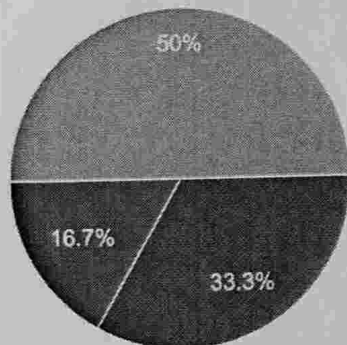
6 responses



- Time Constraint
- Apparatus Errors
- Lack of interest in students
- New experiment that have you not learnt

### Program Content

6 responses

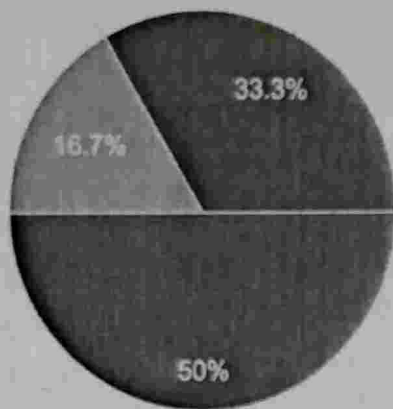


- I was well informed about the objectives of the workshop
- The workshop was designed to my expectations
- The content of the workshop was relevant



# What was the best aspect of the workshop ?

6 responses



- Presentation
- Practical session through virtual labs
- Online Demonstration
- Information about virtual labs
- Well planned

Seema

Principal  
Kanoria PG Mahila Mahavidyalaya  
JAIPUR

# Attendance Sheet



भारतीय प्रौद्योगिकी संस्थान दिल्ली  
Indian Institute of Technology Delhi



Virtual

For Mail: Govt of India Initiative

## Virtual Labs Workshop Student Attendance Form

Institute Name: Kanoria PG Mahila Mahavidyalaya, Jaipur

Date: May 10, 2023

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1	Monika Bhaskar	M.Sc(Phy)	monubhaskar100@gmail.com
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4	Timcy	M.Sc(Phy)	jindal.timcy@gmail.com
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10	Bushra	M.Sc(Phy)	bushrahakeem05@gmail.com
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13	Ayushi	M.Sc(Phy)	ayushi.chhapewala2003@gmail.com
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Field Engineer

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Signature of Head of Institution

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Kanoria PG Mahila Mahavidyalaya  
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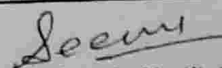
Virtual Labs Workshop Student Attendance Form

Institute Name: Kanoria PG Mahila Mahavidyalaya, Jaipur

Date: May 11, 2023

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1	Timcy	Science	jindaltimcy@gmail.com
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Field Engineer

  
Signature of Head of Institution  
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Kanoria PG Mahila Mahavidyalaya  
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Virtual Labs Workshop Student Attendance Form

Institute Name: Kanoria PG Mahila Mahavidyalaya, Jaipur

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Field Engineer

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Signature of Head of Institution

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Virtual Labs Workshop Student Attendance Form

Institute Name: Kanoria PG Mahila Mahavidyalaya, Jaipur

Date: May 13, 2023

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Field Engineer

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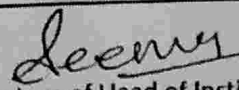
Virtual Labs Workshop Student Attendance Form

Institute Name: Kanoria PG Mahila Mahavidyalaya, Jaipur

Date: May 14, 2023

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Field Engineer

  
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