GOVT. HOLKAR (MODEL AUTONOMOUS) SCIENCE COLLEGE, INDORE

(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Document Title:

Collaborative Quality initiatives with other Institutions

SURESH T SILAWAT

Digitally signed by SURESH T SILAWAT
Date: 2023.09.04 16:38:40 +05'30'

तमसो मा ज्योतिर्गमय

List of Collaborative Quality Initiatives with Other Institutions

S.No.	Name of the Collaborative Institution	Purpose of MOU/Collaboration	List the actual collaborative activities	Date of the activity conducted
1.	Research Institute of Organic Agriculture Switzerland (FiBL) and the bioRe Association (India)	Research, Students and Faculty Training, Internship, etc	Guest lecture by Dr. Akansha Singh, Project Coordinator, India FiBL, Switzerland, under active collaboration with the Research Institute of Organic Agriculture Switzerland (FiBL) and the bioRe Association (India)	26-07-2022
			National Scientific Board Meeting under active collaboration with the Research Institute of Organic Agriculture Switzerland (FiBL) and the BioRe Association (India)	04-11-2022
			SysCom India National Scientific Advisory Board (NSAB) Meeting	25-09-2021
			Guest lectures were delivered by Dr. Gurbir Bhullar and Dr. Navreet Bhullar of the Research Institute of Organic Agriculture Switzerland (FiBL) under collaborative activity.	14/15 Dec, 2019
2.	Anchor Software Developers and Solution Pvt. Ltd., Indore	Collaborative Internship/Project Work Anchor Software Developers and Solution Pvt. Ltd., Indore,	conducted a collaborative series of various training sessions for the certificate and internship programs.	01/12/2022 to 07/01/2023
3.	Wild Warriors Society, Indore	Students and Faculty Training, Internship, etc	Environmental awareness activities: Bird Survey at college campus in association with Wild Warriors Society, Indore	22-05-2022
4.	UGC-DAE Consortium for Scientific Research, Indore	Research, Students and Faculty Training/exchange, Internship, etc	4A. Raman spectroscopy was carried out at UGC-DAE CSR, Indore	07-09-2022
			Under the MoU with UGC-DAE CSR, Indore, research work on Qualitative study of structural phase transition in nickel-doped La2CoTi(1x)NixO6 double perovskite was carried out in collaboration with Dr. R. J. Choudhary, Scientist, UGC-DAE CSR, Indore.	20-09-2022
			An invited lecture was delivered by Dr. Vasant V Sathe, Center Director, UGCDAE CSR, Indore, in a Virtual workshop on Instrumental techniques.	01-10-2022
			Educational visit of participants of the virtual workshop at UGC-DAE CSR, Indore, under the MoU between both institutes.	10-10-2022
			Research activity and joint publication with Dr. G. S. Okram, UGC-DAE CSR, Indore, as Principal Collaborator from the CSR side	28-07-2022

			Research activity and joint publication with Dr. G. S. Okram, UGC-DAE CSR, Indore, as Principal Collaborator from the CSR side	16-07-2021
			Research activity and joint publication with Dr. G. S. Okram, UGC-DAE CSR, Indore, as Principal Collaborator from the CSR Side	16-07-2020
			Research activity and joint publication with Dr. G. S. Okram, UGC-DAE CSR, Indore, as Principal Collaborator from the CSR side	12-07-2019
5.	Indian Institute of Technology Indore	Collaborative and outreach programme	Educational visit to Indian Institute of Technology Indore	18-11-2022
6.	Soil and Soul foundation, Bangalore, Karnataka	Promotion of Research, Students and Faculty Training, Internship, etc	Workshop on "Eco-friendly plant stress relievers in the present scenario" in association with the Soil and Soul Foundation, Bangalore, Karnataka	28/29 March, 2022
7.	Noble Alchem. Pvt. Ltd. Rohatak Road, Bhiwani, Haryana & M.P. & Noble Alchem Pvt. Ltd. (Agribooster), Sanwer Road, Indore, M.P.	Promotion of Research, Students and Faculty Training, Internship, etc	Workshop on "Eco-friendly plant stress reliever in the present scenario" in association with Noble Alchem. Pvt. Ltd., Rohatak Road, Bhiwani, Haryana (M.P.)	28/29 March, 2022
			collaborative research work on "Effect of pre-sowing seed treatment with silica and fungicide on growth, photosynthetic pigments, and oxidative stress parameters of mung bean (Vigna radiata) with Noble Alchem Pvt. Ltd., Indore	2020
			collaborative research work on the effect of Soluble Silica on the Plant Growth, leaf Chlorophyll content, and Bulb Quality of garlic (Allium sativum L.) against Drought Stress with Noble Alchem Pvt. Ltd., Indore 2019	2019
			Research Activities were carried out: 1) Role of soluble silica in alleviating oxidative stress in soybean crops; 2). The Role of Soluble Silica in Counteracting Lead Toxicity in Wheat (Triticum aestivum L.)	2018
8.	National Dong Hwa University, Hualien, Taiwan	Promotion of Research, Students and Faculty Development, etc	Thematic webinar on the International Year of Basic Sciences for Sustainable Development: Inaugural Note by Prof. Y. K. Kuo, National Dong Hwa University, Hualien, Taiwan	09-08-2022
			National Conference on Physics and Chemistry of Materials: Keynote Speaker: Prof. Y-R Ma, National Dong Hwa University, Hualien, Taiwan	14-16 Dec., 2020
9.	Manganese Ore (India) Limited, Balaghat	Collaboration for Student Internship	Internship of students with MOIL, Balaghat.	01/11/2022 to 10/11/2022
10.	Azim Premji University, Bengaluru, India	Promotion of Research, Translation & Workshops, Students and Faculty Training, Internship, etc	Workshop on translation work in science subjects conducted by Azim Premji University, Bengaluru, India	07-06-2022
			Online meeting organized for Translation work of Physics books from English to Hindi	18-01-2021

			in association with Azim Premji University, Bengaluru, India	
11.	Infutech Health Care Pvt. Ltd., Indore	Exchange, Research Collaboration, Support for Research project, and educational Visit	Internship training is provided to microbiology students by Infutech Health Care Pvt. Ltd., Indore, under active collaboration.	11/02/2021 to 20/02/2021
12.	Dr. Kamal Kumar Choudhary, Army Cadet College (ACC), Indian Military Academy, Dehradun, Uttrakhand	Collaboration for Research and Development	Collaborative Research activity and joint publication	04-07-2020
			Collaborative Research activity and joint publication	03-07-2019
			Collaborative Research activity and joint publication	01-07-2018
			Collaborative Research activity and joint publication	05 -07 -2017
13.	Tuteja's Forensic Document Examination and Research Centre, Indore (M.P.)	Promotion of Research, Students and Faculty Training/exchange, Internship, etc	Guest Lecture by Mr. H. S. Tuteja from Tuteja's Forensic Document Examination and Research Centre, Indore, under active collaboration between both institutes	15-01-2020
14.	State level NAAC Cell (SLNC), DHE, Bhopal, M.P.	Collaborative Qualitative Initiatives under the Umbrella of SLNC with all Govt. Colleges of Madhya Pradesh	Review Meeting by Member Secretary, State Level NAAC Cell(SLNC)	07-12-2022
			Series of "Enriching Thursdays" for Collaborative Quality Enrichment on various NAAC Parameters every week	08-12-2022 15-12-2022 29-12-2022
15.	Madhya Pradesh Higher Education Quality Improvement Program (MPHEQIP) & Quality Learning Centre (QLC), State Project Directorate, RUSA, DHE, Bhopal	Collaborative Qualitative Initiatives with all Govt. Colleges of Madhya Pradesh	Sensitization Programme on "Environmental Challenges due to Climate Change	22.10.2021
16.	Department of Geography, MLSU, Udaipur, Rajasthan	Major RUSA sponsored Titled "Electoral Information System for Governance and Developmental Planning: A Governance Initiative	Various objectives are undertaken for the the year 2022 in the Electoral Information System for Governance and Developmental Planning: A Governance Initiative	2022
		Major RUSA Sponsored Project Titled "Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS"	Database creation, validation for next phase from both primary and secondary data of Dungarpur and Banswara district	Mar. 2022
		Major RUSA sponsored Titled "Electoral Information System	Various objectives undertaken for the year 2021 in the Electoral Information System for Governance and	2021

		for Governance and Developmental Planning: A GGovernance Initiative"	Developmental Planning: A Governance Initiative	
		Major RUSA Sponsored Project Titled "Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS"	Preparation of questionnaire, Data collection ,compilation and preparation; Field data collection and primary survey in the collaborative research project	March, 2021
		Major RUSA Sponsored Project Titled "Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS"	Generation of Geospatial database; Web application development in the collobrative research project	July, 2021

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Metric No. : 6.5.3

Collaborative Institute:

Research Institute of Organic Agriculture Switzerland (FiBL) and the bioRe Association (India)

तमसो मा ज्योतिर्गमय

1A

Activity Title:

Guest lecture by Dr. Akansha Singh, Project Coordinator, India FiBL, Switzerland, under active collaboration with the Research Institute of Organic Agriculture Switzerland (FiBL) and the bioRe Association (India)

Office of the Principal
Govt. (Model Autonomous) Holkar Science College
Indore (M.P.)
0731-2464074(O), 2446806, 2764027 (Exam)
e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org
(Re-accredited 'A' Grade by NAAC)

Date:-

Memorandum of Agreement

between the

Research Institute of Organic Agriculture, Switzerland (FiBL)

and the

Government Model Autonomous Holkar Science College Indore (India)

As well as the

Remei India Limited and bioRe Association (India)

concerning the doctoral project entitled

"Developing socio-economically and ecologically resilient cotton rotational farming systems"

And concerning

Scientific exchange between the four institutions

The Research Institute of Organic Agriculture (hereafter called "FiBL"), the Government Model Autonomous Holkar Science College Indore (hereafter called "Holkar College"), the Remei India Limited and the bioRe Association (hereafter called "bioRe") wishing to strengthen their collaboration in international agricultural research agree to engage in a doctoral research project.

Article 1: Objectives

1.1 The collaboration shall provide international doctoral research experience to a "research fellow". The research fellow shall be assigned to the project entitled "Developing socio-economically and ecologically resilient cotton rotational farming systems" (hereby called "the project").

1.2 The research to be conducted and a timetable for the project are set out in the project proposal.

1.3 The overall objective is to strengthen the established institutional collaboration between FiBL, Holkar College, Remie India Limited and bioRe (hereby called "collaborating partners") by conducting the project of the research fellow as described below.

1.4 The collaboration further aims to strengthen the socio-ecological research exchange between the collaborating institutes. For this purpose two interdisciplinary workshops will be organised at Holkar college.

Article 2: Period and Place of Assignment

2.1 The research fellow shall be assigned for a time period of three years (January 2023 – December 2026).

2.2 The place of assignment will principally be at the bioRe research station, located at the 5th Km Milestone, Kasrawad Mandleshwar road, Tehsil Kasrawad, District – Khargon, Madhya

Article 3: Infrastructure, Budget and Payment to the Research Fellow

3.1 A consolidated fellowship amounting to twenty-eight thousand Indian rupees (28,000 INR) per month will be provided to the research fellow, by the bioRe Association, corresponding to the respective head in the FiBL SysCom Project.

3.2 The infrastructure and staff resources necessary to conduct the project field activities are either available at the research station or these will be arranged by the research staff together with the research fellow.

3.3 Basic analysis of the samples could be carried out at the field lab at bioRe research station.

3.4 For more advanced analysis Holkar College will make arrangement with the specialised labs in other institutes as needed.

3.5 The research project will support four internship projects of four PG students to support the assigned research fellow. The research project will support these master students for food and accommodation at the research station. The project will also support the students for basic analysis needed and for their travel required (one travel per month) to the bioRe research station.

Article 4: Supervision, Backstopping and Publication

4.1 The PhD project of the research fellow will be jointly supervised by a supervising committee comprising Dr. Sanjeeda Iqbal (Holkar College) and Dr. Akanksha Singh (FiBl). Dr. Iqbal - being the main supervisor - will ensure the punctuality of planned research activities, along with sound quality of data and appropriate publication of results.

4.2 The research fellow will work in close collaboration with the researchers responsible for the long-term trial at bioRe, lab technician of bioRe and dissemination specialist of bioRe. The research staff at bioRe will provide the support and basic information required to carry out field activities.

4.3 The results obtained from this project will be published in international peer reviewed journals. The research fellow supported by the main supervisor will be responsible for sound data analysis and preparation of first draft of the manuscript(s). Both members of the supervising committee will support and contribute towards the publication process.

4.4 As a general rule, the data obtained from the field trials and surveys of FiBL is owned by FiBL and therefore all the publication rights are reserved by FiBL. No part of the data obtained from this project could be published or presented in any form without the approval of FiBL. Upon approval by FiBL, the results could be presented in national and international conferences.

4.5 The research fellow and both members of the supervising committee (depending upon their contribution), will gain authorship on the publication originating from the project. The order of authorship and corresponding authorship will be jointly decided by the supervising committee. In general, Dr. Singh will serve as a last author on these publications.

4.6 Plagiarism is a serious offence in scientific publication. Therefore, the research fellow and the main supervisor will ensure that the manuscripts produced from the project are free from Plagiarism.

4.7 In addition to the scientific publications, the fellow will compile a doctoral thesis and submit to his affiliating university (Devi Ahilya Vishwavidyalaya, Indore) as per the requirements and regulations set forth by the doctoral programme.

4.8 Considering the political nature of the project, the research fellow is instructed not to discuss or present anything related to this project in print or electronic media.

4.9 The envisaged internships of the four PG students will be conceptualised and supervised jointly by the research fellow and the supervising committee.

Signed at Frick, Switzerland on 10 August, 2022
For the Research Institute of Organic Agriculture (FiBL), Frick, Switzerland

FiBL Switzerland

Dr. Akanksha Singh (SysCom India – Country Leader)

Signed at Indore, India on 10 August, 2022
For the Government Model Autonomous Holkar Science College

Dr. Suresh T. Silawat (Principal, Holkar Science College)

Signed at Frick, Switzerland on 27 August, 2022
For Remei India

Vivek Kumar Rawal (Director Remei India Limited, General Secretary, bioRe Association India)

Signed at Indore, India on 27 August, 2022

Dr. Sanjay Vyas (Head of Department of Botany, Holkar Science College)

Signed at Indore, India on 27 August, 2022

Dr. Sanjeeda Iqbal (Main Supervisor, Department of Botany, Holkar Science College)

Department of Botany, Govt. Holkar Science college, Indore

Date – 24-07-2022

Notice

All the students of M.Sc. Classes are informed to gather in final class lab. for the guest lecture of Dr. Akansha sing project Co-Ordinator, Research Institute of Organic agriculture, Switzerland on 26/07/2022 "Organic farming: impact and importance in present scenario" at 1:30 PM.

Head of Department
Department of Botany
Govt. Holkar Science College,
Indore

M.Sc II Sem Date - 26/07/22

1.	Pooja Kanojiya	Pooja.
2.	Simran Thawani	Phawani
3.	Pragati Patidar.	Pragati
4.	Sneha Trivedi	Sneha
5.	Pooja Pawar	Pawar
6.	Radhika Gadriya.	Bedukar
7.	Priti Badole.	Priti
8.	Sunita Bardod.	Sunita
9.	Rakesh Bamniya	Rakesh
10	Rajendra Damar.	Rajendra
11	Praveen Keshari.	Praveen
12	Kapil Dangi.	Kapil
13.	Kajal gawad	Kajal
14.	Vinita Bariya	Vinita
15.	Sheetal Kanesh.	Sheetal
16.	Manisha Mussel.	Manisha
17.	Rupali Patidar.	Rupali
18.	Ayushi Tomar.	Ayushi
19.	Sapna Patel.	Sapna Patel
20.	Mahima Dasar Dubey	Mahima
21.	Kapil Kanesh	Kapil
22.	Jitendra verma	


Holkar Scie
College
Google
Indore, Madhya Pradesh, India
1 , Holkar Service Road, Bhawarkua Main Rd, Janki Nagar, Indore, Madhya Pradesh 452001, India
Lat 22.694199°
Long 75.869552°
26/07/22 02:54 PM

1B

Activity Title:

National Scientific Board Meeting under active collaboration with the Research Institute of Organic Agriculture Switzerland (FiBL) and the BioRe Association (India)

Office of the Principal
Govt. (Model Autonomous) Holkar Science College
Indore (M.P.)
0731-2464074(O), 2446806, 2764027 (Exam)
e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org
(Re-accredited 'A' Grade by NAAC)

Date:-

Memorandum of Agreement

between the

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and the

Government Model Autonomous Holkar Science College Indore (India)

As well as the

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concerning the doctoral project entitled

"Developing socio-economically and ecologically resilient cotton rotational farming systems"

And concerning

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4.4 As a general rule, the data obtained from the field trials and surveys of FiBL is owned by FiBL and therefore all the publication rights are reserved by FiBL. No part of the data obtained from this project could be published or presented in any form without the approval of FiBL. Upon approval by FiBL, the results could be presented in national and international conferences.

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4.9 The envisaged internships of the four PG students will be conceptualised and supervised jointly by the research fellow and the supervising committee.

Signed at Frick, Switzerland on 10 August, 2022
For the Research Institute of Organic Agriculture (FiBL), Frick, Switzerland

FiBL Switzerland

Dr. Akanksha Singh (SysCom India – Country Leader)

Signed at Indore, India on 10 August, 2022
For the Government Model Autonomous Holkar Science College

Dr. Suresh T. Siwant (Principal, Holkar Science College)

Signed at Frick, Switzerland on 27 August, 2022
For Remei India

Vivek Kumar Rawal (Director Remei India Limited, General Secretary, biotic Association India)

Signed at Indore, India on 27 August, 2022

Dr. Sanjay Vyas (Head of Department of Botany, Holkar Science College)

Signed at Indore, India on 27 August, 2022

Dr. Sanyeeda Iqbal (Main Supervisor, Department of Botany, Holkar Science College)

Dr. Sanjeeda Iqbal

Certificate of attendance

SysCom India "National Scientific Advisory Board (NSAB)" Meeting 2022

Hereby it is certified that, **Dr. Sanjeeda Iqbal** – Professor, Holkar Science college, Indore and member of NSAB committee 2022-23 attended the NSAB meeting was held on 4th November 2022 at bioRe Association, Kasarwad, Dist. Khargone, 451228 M.P. India

The main objective of the meeting was to gather inputs from the national experts for the next phase of the **"Farming system comparison trials in tropics (SysCom India)"** project and, to further reflect on the results of the past phases.

Country Leader
(SysCom-India)

FiBL Switzerland

Dr. Akanksha Singh
(Dr. rer. nat.)
Department of International Cooperation

1C

Activity Title:

National Scientific Advisory Board (NSAB) Meeting

FiBL Research Institute of Organic Agriculture FiBL

SysCom

Dr. Sanjeeda Iqbal

Certificate of attendance

SysCom India "National Scientific Advisory Board (NSAB)" Meeting 2021

Hereby it is certified that, **Dr. Sanjeeda Iqbal** – Professor, Holkar Science college, Indore and member of NSAB committee 2021-22 attended the NSAB meeting was held on 25 September 2021 at bioRe Association, Kasarwad, Dist. Khargone, 451228 M.P. India

The main objective of the meeting was to gather inputs from the national experts for the next phase of the **"Farming system comparison trials in tropics (SysCom India)"** project and, to further reflect on the results of the past phases.

Country Leader
(SysCom-India)

Dr. Akanksha Singh
(Dr. rer. nat.)
Department of International Cooperation

FiBL Switzerland

Research Institute of Organic Agriculture FiBL | Ackerstrasse 113 | P.O. box 219
5070 Frick | Switzerland | +41 62 865 72 72 | info.suisse@fibl.org | www.fibl.org

1D

Activity Title:

National Scientific Advisory Board (NSAB) Meeting

MEMORANDUM OF UNDERSTANDING

between the

Research Institute of Organic Agriculture, Switzerland (FiBL)

and the

Government Holkar (Model, Autonomous) Science College Indore (India)

as well as the

bioRe Association (India)

In the spirit of international understanding, Govt. Holkar (Model, Autonomous) Science College Indore, India and Research Institute of Organic Agriculture, Switzerland (FiBL), agree to examine the possibility of establishing a framework for educational and research cooperation for our students, faculty and staff.

In preparation for establishing a formal framework for future activities, the parties hereto agree as follows:

1. Explore possibilities for faculty and staff exchanges for research, lectures, and discussions that mutually benefit both institutions;
2. Explore the feasibility of student exchanges and study programs;
3. Seek support for projects determined to be mutually beneficial to both institutions;
4. The terms of joint activities and arrangements for specific visit, exchanges, and other forms of cooperation will be agreed upon in writing prior to the initiation of any activity. Any commitment of resources, financial or otherwise, in support of these activities must be contained in subsequent specific agreements;
5. While no binding commitments have been made, we sign this Memorandum of Understanding in recognition of our common interests and agree to consult periodically concerning the status of our collaboration.

For the Research Institute of Organic Agriculture, Switzerland (FiBL)

15.12.19

Dr. Gurbir S. Bhullar

(System Project Coordinator)

For the Government Holkar (Model, Autonomous) Science College Indore (India)

15/12/19

Dr. Suresh T. Silawat

(Principal)

For bioRe association

President bioRe association

For Principal Investigator

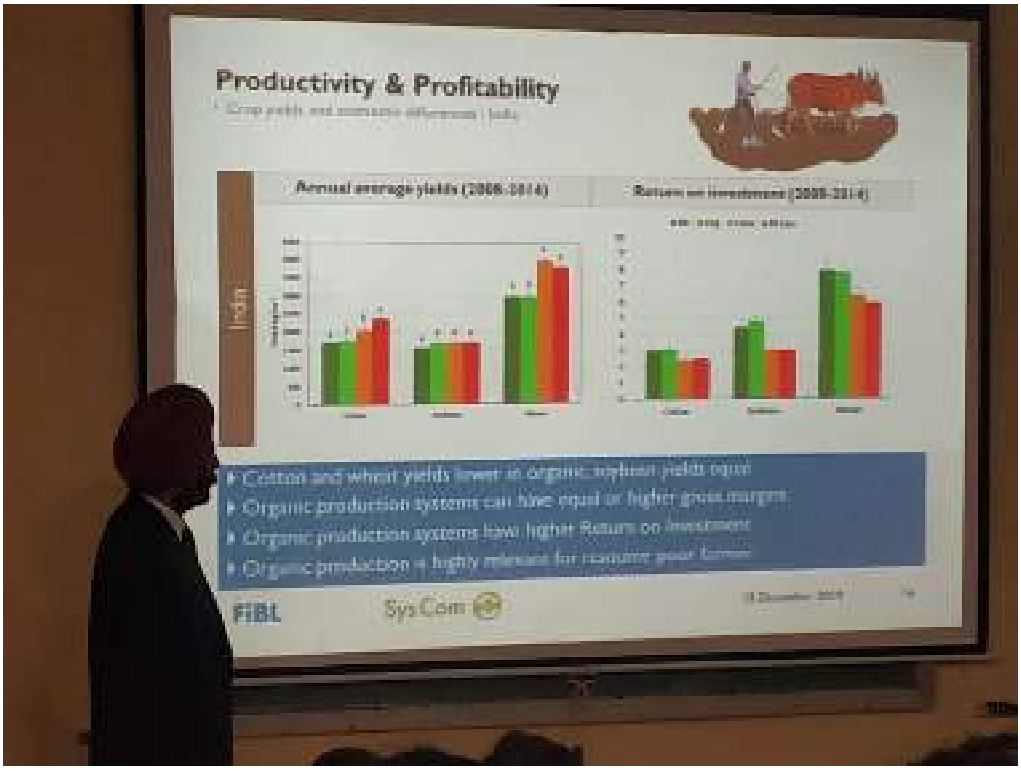
15/12/19

Dr. Sanjeeda Iqbal

(Professor & Head Dept. of Botany)

Guest lecture by Dr. Gurbir Bhullar, Switzerland

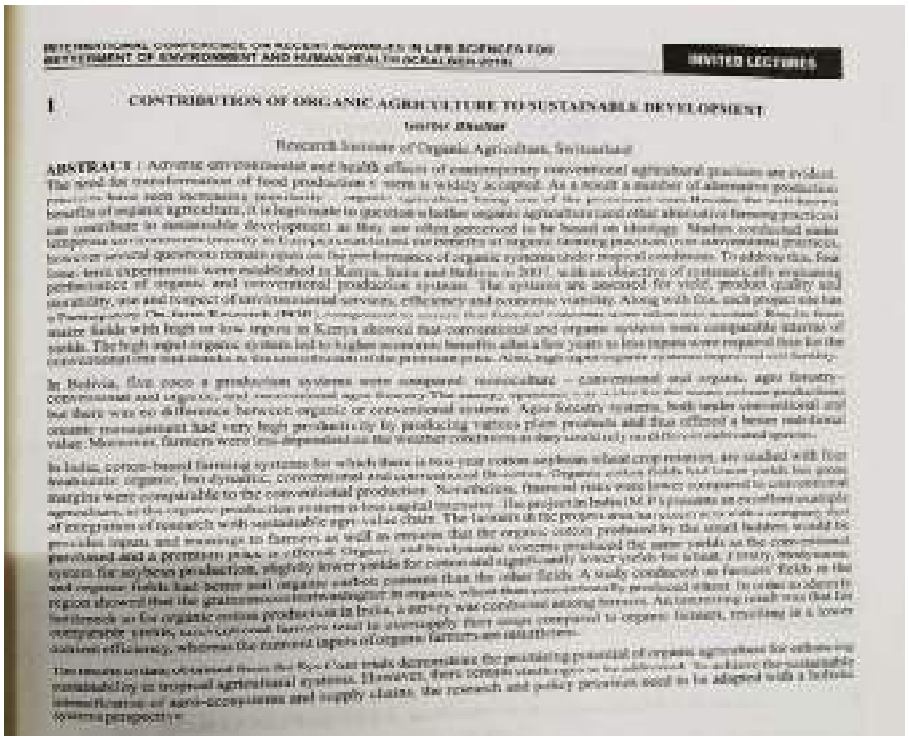




Interaction with students



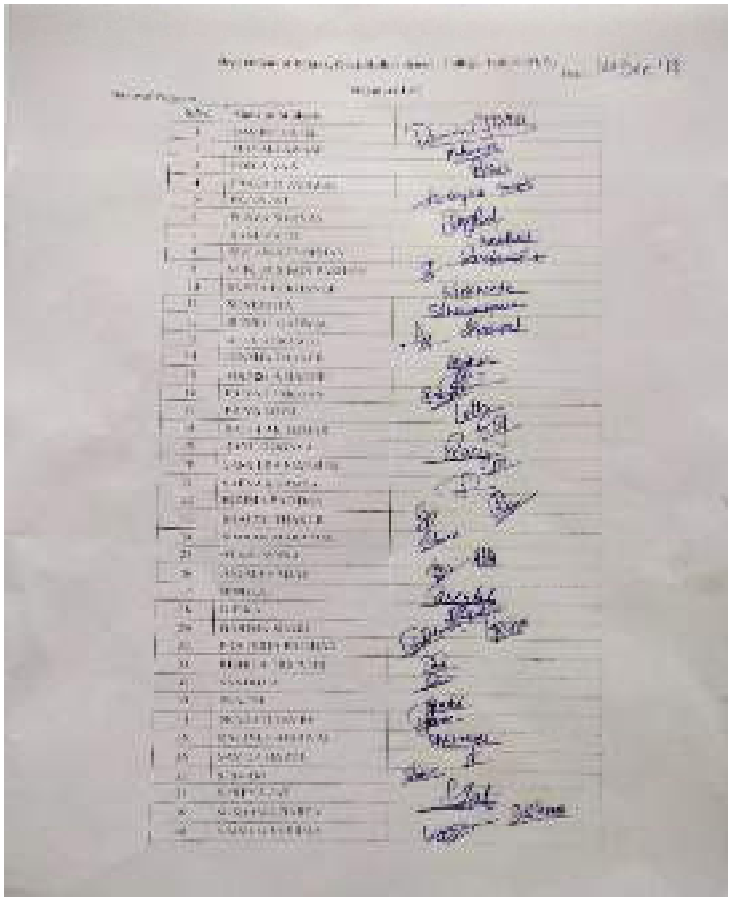




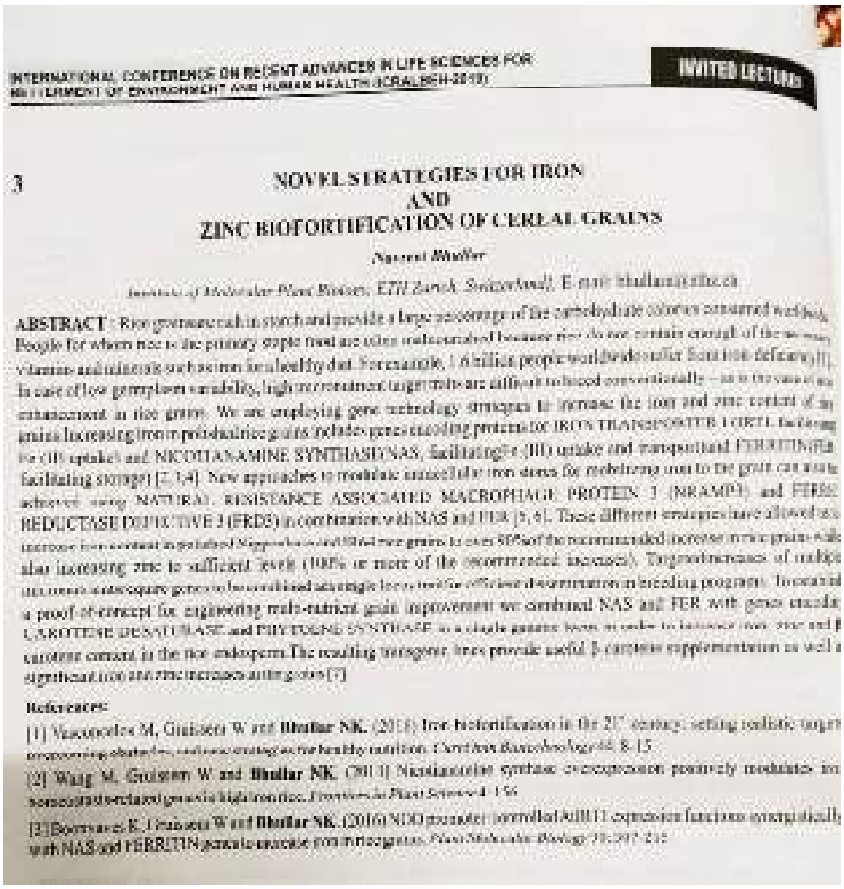
1 CONTRIBUTION OF ORGANIC AGRICULTURE TO SUSTAINABLE DEVELOPMENT

ABSTRACT

Guest lecture by Dr. Gurbir Bhullar, Switzerland



Guest lecture by Dr. Navreet Bhullar, Switzerland



INTERNATIONAL CONFERENCE ON RECENT ADVANCES IN LIFE SCIENCES FOR ... OF ENVIRONMENT AND HUMAN HEALTH (ICRALSEH-2016)

INVITED LECTURES

3

NOVEL STRATEGIES FOR IRON AND ZINC BIOFORTIFICATION OF CEREAL GRAINS

Navreet Bhullar

Institute of Molecular Plant Biology, ETH Zurich, Switzerland, E-mail: bhullarn@ethz.ch

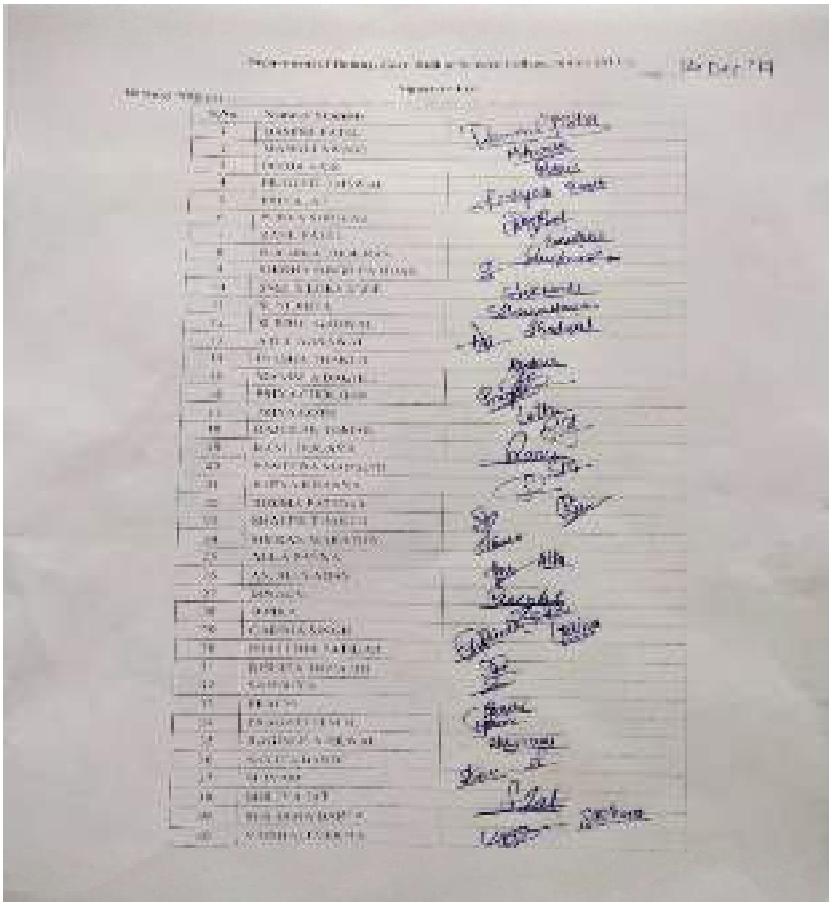
ABSTRACT: Rice grain rich in starch and provide a large percentage of the carbohydrate calories consumed worldwide. People for whom rice is the primary staple food are often malnourished because rice does not contain enough of the micronutrients, vitamins and minerals such as iron for a healthy diet. For example, 1.4 billion people worldwide suffer from iron deficiency [1]. In case of low genetic variability, high micronutrient target traits are difficult to breed conventionally – as is the case for iron enhancement in rice grains. We are employing gene technology strategies to increase the iron and zinc content of rice grains. Increasing iron in polished rice grains includes genes encoding proteins IRON TRANSPORTER 1 (IRT1) facilitating Fe (II) uptake and NICOTIANAMINE SYNTHASE (NAS) facilitating Fe (II) uptake and transportand FERRITIN facilitating storage) [2, 3, 4]. New approaches to mobilize stored iron stores for redirecting iron to the grain can also be achieved using NATURAL RESISTANCE ASSOCIATED MACROPHAGE PROTEIN 1 (NRAMP1) and FERRIC REDUCTASE DEFECTIVE 3 (FRD3) in combination with NAS and FER [5, 6]. These different strategies have allowed us to increase iron content in polished *Oryza sativa* Nipponbare and Kitaake rice grains to over 50% of the recommended increase in rice grain while also increasing zinc to sufficient levels (100% or more of the recommended increase). The effectiveness of multiple transgenes to square grain to be combined advantageously over conventional determinants in breeding programs. To establish a proof-of-concept for engineering multi-nutrient grain improvement we combined NAS and FER with genes encoding CAROTENE DESATURASE and PHYTOENE SYNTHASE in a single genetic locus to increase iron, zinc and provitamin A carotene content in the rice endosperm. The resulting transgenic lines provide useful β-carotene supplementation as well as significant iron and zinc increases in the grains [7].

References:

[1] Vasconcelos M, Grusak M and **Bhullar NK.** (2018) Iron biofortification in the 21st century: setting realistic targets, overcoming obstacles, and new strategies for healthy nutrition. *Current Opinion Biotechnology* 44: 8-15

[2] Wang M, Gruissem W and **Bhullar NK.** (2013) Nicotianamine synthase overexpression positively modulates iron homeostasis-related genes and iron traffic. *Frontiers in Plant Science* 4: 156

[3] Boonyaves K, Gruissem W and **Bhullar NK.** (2016) NAS promoter: controlled AtIRT1 expression functions synergistically with NAS and FERRITIN genes to increase iron in rice grains. *Plant Molecular Biology* 91: 507-519



GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Anchor Software Developers and Solution Pvt. Ltd., Indore

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2A

Activity Title:

Conducted a collaborative series of various training sessions for the certificate and internship programs.

SKILL DEVELOPMENT PROGRAM
2022-23

S. No	Component/Activities	Details
1	Name of the Department / Unit / Agency:	Department of Electronics
2	Name of the Activity:	Practical training on Web Design
3	Name of the Scheme:	Practical training
4	Date and Year of the Activity:	1 December 2022 to 07 January 2023
5	Number of Students Participated in the activity:	104
6	Report of the Activity (in 100 words):	Web Design is the design of websites that are displayed on the internet. To give future scope in the field of Web Design, the Electronics Department, Government Holkar (Model, Autonomous) Science College, Indore has organized a Practical training on Web Design at Anchor Software Developers and Solution Pvt. Ltd. Students developed some Web Page during this activity. The industry has allowed 104 students for this, and this hands-on training is held on 1 December 2022 onwards. Mr. Akhilesh Khare has approved this event on the industry side; Dr. Suresh T. Silawat, the principal, and Dr. Netram Kaurav, have approved this event from the institution side.

CIN: U72200MP2010PTC024998

ANCHOR SOFTWARE
DEVELOPERS AND SOLUTIONS PVT. LTD.

Ref. No :_____ Date : 10/11/2022

To,

Head,

Department of Electronics,

Govt. Holkar Science College, Indore

Subject: -Acceptance Letter for Lecture/Training/Learning of your Students.

Dear Sir,

This is to inform you that we have cordially accepted your request for a hands-on training session we are drafting a Module with the Practical session included in it.

You are requested to arrange a required module.

Thanking you

Anchor Software Developers and Solutions P. Ltd.
Director

B.O. : 201-BABARI COMPLEX, NEAR PIPLIYANHA SQUIRE, MYH LINK ROAD, INDORE (M.P.) 452016 MOB. NO. : 9993915996

Department of Electronics
Web Design Class
Time Table

S.No.	Date	Theory Class Time	Practical Class Time
1	01-12-22	9:30 to 10:30 am	10:30 to 11:30 am
2	02-12-22	9:30 to 10:30 am	10:30 to 11:30 am
3	03-12-22	9:30 to 10:30 am	10:30 to 11:30 am
4	05-12-22	9:30 to 10:30 am	10:30 to 11:30 am
5	06-12-22	9:30 to 10:30 am	10:30 to 11:30 am
6	07-12-22	9:30 to 10:30 am	10:30 to 11:30 am
7	08-12-22	9:30 to 10:30 am	10:30 to 11:30 am
8	09-12-22	9:30 to 10:30 am	10:30 to 11:30 am
9	10-12-22	9:30 to 10:30 am	10:30 to 11:30 am
10	12-12-22	9:30 to 10:30 am	10:30 to 11:30 am
11	13-12-22	9:30 to 10:30 am	10:30 to 11:30 am
12	14-12-22	9:30 to 10:30 am	10:30 to 11:30 am
13	15-12-22	9:30 to 10:30 am	10:30 to 11:30 am
14	16-12-22	9:30 to 10:30 am	10:30 to 11:30 am
15	17-12-22	9:30 to 10:30 am	10:30 to 11:30 am
16	19-12-22	9:30 to 10:30 am	10:30 to 11:30 am
17	20-12-22	9:30 to 10:30 am	10:30 to 11:30 am
18	21-12-22	9:30 to 10:30 am	10:30 to 11:30 am
19	22-12-22	9:30 to 10:30 am	10:30 to 11:30 am
20	23-12-22	9:30 to 10:30 am	10:30 to 11:30 am
21	24-12-22	9:30 to 10:30 am	10:30 to 11:30 am
22	26-12-22	9:30 to 10:30 am	10:30 to 11:30 am
23	27-12-22	9:30 to 10:30 am	10:30 to 11:30 am
24	28-12-22	9:30 to 10:30 am	10:30 to 11:30 am
25	29-12-22	9:30 to 10:30 am	10:30 to 11:30 am
26	30-12-22	9:30 to 10:30 am	10:30 to 11:30 am
27	31-12-22	9:30 to 10:30 am	10:30 to 11:30 am
28	02-01-23	9:30 to 10:30 am	10:30 to 11:30 am
29	03-01-23	9:30 to 10:30 am	10:30 to 11:30 am
30	04-01-23	9:30 to 10:30 am	10:30 to 11:30 am
31	05-01-23	9:30 to 10:30 am	10:30 to 11:30 am
32	06-01-23	9:30 to 10:30 am	10:30 to 11:30 am
33	07-01-23	9:30 to 10:30 am	10:30 to 11:30 am

7	List of Participants	Enclosed

Govt. Holkar(Model, Autonomous) Science College, Indore (M.P)
Department of Electronics
Student List

S. No.	NAME OF STUDENT	CLASS	SIGNATURE
1	ABHISHEK PANDEY	B.Sc. III Year	
2	AMAN PARMAR	B.Sc. III Year	
3	AMBIKA NAGAR	B.Sc. III Year	
4	AMISHA PATEL	B.Sc. III Year	
5	ANJALI TIWARI	B.Sc. III Year	
6	ARTI KARMA	B.Sc. III Year	
7	ARVIND DEVDA	B.Sc. III Year	
8	ARVIND MANDLOI	B.Sc. III Year	
9	ASHISH SAINI	B.Sc. III Year	
10	ASTHA CHOUHAN	B.Sc. III Year	
11	DEEPA JOSHI	B.Sc. III Year	
12	DEVYANI KOLTE	B.Sc. III Year	
13	DIVYANSHU AHIRWAR	B.Sc. III Year	
14	FARHEEN KHAN	B.Sc. III Year	
15	HARSHAL JOSHI	B.Sc. III Year	
16	HRISHABH MEENA	B.Sc. III Year	
17	JAGRATI NAMDEV	B.Sc. III Year	
18	JYOTI BALA DAMOR	B.Sc. III Year	
19	KARTIKA PATHAK	B.Sc. III Year	
20	KAUSTABH GAUTAM	B.Sc. III Year	
21	MUSKAN SOLANKI	B.Sc. III Year	
22	NANDINI SONI	B.Sc. III Year	
23	SONIYA SANKLIYA	B.Sc. III Year	
24	NIDHI TAWDIYA	B.Sc. III Year	
25	OM NAYAK	B.Sc. III Year	
26	PALAK SHARANAGAT	B.Sc. III Year	
27	PRACHI SONWANE	B.Sc. III Year	
28	PRANSHU SINGH	B.Sc. III Year	
29	PRITIKA PATEL	B.Sc. III Year	
30	PRIYANKA KURMI	B.Sc. III Year	
31	PRIYANKA LODHI	B.Sc. III Year	
32	RADHIKA KARAHE	B.Sc. III Year	
33	RAHUL GULWANI	B.Sc. III Year	
34	RAVINA PATIDAR	B.Sc. III Year	
35	RISHABH KHATRI	B.Sc. III Year	

S. No.	NAME OF STUDENT	CLASS	SIGNATURE
36	SAGARIKA SONI	B.Sc. III Year	
37	SAINABH CHAURASIYA	B.Sc. III Year	
38	SANJAY BHAYDIYA	B.Sc. III Year	
39	SANSKRATI JAIN	B.Sc. III Year	
40	SATAYM PANDEY	B.Sc. III Year	
41	SHUBHAM BARASKAR	B.Sc. III Year	
42	SHUBHAM PATEL	B.Sc. III Year	
43	SUMIT ASTAYA	B.Sc. III Year	
44	SUMIT SONI	B.Sc. III Year	
45	VIKASH GOYAL	B.Sc. III Year	
46	RINKI YADAV	B.Sc. III Year	
47	PRACHI KAURAV	B.Sc. III Year	
48	PRANJAL JAIN	B.Sc. III Year	
49	SAHIL KHAN	B.Sc. III Year	
50	AJAY SINGH RANG	B.Sc. III Year	
51	MOHIT RATHORE	B.Sc. III Year	
52	ABHAY BHASKAR	B.Sc. III Year	
53	ABHIMNYU PARIHAR	B.Sc. III Year	
54	ADARSH SHARMA	B.Sc. III Year	
55	ADITYA RAJAK	B.Sc. III Year	
56	AKASH CHOUHAN	B.Sc. III Year	
57	AKSHAD JOSHI	B.Sc. III Year	
58	AMAN SEN	B.Sc. III Year	
59	AMIT DWIVEDI	B.Sc. III Year	
60	AMITA MAKWANA	B.Sc. III Year	
61	ANIL BHURIYA	B.Sc. III Year	
62	ANISHKA GUPTA	B.Sc. III Year	
63	ANJALI PADMOR	B.Sc. III Year	
64	ANKITA SOLANKI	B.Sc. III Year	
65	ANUSHKA JAIN	B.Sc. III Year	
66	ANUSHKA LATH	B.Sc. III Year	
67	ANUSHRI CHANDOLIYA	B.Sc. III Year	
68	ARMAN SONI	B.Sc. III Year	
69	ARYAN KHAN	B.Sc. III Year	
70	ASHISH JAAT	B.Sc. III Year	
71	ATUL JAAT	B.Sc. III Year	
72	AYUSHI SUROSHI	B.Sc. III Year	
73	BHAGWATI DAS BAIRAGI	B.Sc. III Year	

S. No.	NAME OF STUDENT	CLASS	SIGNATURE
74	BHAGYASHRI DAS	B.Sc. III Year	
75	BHUPENDRA DHAKAR	B.Sc. III Year	
76	CHANCHAL PATEL	B.Sc. III Year	
77	CHARVEE SHARMA	B.Sc. III Year	
78	CHELSI PORWAL	B.Sc. III Year	
79	DAMINI JAMOD	B.Sc. III Year	
80	DEEPSHIKHA CHOUGDE	B.Sc. III Year	
81	DEEVESH CHAUSIYA	B.Sc. III Year	
82	DIPIKA BAGHEL	B.Sc. III Year	
83	GAURAV PANDEY	B.Sc. III Year	
84	GUNJAN GADRIYA	B.Sc. III Year	
85	ABHISHEK KUMAR MISHRA	B.Sc. III Year	
86	IMRAN KHAN	B.Sc. III Year	
87	KAIVALYANSHI CHAUBEY	B.Sc. III Year	
88	LALIT PRAJAPAT	B.Sc. III Year	
89	MAHENDRA SINGH CHAUHAN	B.Sc. III Year	
90	NEHA SHUKLA	B.Sc. III Year	
91	POOJA SASTYA	B.Sc. III Year	
92	PRANJALI	B.Sc. III Year	
93	RINKI LOVANSHI	B.Sc. III Year	
94	ROHAN CHOUDHARY	B.Sc. III Year	
95	SANJAY THAKUR	B.Sc. III Year	
96	SANKRATI YADAV	B.Sc. III Year	
97	SHIVAM GUPTA	B.Sc. III Year	
98	SUDHANSHU MISHRA	B.Sc. III Year	
99	SWATI KUSHWAHA	B.Sc. III Year	
100	UMESH KUSHWAHA	B.Sc. III Year	
101	URJA SAHU	B.Sc. III Year	
102	VAGESH SHARMA	B.Sc. III Year	
103	VISHWASI YADAV	B.Sc. III Year	
104	RAJ BATHRE	B.Sc. III Year	

SSR DOCUMENT

2022

CRITERION – 3

MoUs/Linkages/Collaborations

Wild Warriors Society, Indore

Document Title:

Environmental awareness activities: Bird Survey at college campus in association with Wild Warriors Society, Indore (MP)

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Wild Warriors Society, Indore

तमसो मा ज्योतिर्गमय

3A

Activity Title:

Environmental awareness activities: Bird Survey at college campus in association with Wild Warriors Society, Indore (MP)

Registration No. 03/27/01/23145/21
Mob. 9575300232, 9425900083
E-mail : wildwarriorsindore@gmail.com

Registered Address : 59/4, Vallabh Nagar, Indore (M.P.)

Sr.No

Date .....

MEMORANDUM OF UNDERSTANDING FOR NATURE & WILDLIFE RELATED ACTIVITIES

BETWEEN

Govt. [Model, Autonomous] Holkar Science College, Indore, M. P.
AND
Wild Warriors Society, Indore.

The representatives of Govt. [Model, Autonomous] Holkar Science College, Indore and *Wild Warriors Society, Indore*, agree to this Memorandum of Understanding.
The Memorandum of Understanding (MOU) establishes the following:

1. OBJECTIVE OF THE AGREEMENT

To establish a mutually beneficial relationship built on nature and wildlife related activities between the Govt. [Model, Autonomous] Holkar Science College, Indore, M. P. and *Wild Warriors Society, Indore* include the theoretical and field work related to nature and wildlife within and outside the premises of Govt. Holkar Science College involving the students of the college in the activities.

2. GOALS

The signing institutions agree to provide opportunity, as appropriate, for the following activities towards the completion of the objective of this MOU.

1. Bird Watching and field visit to any of the nearby jungle/wetland etc.
2. Online/Offline lecture on environment and wildlife related subject.(on chargeable basis)
3. Session on Basics of Photography.
4. Trekking/Nature Walk in the nearby areas. (on chargeable basis)
5. Participation in the bird and butterfly survey to be organised at Govt .Holkar Science College.
6. Organization/Participation in Plantation Drives.
7. Organization/Participation in Nature Cleanliness Drives.
8. Internships & Projects.
9. Any other projects related with nature and wildlife.

3. IMPLEMENTATION OF THE MEMORANDUM OF UNDERSTANDING

The objectives of the MOU will be implemented and regulated in the following manner:

All the expenses shall be the direct responsibility of the participating student (subject to any agreements on payment arrangements made by either institution with its own students). These expenses include:
i. Any transportation related cost to & fro to reach up to the base camp/destination to commence activities.
ii. Any related equipment's like binoculars, camera etc needs to be procured by the student itself.

Registration No. 03/27/01/23145/21
Mob. 9575300232, 9425900083
E-mail : wildwarriorsindore@gmail.com

Registered Address : 59/4, Vallabh Nagar, Indore (M.P.)

Sr.No. Date .....

iii. Any type of administrative or lodging, boarding expenses in case of moving out of the Indore City will be borne by the students only.

iv. Wild Warriors will/may charge a subsidised/discounted (in comparison to current market rates) nominal amount from the students and if student actively participate in the activities and fulfill all the parameters they will be provide an internship completion certificate.

v. If any expenses required for conducting any such activity other than that mentioned in the above MOU will be discussed and agreed mutually by both the parties.

4. DURATION AND RECINDENCE OF MOU

a. The agreement shall come into effect on **16th Day of May 2022** .Changes to this agreement shall be made by mutual consent between both institutions. In cases of disagreement, the Institute wishing to depart from the agreement shall, wherever possible, give two month's notice of its intention to do so. The agreement shall be reviewed after a period of one year.

b. This MOU is being signed purely with the intention to inculcate and nurture students of Govt. Holkar Science College about Nature & Wildlife.

This MOU is signed by,

Dr. Suresh T Silawat, Principal,
Govt. [Model, Autonomous] **Holkar Science College**,
Indore, Madhya Pradesh

And

Shri Swapnil Phanse
Secretary - Wild Warriors Society,
Indore, Madhya Pradesh

WILD WARRIORS SOCIETY * INDORE *

In presence of the following witnesses:

1. .....

2. .....

BIRD SURVEY

GOVERNMENT HOLKAR SCIENCE COLLEGE

INDORE (M.P.)



22 MAY 2022

A SURVEY REPORT

BY

Wild Warriors

&

GOVERNMENT HOLKAR SCIENCE COLLEGE



ABOUT GOVERNMENT HOLKAR SCIENCE COLLEGE

Govt.(Model, Autonomous) Holkar Science college, Indore was established by, the then King of erstwhile Holkar state, Hon'ble Maharaja Shivaji Rao Holkar, in June 1891. The visionary king selected Mr. Cholmondeley from UK as its first principal. The college started with the best talent available in teaching in India and abroad. At the time of opening of the new building of the college, the manager of the state stressed the need of girls' education. The king could foresee that conservatism and dogmatic religious beliefs would soon give way to scientific outlook and rationalism. With the increasing number of students and multiplication of disciplines, the college was split into two separate and independent units. One of these two colleges was designated as Govt. Arts and Commerce College while this college retained its prestigious original name i.e. Holkar College and continued to be housed in the old college building.

Ever since its inception the institution has striven hard to fulfill its promises of providing quality education to produce thoughtful, intelligent and competent human beings, capable of facing the challenges of the life bravely. The alumni of the college has occupied prestigious positions in almost every walk of life. Perhaps this is the only college which produced Chief Justice of Supreme Court of India, Hon'ble Justice R.C.Lahoti and Chief Justice of Pakistan Hon'ble Justice Alvin "Bobby" Robert Cornelius.The father of Justice Cornelius was a faculty member of the college. At present, the institution is imparting education in science with the emphasis on scientific research. The college has the privilege to be visited by VVIPs like Pt. Jawaharlal Nehru (First Prime Minister of Independent India),Dr.S. Radhakrishnan, Dr.A.P.J.Abdul Kalam (Former President of India),Dr. Shankar Dayal Sharma (Former Vice President of India), Shri L.K.Advani(Former Home Minister of India) and almost all the Chief Ministers of Madhya Pradesh.Besides these dignitaries, the college also witnessed the presence of Shri Prithviraj Kapoor (Actor), Shri Hemant Kumar (Singer), Shri Anil Biswas (Music Director), Pt.Madan Mohan Malviya (Indian educationist), Shri Shard Joshi (Poet), Mrs. Malti Joshi (Literature) etc. to name a few.



ACKNOWLEDGEMENT



DR SURESH T SILAWAT

PRINCIPAL

GOVT. HOLKAR SCIENCE COLLEGE, INDORE

WE WOULD LIKE TO EXTEND OUR SPECIAL THANKS TO DR SURESH SILAWAT PRINCIPAL FOR THIS WONDERFUL INITIATIVE TO INVOLVE STUDENTS IN SUCH A UNIQUE ACTIVITY WHICH NOT ONLY HELPS IN IDENTIFICATION OF FLORA & FAUNA OF THE AREA BUT ALSO BRING THEM CLOSE TO NATURE. HIS SCINECER EFFORTS IN PROMOTING NATURE RELATED ACTIVITIES IS HIGHLY APPRESIABLE.

DR SANJAY VYAS

HOD-BOTANY, SEED TECHNOLOGY & HORTICULTURE

WE ARE THANKFUL TO DR SANJAY VYAS FOR HELPING IN SMOOTH EXECUTION OF THE SURVEY. HIS IMMENSE SUPPORT AND PRESENCE DURING THE SURVEY MOTIVATED THE SURVEY TEAM.



MANAGING TEAM WILD WARRIORS



SHRI RITESH KHABIA WILD WARRIORS



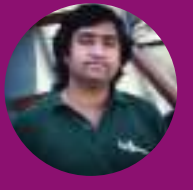
SHRI SACHIN MATKAR WILD WARRIORS



SHRI KAMLESH NACHAN WILD WARRIORS



SHRI ANSHUMAN SHARMA WILD WARRIORS



SHRI SWAPNIL PHANSE WILD WARRIORS

OBJECTIVE

BIRD SURVEY

- To introduce Birds and Birding to the students of Govt. Holkar Science College.
- To inculcate love for nature amongst the students.
- To document the bird species available at Govt. Holkar Science College Campus.
- To spread awareness amongst the students and staff of Govt. Holkar Science College about birds and nature.
- To draw up a base data of birds species available.
- To record the bird diversity on eBird, so that the compiled data is easily accessible to students, academicians, nature volunteers researchers scientists seamlessly.
- To make future strategies as how to increase the green cover of college to get biodiversity rich





METHODOLOGY & PROTOCOL USED

BIRD SUREY

- A total of 2 different birding routes/trails were identified on which the 02 teams travelled on foot and documented the different species of bird that came across.

- Each team constituted of 12 members and every team was expected to be in the field for minimum 1.30 hrs. The team walked an approximate distance of 2-3 kms. The walk started at 6.30 hrs.

- During the survey, the list of birds is made on eBird All the eBird checklists were uploaded on the eBird site and shared with one common group account named online.

- The team's task was to record as many species as possible, but it was more important to record correct identity of the bird.

- Birders were also encouraged to record bird calls, as some of the times it is very helpful in identifying a bird species. The team leaders had the responsibility to submit the completed checklists on eBird.

- To record the bird diversity on eBird, so that the compiled data is easily accessible to students, academicians, nature volunteers researchers scientists & researchers seamlessly.

BIRD SPECIES DOCUMENTED

S.NO	SPECIES	SCIENTIFIC NAME
1	LITTLE SWIFT (INDIAN HOUSE SWIFT)	APUS AFFINIS
2	INDIAN POND-HERON	ARDEOLA GRAYII
3	PURPLE SUNBIRD	CINNYRIS ASIATICUS
4	ROCK PIGEON (BLUE ROCK PIGEON)	COLUMBA LIVIA
5	LAUGHING DOVE (LITTLE BROWN DOVE)	STREPTOPELIA SENEGALENSIS
6	GREATER COUCAL	CENTROPUS SINENSIS
7	ASIAN KOEL	EUDYNAMYS SCOLOPACEUS
8	WHITE-BREASTED WATERHEN	AMAURORNIS PHOENICURUS
9	RED-WATTLED LAPWING	VANELLUS INDICUS
10	LITTLE EGRET	EGRETTA GARZETTA
11	SHIKRA	ACCIPITER BADIUS
12	BLACK KITE	MILVUS MIGRANS
13	INDIAN GREY HORNBILL	OCYCEROS BIROSTRIS
14	COPPERSMITH BARBET	PSILOPOGON HAEMACEPHALUS
15	ROSE-RINGED PARAKEET	PSITTACULA KRAMERI
16	BLACK DRONGO	DICRURUS MACROCERCUS
17	RUFOUS TREEPIE	DENDROCITTA VAGABUNDA
18	COMMON TAILORBIRD	ORTHOTOMUS SUTORIUS
19	ASHY PRINIA	PRINIA SOCIALIS
20	RED-VENTED BULBUL	PYCNONOTUS CAFER
21	JUNGLE BABBLER	ARGYA STRIATA
22	BRAHMINY STARLING	STURNIA PAGODARUM
23	COMMON MYNA	ACRIDOTHERES TRISTIS
24	PURPLE-RUMPED SUNBIRD	LEPTOCOMA ZEYLONICA

TEAM MEMBMERS

S.NO	STUDENT'S NAME
1	MR ANIMESH SHARMA
2	MR RANA PRATAP PATHAK
3	MR SOURABH PATIDAR
4	MR MOHIT PATIDAR
5	MS NEHASHWARI TIWARI
6	MR RAJ KUMAR SOUR
7	MR RAHUL PARIHAR
8	MS BHAVNA JAGTAP
9	MR YOGESH BHURIYA
10	MR MAHENDRA MANDLOI
11	MR ANKIT YADAV
12	MR SATRUDHAN PATEL
13	MR DHEERAJ MALVIYA
14	MR HRITIK BAGRI
15	MR RAVINDRA SISODIYA
16	MS PRAGYA MASOORKAR
17	MS DIVYA SING THAKUR
18	MR NIKHIL CHAUHAN
19	MS NEELAM PANDAY
20	MR ANKIT BHALSE
21	MR RAMKARISHN KACHWARE
22	MR HARSHVARDHAN
23	MS ANJALI

S.NO	PROFESSOR'S NAME
1	SHRI DHARMENDRA JAT
2	SHRI GOVIND JAT
3	SHRI LOV ASATI

S.NO	TEAM WILD WARRIORS
1	MR SACHIN MATKAR
2	MR RITESH KHABIA
3	MR ANSHUMAN SHARMA
4	MR KAMLESH NACHAN
5	MR SHRIKANT KALAMKAR
6	MR SWAPNIL PHANSE

TEAM





SURVEY AT A GLANCE









- PROF DHARMEDRA JAT INTRODUCED ALL THE STUDENTS ABOUT THE ACTIVITY TO BE DONE AND PURPOSE OF THE ACTIVITY.
- SHRI SACHIN MATKAR EXPLAINED ABOUT THE METHODOLOGY OF THE SURVEY AND PROTOCOLS TO FOLLOW.
- SURVEY STARTED AT 6.30 AM AND ENDED AT 8.00 AM AND COVERED ENTIRE CAMPUS OF GOVT. HOLKAR SCIENCE COLLEGE.
- POST SURVEY HOD DR SANJAY VYAS GREETED ALL THE STUDENTS AND TEAM WILD WARRIORS FOR THIS INITIATIVE AND TOLD THE PURPOSE OF THE ACTIVITY AND MOTIVATED STUDENTS TO COME CLOSE TO NATURE.
- STUDENTS SHARED THERE EXPERIENCE FOLLOWED BY BREAKFAST AND CONCLUSION OF THE SURVEY.







FLYING JEWELS



WHITE-THROATED KINGFISHER



ASIAN OPENBILL



SPOTTED OWLET



BLACK RUMPED WOODPACKER



LONG TAILED SHRIKE



ORIENTAL MAGPIE ROBIN



ASHY PRINIA



BLACK RED START



BRONZE WINGED JACANA



BLACK DRONGO



PIED KINGFISHER



INDIAN GREY HORNBILL



GOLDEN ORIOLE



GREEN BEE EATER



BLACK WINGED STILT

FLYING JEWELS



COMMON KESTREL



CRESTED SERPENT EAGLE



GREATER COUCAL



COPPERSMITH BARBET



PLUM HEADED PARAKEET



COMMON IORA



INDIAN SILVER BILL



SHIKRA



RIVER TERN



WHITE-EYED BUZZARD



WHITE BREASTED WATERHEN



BAYBACKED SHRIKE



LITTLE RINGED PLOVER



LESSER WHISTLING DUCK



INDIAN WHITE-EYE

Photo Courtesy: Mr Ritesh Khabia

THANK YOU



Govt. Holkar Science College, Indore (MP)

Wild Warriors Society Indore

Wild Warriors Society - 59/4 Vallabh Nagar, Indore (9575300232)
email: wildwarriorsindore@gmail.com

SSR DOCUMENT

2022

CRITERION –3

MoUs/Linkages/Collaborations

Answer Foundation, BM 70 Near Bapat Square, Indore (MP)

Document Title:

Experiential learning for industrial start-ups based on Arduino is provided by Answer Foundation, BM 70, Near Bapat Square, Indore, under a MoU.

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

UGC-DAE CSR, Indore

तमसो मा ज्योतिर्गमय

4A

Activity Title:

Raman spectroscopy was carried out at UGC-DAE CSR, Indore

Office of the Principal
Govt. (Model Autonomous) Holkar Science College
Indore (M.P.)
0731-2464074(O), 2446806, 2764027 (Exam)
e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org
(Re-accredited 'A' Grade by NAAC)

Date:- 07/05/22

Memorandum Of Understanding for Academic and Scientific Research Cooperation

BETWEEN

Government Holkar (Model Autonomous) Science College Indore (M.P.) INDIA

AND

UGC-DAE Centre for Scientific Research, Indore (M.P.) INDIA

In the spirit of mutual understanding, Government Holkar (Model Autonomous) Science College, Indore (M.P.), India and UGC-DAE Centre for Scientific Research, Indore (M.P.), India, agree to examine the possibility of establishing a framework for educational and research cooperation for students, faculty and staff of Government Holkar (Model Autonomous) Science College, Indore.

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1. To support academic and scientific cooperation. Faculties of consortium will provide suggestions on academic curriculum and establishing research facilities.
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3. To conduct workshop/science popularization programs on a mutually agreed area of scientific interest by both the institutes. A discussion will require prior commencement of this activity.

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The Department of Physics will be implementing nodal department from Government Holkar (Model Autonomous) Science College, Indore side. A faculty/staff will be assigned by Centre Director from Consortium side.

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This MoU shall be effective upon signature by the two institute and shall remain in force for a period of five (5) years. Thereafter it shall be automatically renewed for another 5 years unless it is terminated.

This MOU is signed by,

Dr. G. D. Gupta, Head of Department

Dr. Suresh T. Silawat, Principal
Govt. Holkar (Model Autonomous) Science College, Indore, (M.P.)

Dr. Vasant G. Sathe, Centre-Director
UGC-DAE Consortium for Scientific Research, Indore (M.P.)

UGC-DAE Consortium for Scientific Research
विश्वविद्यालय अनुदान आयोग- परमाणु ऊर्जा विभाग वैज्ञानिक अनुसंधान संकुल
(An autonomous institution of UGC, New Delhi)
(विश्वविद्यालय अनुदान आयोग, नई दिल्ली द्वारा स्थापित स्वशासी संस्थान)
(Formerly : Inter University Consortium for DAE Facilities, IUC-DAEF)
Indore Centre
इन्दौर केन्द्र

Dr. Vasant Sathe
Centre-Director

डॉ. वसंत साठे
केन्द्र निदेशक

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UGC-DAE Consortium for Scientific Research, Indore (M.P.)

Date: 07/05/22

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www.csr.res.in

CRS Projects:2021-22 Dear faculty members, please submit your progress report,SE/UC report, and work report for the annual report of UGC-DAE CSR.

Accepted Proposals: 8/15

Pending Comp. Report: 3

Pending Exp. Report: 3

Change in Comp. Reports: 0

Proposals Apply for an experiment

S. No.	Proposal No./Date	Facility/Centre	Status	Schedule	Comment	Action	Guest House
1	07/2023/5240 2023-07-23	Raman Spectrosc..... Indore	Submitted		0		
2	07/2023/5158 2023-07-10	SEM/EDAX (Norma..... Indore	Submitted		0		
3	07/2023/5150 2023-07-09	UV-Vis (UPD) Indore	Submitted		0		
4	07/2023/5149 2023-07-09	FTIR (UPD) Indore	Submitted		0		
5	06/2023/4968 2023-06-14	FTIR (UPD) Indore	Accepted	03 July 2023 07 July 2023	1	Withdraw	
6	06/2023/4967 2023-06-14	XPS – VSW (UPD) Indore	Comp.Rep.Verified	1			
7	05/2023/4847 2023-05-26	D8 Advance - Po..... Indore	Rejected		0		
8	05/2023/4845 2023-05-26	SEM/EDAX (Norma..... Indore	Submitted		0		
9	05/2023/4831 2023-05-24	Transmission el..... Indore	Rejected		2		
10	05/2023/4830 2023-05-24	Zeta potential-..... Indore	Submitted		0		
11	05/2023/4829 2023-05-24	UV-Vis (UPD) Indore	Comp.Rep.Verified	0			
12	09/2022/3152 2022-09-07	Raman Spectrosc..... Indore	Comp.Rep.Verified	0			
13	09/2021/786 2021-09-02	Heat Capacity M..... Indore	Submitted		0		
14	09/2021/785 2021-09-02	Diff. Scan. Cal..... Indore	Accepted	20 December 2021 22 December 2021	0	Withdraw	
15	08/2021/748 2021-08-23	Diff. Scan. Cal..... Indore	Accepted	30 August 2021 31 August 2021	2	Withdraw	

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4B

Activity Title:

Under the MoU with UGC-DAE CSR, Indore, research work on Qualitative study of structural phase transition in nickeldoped La2CoTi(1x)NixO6 double perovskite was carried out in collaboration with Dr. R. J. Choudhary, Scientist, UGC-DAE CSR, Indore.

ScienceDirect

Journal of Alloys and Compounds
Volume 943, 15 May 2023, 169126

Qualitative study of structural phase transition in nickel doped $La_2CoTi_{(1-x)}Ni_xO_6$ double perovskite

Neha Solanki [a], R.J. Choudhary [b], Netram Kaurav [c]

[a] Department of Physics, Shri Neelkantheshwar Government Post-Graduate College, Khandwa 450001, India
[b] UGC DAE Consortium for Scientific Research, Indore 452001, India
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Received 20 September 2022, Revised 28 January 2023, Accepted 30 January 2023, Available online 2 February 2023, Version of Record 20 February 2023.

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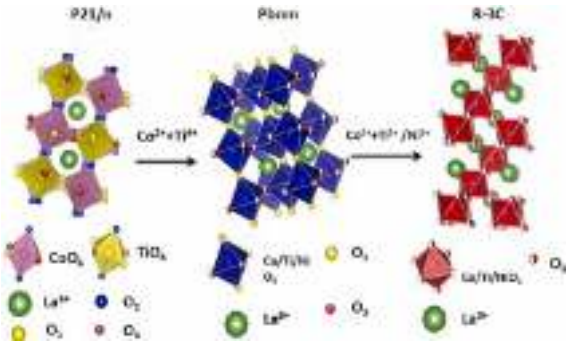
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https://doi.org/10.1016/j.jallcom.2023.169126
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Abstract

$La_2CoTi_{(1-x)}Ni_xO_6$ (x=0, 0.2 and 0.6) ($A_2BB'_{(1-x)}B''_{(x)}O_6$) double perovskite samples in bulk pellet form were prepared successfully by using sol-gel method at a sintering temperature of 1350 °C. From the Rietveld refinement approach, crystal structures of prepared samples were investigated using X-ray powder diffraction data, wherein, a structural phase transition occurred from monoclinic (*P21/n*) to orthorhombic (*Pbnm*) to rhombohedral (***R3c***) as the nickel content is increased. X-ray photoelectron spectroscopy study reveals the presence of mixed oxidation state of cobalt ions (Co^{2+}/Co^{3+}) which changes significantly as the nickel concentration is increased to 20% and hence affects the bond length with the structure distortion from monoclinic to orthorhombic with symmetry *Pbnm*. In 60% nickel doped compound, there occurs a random distribution of Co^{2+}/Co^{3+} and Ni^{3+} among the B′ and B′′ site with added repulsions between trivalent cobalt cations seeming in the structure due to Ti^{4+} located at antisite B site. Consequently, to maintain charge neutrality, distorted rhombohedral structure was observed. Tolerance factor was also estimated for all the prepared bulk compounds to further confirm the formation and structural transitions in the prepared compounds.

Graphical Abstract



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Introduction

Double perovskite oxides are one of the potential candidates serving as cathode/anode materials for solid oxide fuel cell (SOFC) applications. So far, several double perovskite oxides such as $Sr_2Mg_{1-x}Mn_xMoO_{6-\delta}$, $Sr_2CoTaO_{6-\delta}$, $Pr_xBaFe_2O_{5+\delta}$, $Pr_{1-x}Ca_xBa_{0.94}Co_2O_{5+\delta}$, $Nd_{1-x}Ca_xBaCo_2O_{5+\delta}$, etc. have been successfully employed as potential anode/cathodes for the fabrication of SOFCs [1], [2], [3], [4], [5]. Jiang et al. [1], reported the utility of $Sr_2Mg_{1-x}Mn_xMoO_{6-\delta}$ double perovskite oxide as anode material for SOFCs. Bu et al. [2], employed $Sr_2CoTaO_{6-\delta}$ double perovskite oxide based cathode for intermediate temperature SOFCs. $Pr_xBaFe_2O_{5+\delta}$ double-perovskite serving as cathodes was reported by Lu et al. [3], for SOFC applications. $Nd_{1-x}Ca_xBaCo_2O_{5+\delta}$ double perovskite was reported to be a new oxygen electrode material for reversible SOFCs [5]. However, for such device applications, it is highly imperative to examine the underlying physics behind the structural, and electronic properties of such double perovskite oxides because of the complexities in the coupling of different transition metal cations and their interaction with the adjacent oxygen atoms.

Double perovskites are rare complex perovskites having general stoichiometry $AA'BB'O_6$ or $A_2BB'O_6$ or $AA'B_2O_6$ with cubic symmetry belonging to $Fm\bar{3}m$ space group [6]. It is noteworthy to mention here that lanthanum-cobalt-based and lanthanum-nickel-based oxides of the form $A_2BB'O_6$ have grabbed enormous research interest among the various perovskite-type oxides owing to their remarkable electronic transport properties, mixed ionic-electronic conductivity (MIEC) and SOFC applications [7]. Interestingly, high n- or p-type conductivity can also be acquired via doping or ionic substitution, particularly, at B-site, resulting in octahedral tilts in multiple possible directions in order to adjust the substituted cation's size mismatch. [8], [9]. So far, several double perovskites such as $BaLaLiTeO_6$, $BaLaNaTeO_6$, Ba_2SmBiO_6, Sr_2CoRuO_6, $CaMnTi_2O_6$, La_2FeMnO_6, La_2NiMnO_6, La_2CoMnO_6 have been reported by exhibiting reduced symmetry as a result of the octahedral tilting [10], [11], [12], [13], [14], [15]. Among these, La_2CoTiO_6 has been suggested as a promising MIEC material due to its sensitivity to the Co/Ti ion ratio [16]. The creation of oxygen deficient oxides under reducing conditions, for example, by the reduction of Co^{3+} to Co^{2+}, is also possible which leads to the formation of anionic vacancies and inducing oxygen conduction. Experimental studies based on the growth of double perovskite compounds including $LaCr_{0.5}Mn_{0.5}O_3$ [17], $LaCrO_3$ [18], $BiFeO_3$-$BaTiO_3$ [19], $LaAlO_3$ [20], Al doped $LaCrO_3$ [21], [22], etc. suggest structural phase transitions. In double perovskite $A_2BB'O_6$ system,

the rare earth cobaltite double perovskite La_2CoTiO_6 has distorted monoclinic structure at room temperature [16]. Mohanty et al. [23], have thoroughly examined the structural phase transitions in Cu doped La_2FeMnO_6 double perovskites.

Apart from the choice of the material, synthesis method also significantly influence the properties of the materials. It should be noted here that double perovskite oxides can be successfully prepared via solid state reaction or sol-gel method. However, both of these approaches require high processing/sintering temperatures which can be executed in air or under various gases environment. Sugahara et al. [24], have prepared Sr_2MnMoO_6 sample via solid state method and sintered in an Ar + 5% H_2 atmosphere at 1223 K for 10 h and also annealed the same at 1543 K for 6 h in an Ar + 3% H_2 atmosphere. Cowin et al. [25], have synthesized $Ca_2Fe_{1+x}Mo_{1-x}O_{6-d}$ compounds, sintered at 1200 °C in air for 50 h using the same method. On the other hand, Svensson et al. [26], employed sol-gel approach to synthesize $La_2CrB_{2/3}Nb_{1/3}O_6$ (B = Mg, Ni, Cu) double perovskite under sintering temperature of 1350 °C for 24 h in air. Similarly, Shafeie et al. [27], prepared $La_{2-z}Co_{1+y}(Mg_xNb_{1-x})_{1-y}O_6$ double perovskite sintered at 1100 °C in air via sol-gel technique and reported structural changes from monoclinic (space group (*P21/n*)) to orthorhombic (space group *(Pbnm)*) to rhombohedral (space group ***(R3c)***) with increasing magnesium content in La_2CoTiO_6. It is worthy to mention here that the sol-gel approach is much more fascinating as compared to solid state method as it ensures purity and uniformity of the doped compounds and can also be employed for preparing a wide range of materials. Mondol et al. [28], [29], [30], [31], [32], [33], [34], [35], have employed the same sol-gel technique to fabricate metal-insulator structure (MIS) from HfO_2 and ZrO_2, ZrO_2 and IGZO based thin film transistors, MIS structure using aluminum oxide phosphate, etc. all processed at low temperature.

Lack of experimental reports for structural phase transitions subsequent to Ni doping concentrations, particularly in case of sol-gel synthesized lanthanum-cobalt oxides based double perovskites encourages us to perform a systematic study on structural phase transitions in such double perovskite oxides.

Accordingly, the present work reports on the structural phase transitions in Ni incorporated novel double perovskite series $La_2CoTi_{(1-x)}Ni_xO_6$ (x = 0, 0.2 and 0.6) synthesized by sol-gel route using room temperature X-ray diffraction (XRD) and X-ray photoelectron spectroscopy (XPS).

Section snippets

Experimental details

Bulk samples of double perovskite La_2CoTiO_6, $La_2CoTi_{0.8}Ni_{0.2}O_6$ and $La_2CoTi_{0.4}Ni_{0.6}O_6$ in the form of pellets were synthesized using the sol-gel process. High purity reagents i.e., lanthanum nitrate hexahydrate ($La(NO_3)_3{\cdot}6H_2O$, Sigma Aldrich, 99.99%), Cobalt acetate tetrahydrate ($(CH_3COO)_2Co{\cdot}4H_2O$, Sigma Aldrich, 99.99%), nickel nitrate hexahydrate ($Ni(NO_3)_2{\cdot}6H_2O$, Sigma Aldrich, 98.5%), titanium (IV) butoxide ($C_{16}H_{36}O_4Ti$, Sigma Aldrich, 99.99%), citric acid, ammonium hydroxide and de-ionized (DI)…

Results and discussions

To probe the structure and possible phase transitions in the synthesized $La_2CoTi_{(1-x)}Ni_xO_6$ (x = 0, 0.2 and 0.6) perovskites bulk pellet samples, XRD technique has been employed. The Rietveld refinement analysis using

fullproof software was employed to interpret the XRD results and to mark all the XRD peaks. Study was precisely performed by keeping into mind that the monoclinic symmetry allows the B cation ordering at two different sites while the other symmetries have only unique…

Conclusions

In conclusion, structural phase transitions in nickel doped $La_2CoTi_{(1-x)}Ni_xO_6$ ($A_2BB'_{(1-x)}B''_{(x)}O_6$) double perovskite bulk compounds has been analyzed qualitatively employing XRD and XPS studies. $La_2CoTi_{(1-x)}Ni_xO_6$ (x = 0, 0.2 and 0.6) double perovskite bulk compounds were prepared successfully using sol-gel method. XRD data shows that the bulk compound with x = 0 was crystallized in a monoclinic (*P21/n*) structure, which transformed into an orthorhombic (*Pbnm*) phase for sample with x = 0.2 and in …

CRediT authorship contribution statement

Neha Solanki: Data curation, Software, Investigation, Writing - original draft. **R.J. Choudhary:** Supervision, Validation, Resources. **Netram Kaurav:** Conceptualization, Methodology, Software, Visualization, Software, Investigation, Writing – review & editing.…

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.…

Acknowledgments

The authors sincerely thank to Dr. M. Gupta from UGC-DAE, Centre for Scientific Research, Indore, for providing the XRD facility. The authors are also thanks to Mr. A. Wadikar from Raja Rammana Centre for Advanced Technology, Indore for helping in XPS measurement and Dr. Rupesh Devan, Indian Institute of Technology, Indore for fruitful discussions. Financial Assistance from MP Council of Science and Technology, Bhopal is gratefully acknowledged.…

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CO_2-tolerant $Sr_2CoTaO_{6-\delta}$ double perovskite oxide as a novel cathode for intermediate-temperature solid oxide fuel cell

Mater. Res. Bull. (2022)

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A-site deficient Fe-based double perovskite oxides $Pr_xBaFe_2O_{5+\delta}$ as cathodes for solid oxide fuel cells

J. Alloy. Compd. (2022)

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A-site Ca-doped layered double perovskite $Pr_{1-x}Ca_xBa_{0.94}Co_2O_{5+\delta}$ as high-performance and stable cathode for intermediate-temperature solid oxide fuel cells
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Ceram. Int. (2017)

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Recommended articles (6)

Research article

Defect assisted magneto-tunable photoresponse in ZnO-rGO/$La_{0.7}Sr_{0.3}MnO_3$/ITO heterojunctions

Materials Science and Engineering: B, Volume 290, 2023, Article 116353

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Research article

Improvement of mechanical properties and elastocaloric effect in Ag doped Ni-Mn-In magnetic shape memory alloys

Journal of Alloys and Compounds, Volume 944, 2023, Article 169143

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Research article

Strain induced structural changes and magnetic ordering in thin MoS_2 flakes as a consequence of 1.5 MeV proton ion irradiation

Journal of Alloys and Compounds, Volume 951, 2023, Article 169882

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Research article

Fragmented ferromagnetic-phase and evolution of Re-entrant cluster-glass behavior in $La_{0.6}Sr_{0.4}Co_{1-x}Al_xO_3$ $(0 \leq x \leq 0.15)$ compounds

Ceramics International, Volume 49, Issue 3, 2023, pp. 5217-5227

Show abstract

Research article

Magnetic critical behavior and room temperature magnetocaloric effect in $Ba_{1.9}Pr_{0.1}FeMoO_6$ double perovskite compound

Materials Research Bulletin, Volume 161, 2023, Article 112151

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Research article

Third order nonlinear optical properties and electrochemical performance of La_2CoMnO_6 double perovskite

Materials Science and Engineering: B, Volume 289, 2023, Article 116262

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4C

Activity Title:

An invited lecture was delivered by Dr. Vasant V Sathe, Center Director, UGC-DAE CSR, Indore, in a Virtual workshop on Instrumental techniques.

4D

Activity Title:

Educational visit of participants of the virtual workshop at UGCDAE CSR, Indore, under the MoU between both institutes-2022

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Date:- 07/05/22

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AND

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Dr. Vasant G. Sathe, Centre-Director
UGC-DAE Consortium for Scientific Research, Indore (M.P.)

UGC-DAE Consortium for Scientific Research
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(Formerly : Inter University Consortium for DAE Facilities, IUC-DAEF)
Indore Centre
इन्दौर केन्द्र

Dr. Vasant Sathe
Centre-Director

डॉ. वसंत साठे
केन्द्र निदेशक

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BETWEEN

Government Holkar (Model Autonomous) Science College Indore (M.P.) INDIA

AND

UGC-DAE Centre for Scientific Research, Indore (M.P.) INDIA

In the spirit of mutual understanding, Government Holkar (Model Autonomous) Science College, Indore (M.P.), India and UGC-DAE Centre for Scientific Research, Indore (M.P.), India, agree to examine the possibility of establishing a framework for educational and research cooperation for students, faculty and staff of Government Holkar (Model Autonomous) Science College, Indore.

The Memorandum of Understanding (MOU) establishes the following:

OBJECTIVE OF THE AGREEMENT

1. To support academic and scientific cooperation. Faculties of consortium will provide suggestions on academic curriculum and establishing research facilities.
2. Areas of cooperation include: internship/summer projects/projects for selected students, use of research facilities on the basis of merit, framing of collaborative research projects, providing library facilities on the basis of need. Guest/invited lectures by faculties.
3. To conduct workshop/science popularization programs on a mutually agreed area of scientific interest by both the institutes. A discussion will require prior commencement of this activity.

IMPLEMENTATION OF THE MEMORANDUM OFUNDERSTANDING:

The Department of Physics will be implementing nodal department from Government Holkar (Model Autonomous) Science College, Indore side. A faculty/staff will be assigned by Centre Director from Consortium side.

EFFECTIVE DATE AND DURATION OF THE MOU:

This MoU shall be effective upon signature by the two institute and shall remain in force for a period of five (5) years. Thereafter it shall be automatically renewed for another 5 years unless it is terminated.

This MOU is signed by

Dr. G. D. Gupta, Head of Department

Dr. Suresh T. Shrawat, Principal
Govt. Holkar (Model Autonomous) Science College, Indore, (M.P.)

Dr. Vasant G. Sathe, Centre-Director
UGC-DAE Consortium for Scientific Research, Indore (M.P.)

Date: 07/05/22

विश्वविद्यालय परिसर, खण्डवा रोड, इन्दौर-452 001 (म.प्र.)
University Campus, Khandwa Road, INDORE - 452 001 (M.P.) INDIA
Phone : +91-731-2472200, 2908150 - Direct, PBX- 2463913,2762267, 2472201 Exnt 192, 311
Fax : +91-731- 2465437 ; email : vasant@csr.res.in; cd.indore@csr.res.in
www.csr.res.in

GOVT. HOLKAR (MODEL. AUTONOMOUS) SCIENCE COLLEGE, INDORE (M.P.), 452017

Department of Forensic Science

Date: 29/09/2022

To,

Dr. Vasant Sathe
Central Director, Indore
UGC-DAE Consortium for Scientific Research

Subject: Invitation Letter for Resource Person in National Virtual Workshop on "Instrumentation".

Respected Sir,

We are pleased to inform you that you are cordially invited as a **"Resource Person"** for the **National Virtual Workshop on "Instrumental Techniques: A Virtual Reflection of the Multi-professional nature of Forensics"** organized by Department of Forensic Science, Govt. Holkar (Model, Autonomous) Science College, Indore (M. P.)

We would be delighted with your presence in the Virtual Workshop.

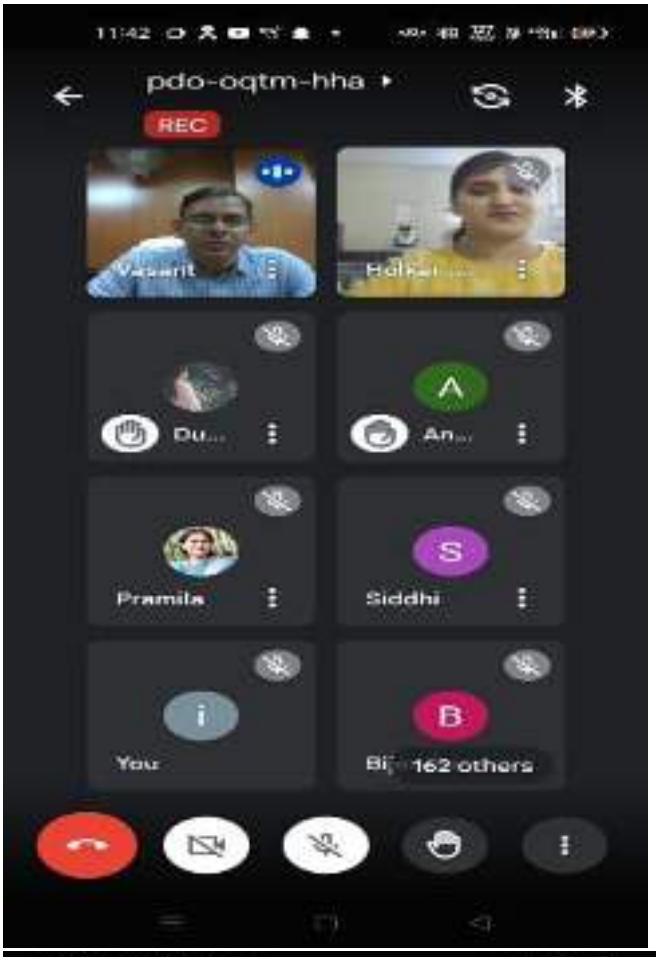
Instrument Name	Date	Time
Raman Spectrophotometer	01/10/22	11:00 AM

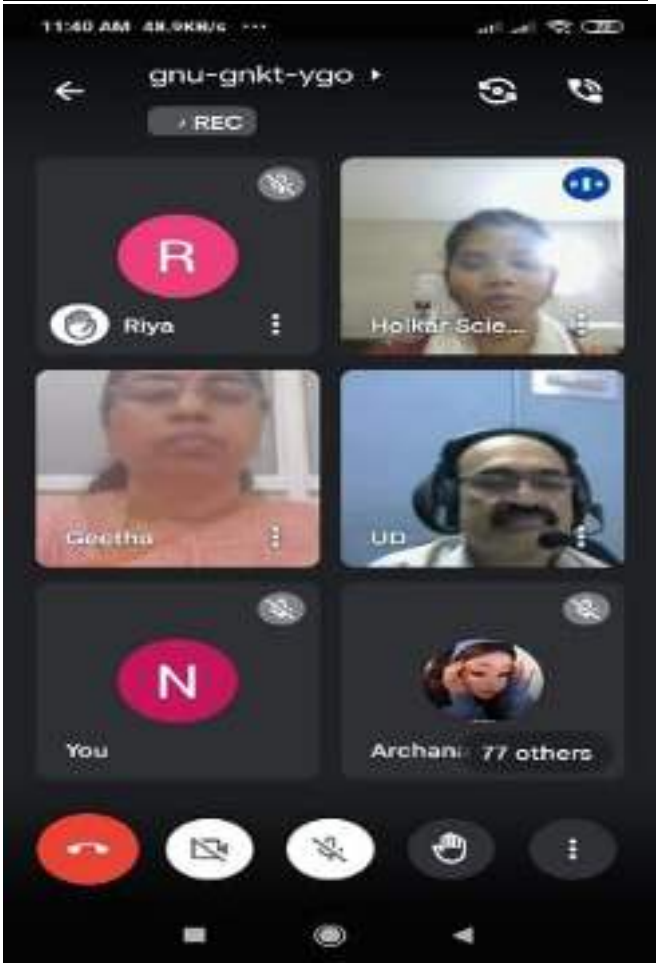
Thanking You!

29/9/22

Dr. Geetha Sarasan
HOD
Department of Forensic Science
Govt. Holkar (Autonomous, Model) Science College, Indore
(M.P.), 452017







An invited lecture was delivered by Dr. Vasant V Sathe, Center Director, UGC-DAE CSR, Indore, in a Virtual workshop on Instrumental techniques.

Educational visit of participants of the virtual workshop at UGC-DAE CSR, Indore, under the MoU between both institutes-2022

GOVERNMENT HOLKAR (MODEL, AUTONOMOUS) SCIENCE COLLEGE INDORE (M.P.), INDIA
Department of Forensic Science
(NAAC Accredited "A" Grade College)
(Request Letter)

Date: - 02/10/2022

To,

The Central Director,
UGC-DAE Consortium for Scientific Research,
Indore (M.P.)

Subject: Request for the Visit of Participants of Virtual Workshop to UGC-DAE Consortium for Scientific Research, Indore

Respected Sir,

This is to state that the participants of Virtual Workshop on Instrumental techniques organizing by Department of Forensic Science, Govt. Holkar (Model, Autonomous) Science College, Indore (M.P.) from 3/10/22 to 10/10/22 want to visit your Centre for attending the **Offline Demonstration of Various Instruments** available in your Centre. So, I Request you to kindly grant the permission for the proposed visit on 10th October 2022.

Thanking You!

Dr. Geetha Sarasan
HOD
Department of Forensic Science
Govt. Holkar Science College, Indore (M. P.)





4E

Activity Title:

Research activity and joint publication with Dr. G. S. Okram, UGC-DAE CSR, Indore, as Principal Collaborator from the CSR side - 2022

UGC-DAE Consortium for Scientific Research

(Formerly: Inter University Consortium for DAE Facilities; IUC-DAEF)
(An Autonomous institution under University Grants Commission, New Delhi)
University Campus, Khandwa Road, Indore-452001, MP, India
Phone (+91)0731-2463913/2762267/2463913 Fax: 0731-2462294/2465437

Dr. Gunadhor S. Okram
Scientist G/ Engineer G
Website http://www.csr.ernet.in/csr/indore/facilities/ltl/profile.html
Email: okramgs@gmail.com, okram@csr.ernet.in

28 July 2022

Collaboration certificate

This is to certify that Dr. Netram Kaurav of Government Holkar (Model, Autonomous) Science College (GHSC), A. B. Road, Indore is a Principal Investigator for the three-year Collaborative Research Scheme project (but extended for another year due to COVID19 lockdown) entitled "*Synthesis and characterization of monodisperse nickel nanoparticles-assisted carbon membranes and their application in gas separation*" of this institute with sanction order No. CSR-IC-MSRSR-02/CRS-210/2017-18/1291, dated 31st March, 2018 under my collaboration with him as the Principal Collaborator of CSR Indore-Centre. This is being issued for the **year 2021-2022** as per the requirements of GHSC of a collaboration certificate.



G. S. Okram

UGC-DAE Consortium for Scientific Research
(Formerly: Inter University Consortium for DAE Facilities, IUC-DAEF(An Autonomous institution under University Grants Commission, New Delhi)(**A Society Registered Under M.P. Society RegistrikaranAdhiniyam, 1973)***Registered Office and Head Office : UGC-DAE Consortium*, University Campus, Khandwa Road, Indore-452 017,Phone 0731-2463913/2762267/2463913 Fax: 0731-2462594/2465437

Ref: CSR-CSR-IC/MSRSR-02/CRS-210/2021-22/ 629 **Date :16/12/2021**

To,
Dr. NetramKaurav,
Assistant Professor,
Holkar Science College,
Indore.

Sub :- Your proposal entitled "Synthesis characterization of monodisperse nickel nanoparticles assisted carbon membranes and their application in gas sepration".

Dear Dr.Kaurav,

We are happy to inform you that your CRS proposal has been renewed for one more year for the period 1st April, 2021 to 31st March, 2022, subject to compliance of other procedures.

The financial allocation for this year will be:

Project Fellow (@31000/-pm+HRA	Rs.3,72,000/- + HRA	
Contingency		Rs. 15,000/-
Consumables		Rs. 30,000/-

1. Dr. G S Okram will coordinate the activities of the project from CSR side.
2. The CSR will reimburse the travel expenses to investigators as well as student under the project as per CSR guidelines for visiting CSR, Indore Centre on project work.
3. The PI and the Co-ordinator from CSR side are requested to make every effort to complete the project in time that may enable the research scholar working in the project to complete his/her Ph.D. degree within this year. As the project is already on extension, further extension may not be possible.
4. This is a Collaborative Research Scheme. In view of the complex and involved nature of the experiments, any publication emerging under the project must be of collaborative in nature with due consents from the participating institutions / persons, and in consultation with the CRS coordinator. The publication should also acknowledge the UGC-DAE CSR, Indore for the project support.
5. Money for the year 2021-22 will be transferred to the Registrar of your University under intimation to you by our Accounts Section after adjusting the unspent balance of the grant released earlier, if any upto financial year ending on 31.3.2021, upon receiving the following: (a) Statement of Account for the period upto31.3.2021 signed by the Registrar and (b) Certificate of Utilization of money spent till 31.3.2021, signed by the Registrar.
6. UC/SE in the prescribed format for Financial Year 2021-22 has to be submitted by 30th April 2022.

Thanking you.

Yours sincerely,

(Dr. Vasant Sathe)
Centre-Director

Copy to the following for information and necessary action:-

2. The Administrative Officer-I (Account), UGC-DAE CSR, Indore Centre
3. The Principal, Holkar Science College, Indore.
4. The Centre-Director, CSR Indore Centre for project file.

UGC-DAE Consortium for Scientific Research
(UGC-DAE CSR)

(Formerly Inter University Consortium for DAE Facilities, IUC-DAEF)
(An Autonomous institution under University Grants Commission, New Delhi)
(A Society Registered Under M.P. Society Registrikaran Adhiniyam, 1973)
Registered Office and Head Office : UGC-DAE Consortium, University Campus, Khandwa Road,
Indore-452 017
Phone 0731-2463913/2462287 Fax 0731-2462294/2465437

No. CSR-Accts/2021-22/

Date 24.12.2021

To,

Speed Post / Courier / By Hand

The Principal
Holkar Science College,
A.B Road,
Indore

Sub : Collaborative research titled "Synthesis characterization of monodisperse nickel nanoparticles assisted carbon membranes and their applications in gas separation" Sanctioned to Dr. Netram Kaurav, Department of Physics, Holkar Science College, A.B Road, Indore.

Ref : Our sanctioned letter No. CSR-IC-210/2021-22/629 dated 16.12.2021.

Sir/Madam,

An amount of Rs. 482100/- has been deposited on 22.12.2021 in your account towards grant sanctioned for the year 2021-22 to CSR Project mentioned above. Details of sanction as follows:

S.No.	Particulars		Amount (Rs.)
01	Project Fellow @ Rs.31000x12 + HRA		437100.00
02	Contingency		15000.00
03	Consumables		
04	Unspent Money	(-)	30000.00
	Total Amount Deposited		**482100.00**

Money has been transfetred in State Bank of India S/B Account No. 53015687345 through PFMS Portal vide **Trn.ID No. 12234285968 on 22.12.2021.**

The next instalment of money, if any sanctioned, will be released only on production of a statement of account and a utilization certificate from your Institution/University.

Please acknowledge receipt of this letter and send us a stamped receipt by return of post.

Yours sincerely,

Administrative Officer-I (Accts.)

Encl: As above

Copy to : (1) Dr. Netram Kaurav, Department of Physics, Holkar Science College, A.B Road, Indore.
(2) The Center Director UGC-DAE CSR Indore

PROGRESS REPORT

Project Title: Synthesis and characterization of monodisperse nickel nanoparticles assisted carbon membranes and their application in gas separation

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal		
						Link to website of the Journal	Link to article/paper /abstract of the article	Is it listed in UGC Care list
Gas permeation properties of nickel nanoparticle-embedded PPO/PVP polymers based carbon membrane	Disha Harinkhere,Netram Kaurav	Physics	Materials Today: Proceedings	2022	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2022.07.195	Scopus Indexed
Structural and optical properties of PPO/PVP blended polymer film	Disha Harinkhere, Nikita Karma, K.K. Choudhary, Netram Kaurav	Physics	Materials Today: Proceedings	2021	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2021.10.206	Scopus Indexed
Preparation and Characterization of Membranes Supports for Filteration Application	Disha Harinkhere, Netram Kaurav	Physics	Materials Today: Proceedings	2021	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2021.10.508	Scopus Indexed
Temperature-dependent transport properties of a FeTe compound	Pavitra Devi Lodhi, Netram Kaurav, K K Choudhary, Y K Kuo	Physics	Bulletin of Materials Science (Springer)	2019	0973-7669	https://www.springer.com/journal/12034	https://doi.org/10.1007/s12034-019-1953-7	Scopus Indexed
High pressure structural phase transition and elastic properties of ZnSexTe1-x semiconducting compounds	Saligram Verma, Arvind Jain, K. K. Choudhary and Netram Kaurav	Physics	International Journal of Modern Physics B	2019	0217-9792	https://www.worldscientific.com/worldscinet/ijmpb	https://doi.org/10.1142/S0217979219502503	Scopus Indexed
Measurement and Analysis of Normal-State Transport Properties of FeSe Superconductor	Pavitra Devi Lodhi, Netram Kaurav, K. K. Choudhary, Y. K. Kuo	Physics	Journal of Low Temperature Physics (Springer)	2019	1573-7357	https://www.springer.com/journal/10909	https://doi.org/10.1007/s10909-019-02198-3	Scopus Indexed
Synthesis and characterization of ZnO nanoparticles by thermal decomposition method	Rathore R.; Harinkhere D.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098752	Scopus Indexed
Effect of sintering temperature on the dielectric properties of non-stoichiometric nickel oxide	Dubey P.; Choudhary K.K.; Singh K.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098725	Scopus Indexed
Structural and Raman analysis of double perovskite La2CoTi0.7Ni0.3O6	Solanki N.; Lodhi P.D.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098715	Scopus Indexed

4F

Activity Title:

Research activity and joint publication with Dr. G. S. Okram, UGC-DAE CSR, Indore, as Principal Collaborator from the CSR side - 2021

UGC-DAE Consortium for Scientific Research

(Formerly: Inter University Consortium for DAE Facilities; IUC-DAEF)
(An Autonomous institution under University Grants Commission, New Delhi)
University Campus, Khandwa Road, Indore-452001, MP, India
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Dr. Gunadhor S. Okram
Scientist G/ Engineer G
Website http://www.csr.ernet.in/csr/indore/facilities/ltl/profile.html
Email: okramgs@gmail.com, okram@csr.ernet.in

16 July 2021

Collaboration certificate

This is to certify that Dr. Netram Kaurav of Government Holkar (Model, Autonomous) Science College (GHSC), A. B. Road, Indore is a Principal Investigator for the three-year Collaborative Research Scheme project (but extended for another year due to COVID19 lockdown) entitled "*Synthesis and characterization of monodisperse nickel nanoparticles-assisted carbon membranes and their application in gas separation*" of this institute with sanction order No. CSR-IC-MSRSR-02/CRS-210/2017-18/1291, dated 31st March, 2018 under my collaboration with him as the Principal Collaborator of CSR Indore-Centre. This is being issued for the **year 2020-2021** as per the requirements of GHSC of a collaboration certificate.



G. S. Okram

UGC-DAE Consortium for Scientific Research
(Formerly: Inter University Consortium for DAE Facilities; IUC-DAEF
An Autonomous Institution under University Grants Commission, New Delhi)
(A Society Registered under M.P. Society Registrikaran Adhiniyam, 1973)
Registered Office and Head Office: *UGC-DAE Consortium, University Campus, Khandwa Road, Indore – 452 001.*
Phone 0731-2463913/2762267 Fax: 0731-2462294/2465437

No. CSR/Acctts/2020-21/ 339

October 23, 2020

The Registrar/Principal,
Holkar Science College,
Indore.

Sub:- Your CRS entitled "Synthesis and characterization.....in gas separation".
Ref:- Our Sanction Letter No: CSR-IC-MSRSR-02/CRS-210/2020-21/288, dated October 13, 2020.

Dear Sir,

An amount of Rs. 2,38,260 has been deposited on 23.10.2020 in your CRS Account No.53015687345 towards grants sanctioned for year 2020-21 (April, 2020 to September, 2020) to CRS project mentioned above. Details of sanction as follows:

S.No.	Particulars	Amount (Rs.)
1	Project Associate-1 @ (Rs.31,000x6) +16% HRA	2,15,760
2	Contingency	7,500
3	Consumables	15,000
	TOTAL	2,38,260
	Less: Unspent balance	nil
	Balance deposited Amount	2,38,260

Money has been transferred through PFMS Portal vide **Trn.ID. C102023792091** on **23-10-2020**.

The remaining six months funds (i.e., from October 2020 to March, 2021) will be released as soon as the funds from UGC, New Delhi received.

The conditions for the award of the grant in aid have been set out in our earlier letter cited above.

Please acknowledge the receipt of this letter and send us a stamped receipt by return of post.

Yours sincerely,

Upadhyay

Administrative Officer-I (Accounts)

Copy to the following for information and necessary action:-
1. Dr. Netram Kaurav, Holkar Science College, Indore.
2. Centre-Director, CSR, Indore Centre.

UGC-DAE Consortium for Scientific Research
(Formerly: Inter University Consortium for DAE Facilities, IUC-DAEF
An Autonomous Institution under University Grants Commission, New Delhi)
(A Society Registered under M.P. Society Registrikaran Adhiniyam, 1973)
Registered Office and Head Office: *UGC-DAE Consortium, University Campus, Khandwa Road, Indore – 452 001.*
Phone 0731-2463913/2762267 Fax: 0731-2462294/2465437

No. CSR/Acctts/2020-21/832 11 March 2021

The Registrar/Principal,
Holkar Science College,
Indore .

Sub:- Your CRS entitled "Synthesis and characterization.....in gas separation".
Ref:- Our Sanction Letter No. CSR-IC-MSRSR-02/CRS-210/2020-21/288, dated October 13, 2020.

Dear Sir,

An amount of Rs. 2,38,260 has been deposited on 09-03-2021 in your CRS Account No.53015687345 towards grants sanctioned for year 2020-21 (October 2020 to March, 2021) to CRS project mentioned above. Details of sanction as follows:

S.No.	Particulars	Amount (Rs.)
1	Project Associate-1 @ (Rs.31,000x6) +16% HRA	2,15,760
2	Contingency	7,500
3	Consumables	15,000
	TOTAL	2,38,260

Money has been transferred through PFMS Portal vide **Trn.ID. C032121269858** on **09-03-2021**.

The conditions for the award of the grant in aid have been set out in our earlier letter cited above.

Please acknowledge the receipt of this letter and send us a stamped receipt by return of post.

Yours sincerely,

Upadhyaya
Administrative Officer-I (Accounts)

Copy to the following for information and necessary action:-
1. Dr. Netram Kaurav, Holkar Science College, Indore.
2. Centre-Director, CSR,Indore Centre.

Dr. D.M. Phase
Centre-Director (Offc.),
CSR, Indore Centre.

UGC-DAE Consortium for Scientific Research
(Formerly: Inter University Consortium for DAE Facilities; IUC-DAEF
An Autonomous Institution under University Grants Commission, New Delhi)
(A Society Registered under M.P. Society RegistrikaranAdhiniyam, 1973)
Registered Office and Head Office: *UGC-DAE Consortium, University Campus, Khandwa Road, Indore – 452 001.*
Phone 0731-2463913/2762267 Fax: 0731-2462294/2465437

Ref: CSR-IC-MSRSR-02/CRS-210/2020-2021/288 October 13, 2020

3 years

Dr. NetramKaurav
Holkar Science College,
Indore,

Sub:- Your proposal entitled "Synthesis and characterization of monodisperse nickel nanoparticles assisted carbon membranes and their application in gas separation".

Dear Dr. NetramKaurav,

We are happy to inform you that your CRS proposal has been renewed for one more year for the period 1st April, 2020 to 31st March, 2021, subject to compliance of other procedures:

Project Associate 1 (@ Rs.31,000/- pm) + HRA	Rs. 3,72,000/- + HRA
Contingency	Rs.15,000/-
Consumables	Rs.30,000/-

1. Dr. G.S. Okram will coordinate the activities of the project from CSR side.
2. **The funds for six months will be released at present, the remaining funds will be released as soon as the grants from UGC, New Delhi have been received.**
3. The Project will be reviewed at the end of each year and a decision will be taken on the financial allocation for the succeeding year.
4. The CSR will be able to reimburse the travel expenses to investigators as well as student under the project as per CSR guidelines for visiting CSR, Indore Centre on project work.
5. The PI and the co-ordinator from CSR side are requested to make every effort to complete the project in time that may enable the research scholar working in the project to complete his/her Ph.D. degree well within the stipulated time limit.
6. This is a Collaborative Research Scheme. In view of the complex and involved nature of the experiments, any publication emerging under the project must be of collaborative in nature with due consents from the participating institutions / persons, and in consultation with the CRS coordinator. The publication should also acknowledge the UGC-DAE CSR, Indore for the project support.
7. Money for the year 2020-21 will be transferred to the Registrar of your University under intimation to you by our Accounts Section after adjusting the unspent balance of the grant released earlier, if any, upto financial year ending on 31.3.2020, upon receiving the following: (a) Statement of Account for the period upto 31.3.2020 signed by the Registrar and (b) Certificate of Utilisation of money spent till 31.3.2020, signed by the Registrar.

Yours sincerely,

(Dr. D.M. Phase)

Copy to the following for information and necessary action:-
1. The Administrative Officer-I (Accounts), UGC-DAE CSR, Indore Centre.
2. The Principal, Holkar Science College, Indore.
3. The PS to Centre-Director, CSR, Indore Centre for project file.

PROGRESS REPORT

Project Title: Synthesis and characterization of monodisperse nickel nanoparticles assisted carbon membranes and their application in gas separation

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal		
						Link to website of the Journal	Link to article/paper /abstract of the article	Is it listed in UGC Care list
Gas permeation properties of nickel nanoparticle-embedded PPO/PVP polymers based carbon membrane	Disha Harinkhere,Netram Kaurav	Physics	Materials Today: Proceedings	2022	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2022.07.195	Scopus Indexed
Structural and optical properties of PPO/PVP blended polymer film	Disha Harinkhere, Nikita Karma, K.K. Choudhary, Netram Kaurav	Physics	Materials Today: Proceedings	2021	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2021.10.206	Scopus Indexed
Preparation and Characterization of Membranes Supports for Filteration Application	Disha Harinkhere, Netram Kaurav	Physics	Materials Today: Proceedings	2021	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2021.10.508	Scopus Indexed
Temperature-dependent transport properties of a FeTe compound	Pavitra Devi Lodhi, Netram Kaurav, K K Choudhary, Y K Kuo	Physics	Bulletin of Materials Science (Springer)	2019	0973-7669	https://www.springer.com/journal/12034	https://doi.org/10.1007/s12034-019-1953-7	Scopus Indexed
High pressure structural phase transition and elastic properties of ZnSexTe1-x semiconducting compounds	Saligram Verma, Arvind Jain, K. K. Choudhary and Netram Kaurav	Physics	International Journal of Modern Physics B	2019	0217-9792	https://www.worldscientific.com/worldscinet/ijmpb	https://doi.org/10.1142/S0217979219502503	Scopus Indexed
Measurement and Analysis of Normal-State Transport Properties of FeSe Superconductor	Pavitra Devi Lodhi, Netram Kaurav, K. K. Choudhary, Y. K. Kuo	Physics	Journal of Low Temperature Physics (Springer)	2019	1573-7357	https://www.springer.com/journal/10909	https://doi.org/10.1007/s10909-019-02198-3	Scopus Indexed
Synthesis and characterization of ZnO nanoparticles by thermal decomposition method	Rathore R.; Harinkhere D.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098752	Scopus Indexed
Effect of sintering temperature on the dielectric properties of non-stoichiometric nickel oxide	Dubey P.; Choudhary K.K.; Singh K.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098725	Scopus Indexed
Structural and Raman analysis of double perovskite La2CoTi0.7Ni0.3O6	Solanki N.; Lodhi P.D.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098715	Scopus Indexed

4G

Activity Title:

Research activity and a joint publication with Dr. G. S. Okram, UGC-DAE CSR, Indore, as Principal Collaborator from the CSR side - 2020

UGC-DAE Consortium for Scientific Research

(Formerly: Inter University Consortium for DAE Facilities; IUC-DAEF)
(An Autonomous institution under University Grants Commission, New Delhi)
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Dr. Gunadhor S. Okram
Scientist G/ Engineer G
Website http://www.csr.ernet.in/csr/indore/facilities/ltl/profile.html
Email: okramgs@gmail.com, okram@csr.ernet.in

16 July 2020

Collaboration certificate

This is to certify that Dr. Netram Kaurav of Government Holkar (Model, Autonomous) Science College (GHSC), A. B. Road, Indore is a Principal Investigator for the three-year Collaborative Research Scheme project (but extended for another year due to COVID19 lockdown) entitled "*Synthesis and characterization of monodisperse nickel nanoparticles-assisted carbon membranes and their application in gas separation*" of this institute with sanction order No. CSR-IC-MSRSR-02/CRS-210/2017-18/1291, dated 31st March, 2018 under my collaboration with him as the Principal Collaborator of CSR Indore-Centre. This is being issued for the **year 2019-2020** as per the requirements of GHSC of a collaboration certificate.



G. S. Okram

UGC-DAE Consortium for Scientific Research
*(Formerly: Inter University Consortium for DAE Facilities; IUC-DAEF)*An Autonomous Institution under University Grants Commission, New Delhi)**(A Society Registered Under M.P. Society RegistrikaranAdhiniyam, 1973)***Registered Office and Head Office : UGC-DAE Consortium,* University Campus, Khandwa Road, Indore-452 017.Phone 0731 2463913/2762267/2463913 Fax 0731-2462294/2465437

No. CSR/Acctts/2019-20/1022 **09 Jan 2020**

Speed Post

To
The Principal,
Holkar Science College,
Indore – 452001.

Sub. : Collaborative research titled "**Synthesis and characterization....their application in gas separation**" sanctioned to Dr. Netram Kaurav, Holkar Science College, Indore – 452001.

Ref: Our letter No. **CSR-IC-MSRSR-02/CRS-210/2019-20/** dated **24 May 2019**

Dear Sir,

An amount of **Rs. 4,53,999/-** has been deposited on **08-01-2020** in your Account No. **53015687345** in State Bank of India towards grants sanctioned for year 2019-20 to CRS project mentioned above. Detail of sanction is as follows:

S. No.	Particulars	Amount (Rs.)
1.	Project Fellow @ Rs.14000/-pm + 16% HRA	1,94,880.00
2.	Contingency	15,000.00
3.	Consumables	30,000.00
	Total	2,39,880.00
	Less: Unspent Balance (-)	81,681.00
	Total	1,58,199.00
	Fellowship Arrears (31000-14000)*15+16% (1-1-2019 to 31-3-2020)	2,95,800.00
	Balance Deposited Amount	**4,53,999.00**

Money has been transferred through PFMS Portal vide **Trn. ID. C012009186564** on 08-01-2020.

The next instalment of money, if any sanctioned, will be released only on production of a statement of account and a utilization certificate from your institution.

The conditions for the award of the grant in aid have been set out in our earlier letter cited above.

Please acknowledge receipt of this letter and send us a stamped receipt by return of post.

Yours sincerely,

Administrative Officer-I (Accounts)

Encl. as above.

Copy to : 1. Dr. Netram Kaurav, Holkar Science College, Indore – 452001.
2. Centre-Director, UGC-DAE CSR, Indore Centre

UGC-DAE Consortium for Scientific Research

विश्वविद्यालय अनुदान आयोग – परमाणु ऊर्जा विभाग वैज्ञानिक अनुसंधान संकुल

(An autonomous institution of UGC, New Delhi)

(विश्वविद्यालय अनुदान आयोग, नई दिल्ली द्वारा स्थापित स्वशासी संस्थान)

(Formerly : Inter University Consortium for DAE Facilities; IUC-DAEF)

Indore Centre
केन्द्र-निदेशक

Dr. V. Ganesan
Centre-Director

Ref: CSR-IC-MSRSR-02/CRS-210/2019-20/ May 24, 2019

Dr. Netram Kaurav
Holkar Science College, Indore.

Sub:- Your proposal entitled "Synthesis and characterization of monodisperse nickel nanoparticles assisted carbon membranes and their application in gas separation".

Dear Dr. Netram Kaurav,

We are happy to inform you that your CRS proposal has been renewed for one more year for the period 1st April, 2019 to 31st March, 2020, subject to compliance of other procedures:

The financial allocation for this year will be:

Project Fellow (@ Rs.14,000/- pm) + HRA	Rs. 1,68,000/- + HRA
Contingency	Rs.15,000/-
Consumables	Rs.30,000/-

1. Dr. G.S. Okram will coordinate the activities of the project from CSR side.
2. The Project will be reviewed at the end of each year and a decision will be taken on the financial allocation for the succeeding year.
3. The CSR will be able to reimburse the travel expenses to investigators as well as student under the project as per CSR guidelines for visiting CSR, Indore Centre on project work.
4. After 2 years as Project Fellow, if the research work is found satisfactory on assessment by a Committee with atleast one research paper in a reputed journal, the Project Fellow may be upgraded to Project Fellow-II with the fellowship of Rs.16,000/- pm + HRA.
5. The PI and the co-ordinator from CSR side are requested to make every effort to complete the project in time that may enable the research scholar working in the project to complete his/her Ph.D. degree well within the stipulated time limit.
6. This is a Collaborative Research Scheme. In view of the complex and involved nature of the experiments, any publication emerging under the project must be of collaborative in nature with due consents from the participating institutions / persons, and in consultation with the CRS coordinator. The publication should also acknowledge the UGC-DAE CSR, Indore for the project support.
7. Money for the year 2019-20 will be transferred to the Registrar of your University under intimation to you by our Accounts Section after adjusting the unspent balance of the grant released earlier, if any, upto financial year ending on 31.3.2019, upon receiving the following: (a) Statement of Account for the period upto 31.3.2019 signed by the Registrar and (b) Certificate of Utilisation of money spent till 31.3.2019, signed by the Registrar.
8. **It may be noted that the funds will be released after receiving grants from UGC.**

Yours sincerely,

V. Ganesan

(V. Ganesan)

Copy to the following for information and necessary action:-

1. The Administrative Officer-I (Accounts), UGC-DAE CSR, Indore Centre.
2. The Principal, Holkar Science College, Indore.
3. The PS to Centre-Director, CSR, Indore Centre for project file.

विश्वविद्यालय परिसर, खण्डवा रोड, इन्दौर-452 001 (म.प्र.)
University Campus, Khandwa Road, INDORE - 452 001 (M.P.) INDIA
Phone : +91-731-2472200, 2908150 - Direct, PBX- 2463913,2762267, 2472201 Exnt 192 311
Fax : +91-731- 2465437 , e-mail vganesan@csr.res.in; cd.indore@csr.res.in
www.csr.res.in

PROGRESS REPORT

Project Title: Synthesis and characterization of monodisperse nickel nanoparticles assisted carbon membranes and their application in gas separation

Title of paper	Name of the author/s	Department of the teacher	Name of journal	Year of publication	ISSN number	Link to the recognition in UGC enlistment of the Journal		
						Link to website of the Journal	Link to article/paper /abstract of the article	Is it listed in UGC Care list
Gas permeation properties of nickel nanoparticle-embedded PPO/PVP polymers based carbon membrane	Disha Harinkhere,Netram Kaurav	Physics	Materials Today: Proceedings	2022	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2022.07.195	Scopus Indexed
Structural and optical properties of PPO/PVP blended polymer film	Disha Harinkhere, Nikita Karma, K.K. Choudhary, Netram Kaurav	Physics	Materials Today: Proceedings	2021	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2021.10.206	Scopus Indexed
Preparation and Characterization of Membranes Supports for Filteration Application	Disha Harinkhere, Netram Kaurav	Physics	Materials Today: Proceedings	2021	2214-7853	https://www.sciencedirect.com/journal/materials-today-proceedings	https://doi.org/10.1016/j.matpr.2021.10.508	Scopus Indexed
Temperature-dependent transport properties of a FeTe compound	Pavitra Devi Lodhi, Netram Kaurav, K K Choudhary, Y K Kuo	Physics	Bulletin of Materials Science (Springer)	2019	0973-7669	https://www.springer.com/journal/12034	https://doi.org/10.1007/s12034-019-1953-7	Scopus Indexed
High pressure structural phase transition and elastic properties of ZnSexTe1-x semiconducting compounds	Saligram Verma, Arvind Jain, K. K. Choudhary and Netram Kaurav	Physics	International Journal of Modern Physics B	2019	0217-9792	https://www.worldscientific.com/worldscinet/ijmpb	https://doi.org/10.1142/S0217979219502503	Scopus Indexed
Measurement and Analysis of Normal-State Transport Properties of FeSe Superconductor	Pavitra Devi Lodhi, Netram Kaurav, K. K. Choudhary, Y. K. Kuo	Physics	Journal of Low Temperature Physics (Springer)	2019	1573-7357	https://www.springer.com/journal/10909	https://doi.org/10.1007/s10909-019-02198-3	Scopus Indexed
Synthesis and characterization of ZnO nanoparticles by thermal decomposition method	Rathore R.; Harinkhere D.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098752	Scopus Indexed
Effect of sintering temperature on the dielectric properties of non-stoichiometric nickel oxide	Dubey P.; Choudhary K.K.; Singh K.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098725	Scopus Indexed
Structural and Raman analysis of double perovskite La2CoTi0.7Ni0.3O6	Solanki N.; Lodhi P.D.; Kaurav N.	Physics	AIP Conference Proceedings	2019	0094-243X	https://pubs.aip.org/aip/acp	https://doi.org/10.1063/1.5098715	Scopus Indexed

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

IIT, Indore

तमसो मा ज्योतिर्गमय

5A

Activity Title:

Educational visit Indian Institute of Technology Indore

भारतीय प्रौद्योगिकी संस्थान इन्दौर
खण्डवा रोड, सिमरोल
इन्दौर ४५३ ५५२, भारत

Indian Institute of Technology Indore
Khandwa Road, Simrol
Indore 453 552, India

IIT Indore

CERTIFICATE OF COMPLETION

This is to certify that ~**89 students** of Master of Science (M.Sc.) from the Department of Physics, Government Holkar (Model Autonomous) Science College, Indore visited Indian Institute of Technology Indore, on **November 18, 2022.**

This academic visit was conducted under a *Collaborative and Outreach Programme* for the students. The visit was coordinated by Dr. Rupesh S. Devan, Department of Metallurgical Engineering and Materials Science, IIT Indore, and Dr. Netram Kaurav and Dr. V.V.S. Murthy from Holkar Science College, Indore.

With best regards,

Rupesh

Dr. Rupesh S. Devan
Associate Professor
Discipline of Metallurgy Engineering
& Materials Science
Indian Institute of Technology Indore
Simrol, Indore 453552, India

Dr. Rupesh S. Devan,
Associate Professor,
Department of Metallurgical Engineering and Materials Science,
Indian Institute of Technology Indore, Khandwa Road, Simrol, 453552, Indore.

18 Nov, 2022

EDUCATIONAL VISIT INDIAN INSTITUTE OF TECHNOLOGY, INDORE



start @8.30 AM Holkar Campus

All students are requested to gathered in campas at 8.30 AM

Trip will be Flag off by:
Dr. G. D. Gupta,
Vice Principal/HOD

Pay attention in tour

- **Bring notebook and Identity Card**
- **There will a batch of 15 students, Total batches =05**
- **Every batch has to prepare: a digital infographic of visit, a story of my batch in IIT Campus, note on opportunities in higher studies.**



10.15 AM



Presentation at Learning Resource Centre, IIT Campus

Virtual Tour of IIT, Campus
Lecture by IIT Faculty

11.00 AM TO 4.00 PM

Departments/Research Labs visit



1.30 PM

At Students Cafeteria, IIT Campus



Department of Physics, Govt. Holkar (Model Autonomous) Science College, Indore (MP)


भारतीय प्रौद्योगिकी संस्थान इंदौर
Indian Institute of Technology Indore


GPS Map Camera
Indore, Madhya Pradesh, India
85,vidhya nagar, behind holkar science college, Janki Nagar, Indore, Madhya Pradesh 452001, India
Lat 22.695448°
Long 75.870915°
18/11/22 09:09 AM GMT +05:30
Google

Department of Physics
Government Holkar (Model Autonomous) Science College, Indore (M.P.), India

IIT Indore Academic Visit on 18 Nov 2022.
Supplymentry list

Academic Visit to IIT Indore on 18 Nov 2022

S.No.	Name of the Students	Mobile No
79	Omika Pateliya	6232887096
80	Goutam Lodhi	7747881314
81	Ayushi Laboti	9039345153
82	Akshay Pratap Singh	9752260477
83	Barkha kushwah	6268535446
84	Anubhav Tiwari	9893586961
85	Amisha	7489162301
86	Mahima	9174752679
87	Swati Chouhan	8305274983
88	Kripanshu Nagle	7049704041
89	Ankit Tiwari	6263528781
90		
91		
92		
93		
94		
95		

Scanned with CamScanner

GOVT. HOLKAR (MODEL AUTONOMOUS) SCIENCE COLLEGE, INDORE

(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Soil and Soul foundation, Bangalore, Karnataka

तमसो मा ज्योतिर्गमय

6A

Activity Title:

Workshop on "Eco-friendly plant stress relievers in the present scenario" in association with the Soil and Soul Foundation, Bangalore, Karnataka

Office of the Principal
Govt. (Model Autonomous) Holkar Science College
Indore (M.P.)
: 0731-2464074(O), 2446806, 2764027 (Exam)
e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org
(Re-accredited 'A' Grade by NAAC)

MEMORANDUM OF UNDERSTANDING FOR ACADEMIC AND SCIENTIFIC COOPERATION

BETWEEN

SOIL AND SOUL FOUNDATION, BANGALORE, KARNATAKA
AND
GOVT. HOLKAR (MODEL, AUTONOMOUS) SCIENCE COLLEGE INDORE (M.P.)

The representatives of **Soil and Soul Foundation, Bangalore, Karnataka** and **Department Of Biochemistry, Govt. Holkar (Model, Autonomous) Science College Indore (M.P.)** agree to this Memorandum of Understanding.

The Memorandum of Understanding (MOU) establishes the following:

1. OBJECTIVE OF THE AGREEMENT

To establish a mutually beneficial relationship built on academic and scientific cooperation. Areas of cooperation between the **Soil and Soul Foundation, Bangalore, Karnataka** and **Department of Biochemistry, Govt. Holkar (Model, Autonomous) Science College Indore (M.P.)** include the exchange of researchers, students, publications, academic programs and research projects.

2. GOALS AND FORMS OF COOPERATION

The signing institutions agree to provide opportunity, as appropriate, for the following activities towards the completion of the objective of this MOU.

1. Exchange of students and/or researchers with the objective of offering courses and realizing research projects in areas mutually agreed upon by both institutes through prior invitation and in accordance with the procedures and expectations established by each institute and specific department.
2. Exchange of books, scientific publications, study programs, academic projects, course information, seminars, conferences and other data and information of common interest.
3. Develop joint research projects and joint publications.
4. All joint activities will be realized through the mutual agreement and clearly established conditions and mutual obligations of the appropriate institute entity.

HEAD
Department of Biochemistry
Holkar Science College, Indore

प्राचार्य
शा. होलकर विज्ञान महाविद्यालय
इन्दौर

Office of the Principal
Govt. (Model Autonomous) Holkar Science College
Indore (M.P.)
: 0731-2464074(O), 2446806, 2764027 (Exam)
e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org
(Re-accredited 'A' Grade by NAAC)

3. IMPLEMENTATIOION OF THE MEMORANDUM OF UNDERSTANDING

The objectives of the MOU will be implemented and regulated in the following manner:

i. Student Exchange
   a. Student and research scholars may visit the corresponding departments of these institutes after finalizing a mutually acceptable schedule.
   b. All the expenses shall be the direct responsibility of the student concerned (subject to any agreements on payment arrangements made by either institution with its own students). These expenses include.
      1. Travel expenses
      2. Reprographic and Internet Usage Expenses
      3. Required student services fees at the host institution
      4. Books and academic supplies
      5. Administrative fees, if any.

ii. Exchange of researchers

With the objective of strengthening ties through joint projects and research activities of both institutes, the MOU allows for the creation of researcher exchange. The following conditions will apply.

   a. The researchers will maintain their status as research scholars at their home institution for the duration of the exchange.
   b. The researchers will be allowed to make use of the instruments and other research facilities available in various departments of these institutes after prior approval of the visiting schedule.
   c. The appropriate departments and administrative offices will assist in securing housing and other necessary arrangements for living in the host institutions city.

iii. Research and resources

Soil and Soul Foundation, Bangalore, Karnataka and **Department of Biochemistry, Govt. Holkar (Model, Autonomous) Science College Indore(M.P.)** remote research and realize collaborative projects, giving priority to interdisciplinary works.

HEAD
Department of Biochemistry
Holkar Science College, Indore

प्राचार्य
श. होलकर विज्ञान महाविद्यालय
इन्दौर

Office of the Principal
Govt. (Model Autonomous) Holkar Science College
Indore (M.P.)
) 0731-2464074(O), 2446806, 2764027 (Extn.)
e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org
(Re-accredited 'A' Grade by NAAC)

4. DURATION AND RECINDENCE OF MOU

a. The agreement shall come into effect on 12/03/21 changes to this agreement shall be made by mutual consent between both institutions. In cases of disagreement, the Institute wishing to depart from the agreement shall, wherever possible, give two months' notice of its intention to do so. The agreement shall be reviewed after a period of five years.

b. This MOU is being signed purely with the intention of academic and scientific cooperation

This MOU is signed by,

Preeti Rao

Founder
(Soil and Soul Foundation, Bangalore, Karnataka)

SOIL AND SOUL FOUNDATION Bangaluru

&

12/03/21

Head
Department of Biochemistry
Govt. Holkar (Model, Autonomous) Science College Indore (M.P.)

HEAD
Department of Biochemistry
Holkar Science College, Indore

Principal
Govt. Holkar (Model, Autonomous) Science College Indore (M.P.)

प्राचार्य
शा. होलकर विज्ञान महाविद्यालय
इन्दौर

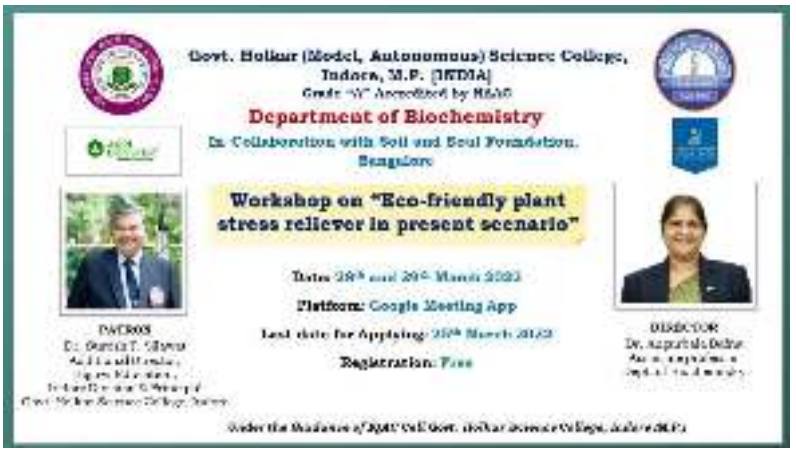
In presence of the following witnesses:

1. .....

2. .....

Department of Biochemistry

S. No.	Component/ Activities	Details of event
1	Name of the Department / Unit / Agency:	Biochemistry
2	Name of the Sponsor:	Soil and Soul Foundation, Bangalore
3	Date and Year of the Activity:	28 March 2022- 29 March 2022
4	Number of Students Participated in the activity:	88 participants
5	Photo of Activity:	 

6	Poster of Activity	 
7	Media Report of Activity:	

8	List of Participants	GOVT. HOLKAR SCIENCE COLLEGE, INDORE (M.P.) workshop on "Ecofriendly plant stress Relievers in Present Scenario"

S.N	Name	Class	Dpt.
1.	Adarsh Shah Jagat	M.sc.	Biochemistry
2.	Amit Oste	M.sc.	Biochemistry
3.	Anil Tiwari	M.sc.	Biochemistry
4.	Anjali Chaturvedi	M.sc.	Biochemistry
5.	Anjlas Panchgra	M.sc.	Biochemistry
6.	Ankita Tongya	M.sc.	Biochemistry
7.	Antim Bhadoriya	M.sc.	Biochemistry
8.	Bhagyalaxe Mandlo	M.sc.	Biochemistry
9.	Bhawana Pal	M.sc.	Biochemistry
10.	Bhavika Verma	M.sc.	Biochemistry
11.	Deepak Mishra	M.sc.	Biochemistry
12.	Deepak Panchgre	M.sc.	Biochemistry
13.	Dikshika Shah	M.sc.	Biochemistry
14.	Durgesh Kevat	M.sc.	Biochemistry
15.	Gowardhan Lal Nayak	M.sc.	Biochemistry
16.	Harsha Goyal	Ph.D	Scholar Biochemistry
17.	Jayshree Karma	M.sc.	Biochemistry
18.	Kajal Marva	M.sc.	Biochemistry
19.	Kavita Parmar	M.sc.	Biochemistry
20.	Manisha Singh	M.sc.	Biochemistry
21.	Mayuri Bisen	M.sc	Biochemistry
22.	Monika Patidar	M.sc.	Biochemistry
23.	Muskan Pathan	M.sc.	Biochemistry
24.	Muskan Verma	M.sc.	Biochemistry
25.	Nandini Kashyap	M.sc.	Biochemistry
26.	Neelim Ramesh	M.sc.	Biochemistry
27.	Nidhi Tiwari	M.sc.	Biochemistry
28.	Preeti Choudhary	M.sc.	Biochemistry
29.	Priya Malviya	M.sc.	Biochemistry
30.	Ravina Khandelwal	M.sc.	Biochemistry
31.	Ramasani	M.sc.	Biochemistry
32.	Rinki Shah	M.sc.	Biochemistry
33.	Ronak Parihar	M.sc.	Biochemistry
34.	Shilla Gupta	M.sc.	Biochemistry
35.	Shivanee Sonane	M.sc.	Biochemistry
36.	Shraddha Rawal	M.sc.	Biochemistry
37.	Shruti Tiwari	M.sc.	Biochemistry
38.	Sonali Mittal	M.sc.	Biochemistry
39.	Sonam Vishwakarma	M.sc.	Biochemistry
40.	Surabhi Agrawal	M.sc.	Biochemistry
41.	Sweta Roychoudhary	M.sc.	Biochemistry
42.	Swati Mali	M.sc.	Biochemistry
43.	Urmila Kanwar	M.sc.	Biochemistry
44.	Urmila Sonana	M.sc.	Biochemistry
45.	Vama Malviya	M.sc.	Biochemistry
46.	Vijay Solanki	M.sc.	Biochemistry
47.	Yasvi Chaturvedi	M.sc.	Biochemistry
48.	Dheeraj Malviya	M.sc.	Seed technology

49	Divya Singh	M.sc.	Seed technology
50	Hetal Bajaj	M.sc.	Seed technology
51	Nehalkumari Tiwari	M.sc. (Agri.)	Seed technology
52	Pragya Mawandia	M.sc.	Seed technology
53	Ravikishan Kachroo	M.sc.	Seed technology
54	Sonali Parmar	M.sc.	Seed technology
55	Anjali Bhaskar	M.sc.	Zoology
56	Deepika Maru	M.sc.	Zoology
57	Deepika Rathod	M.sc.	Zoology
58	Dilip Isave	M.sc.	Fisheries
59	Hetisa Yadav	M.sc.	Zoology
60	Harshad Lodwal	M.sc.	Zoology
61	Kajal Bareth	M.sc.	Zoology
62	Mukesh Bhadkar	M.sc.	Fisheries
63	Nikky Oj	M.sc.	Zoology
64	Nitin Jain	M.sc.	Zoology
65	Sarita Gupta	M.sc.	Zoology
66	Saraswati Malviya	M.sc.	Zoology
67	Archana Sahu	M.sc.	Biochemistry
68	Bhavna Silhotra	M.sc.	Biochemistry
69	Jayshree Baiya	M.sc.	Biochemistry
70	Mamta Sharma	M.sc.	Biochemistry
71	Pooja Pandey	M.sc.	Biochemistry
72	Anju Verma	M.sc.	Biochemistry
73	Shubhangi Khare	M.sc.	Biochemistry
74	Shweta Prajapati	M.sc.	Biochemistry
75	Soniya Patel	M.sc.	Biochemistry
76	Sonu Muzalda	M.sc.	Biochemistry
77	Yamini Magarde	M.sc.	Biochemistry
78	Anshi Verma	M.sc.	Biochemistry
79	Anjali Tenamiya	M.sc.	Biochemistry
80	Ganga Ajmera	M.sc.	Biochemistry
81	Hemlata Yadav	M.sc.	Biochemistry
82	Kajal Yadav	M.sc.	Biochemistry
83	Kiran Kotwal	M.sc.	Biochemistry
84	Shivani Bhanwar	M.sc.	Biochemistry
85	Shubhangi Chaudhary	M.sc.	Biochemistry
86	Sonali Lohare	M.sc.	Biochemistry
87	Tejaswini Bhargav	M.sc.	Biochemistry
88	Vanshu Patidar	M.sc.	Biochemistry

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Noble Alchem. Pvt. Ltd. Rohatak Road, Bhiwani, Haryana (M.P.)

तमसो मा ज्योतिर्गमय

7A

Activity Title:

Workshop on "Eco-friendly plant stress reliever in the present scenario" in association with Noble Alchem. Pvt. Ltd., Rohatak Road, Bhiwani, Haryana

Office of the Principal

Govt. (Model Autonomous) Holkar Science College
Indore (M.P.)

✆ 0731-2464074(O), 2446806, 2764027 (Exam)
e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org
(Re-accredited 'A' Grade by NAAC)

Date:-

MEMORANDUM OF UNDERSTANDING FOR ACADEMIC AND SCIENTIFIC COOPERATION

BETWEEN NOBLE ALCHEM PVT. LTD., SANWER ROAD, INDORE, (M.P.)
AND
GOVT. HOLKAR (MODEL, AUTONOMOUS) SCIENCE COLLEGE INDORE (M.P.)

The representatives of **Noble Alchem Pvt. Ltd, Sanwer Road, Indore, (M.P.)** and **Department Of Biochemistry, Govt. Holkar (Model, Autonomous) Science College Indore (M.P.)** agree to this Memorandum of Understanding.

The Memorandum of Understanding (MOU) establishes the following:

1. OBJECTIVE OF THE AGREEMENT

To establish a mutually beneficial relationship built on academic and scientific cooperation. Areas of cooperation between the **Noble Alchem Pvt. Ltd, Sanwer Road, Indore, (M.P.)** and **Department of Biochemistry, Govt. Holkar (Model, Autonomous) Science College Indore (M.P.)** include the exchange of researchers, students, publications, academic programs and research projects.

2. GOALS AND FORMS OF COOPERATION

The signing institutions agree to provide opportunity, as appropriate, for the following activities towards the completion of the objective of this MOU.

1. Exchange of students and/or researchers with the objective of offering courses and realizing research projects in areas mutually agreed upon by both institutes through prior invitation and in accordance with the procedures and expectations established by each institute and specific department.
2. Exchange of books, scientific publications, study programs, academic projects, course information, seminars, conferences and other data and information of common interest.
3. Develop joint research projects and joint publications.
4. All joint activities will be realized through the mutual agreement and clearly established conditions and mutual obligations of the appropriate institute entity.

प्राचार्य
शासकीय होल्कर स्वशासी
विज्ञान महाविद्यालय,
इन्दौर (म.प्र.)

Office of the Principal

Govt. (Model Autonomous) Holkar Science College
Indore (M.P.)

✆ 0731-2464074(O), 2446806, 2764027 (Exam)
e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org
(Re-accredited 'A' Grade by NAAC)

Date:-

3. IMPLEMENTATIOION OF THE MEMORANDUM OF UNDERSTANDING

The objectives of the MOU will be implemented and regulated in the following manner:

i. Student Exchange

a. Student and research scholars may visit the corresponding departments of these institutes after finalizing a mutually acceptable schedule.

b. All the expenses shall be the direct responsibility of the student concerned (subject to any agreements on payment arrangements made by either institution with its own students). These expenses include.

1. Travel expenses
2. Reprographic and Internet Usage Expenses
3. Required student services fees at the host institution
4. Books and academic supplies
5. Administrative fees, if any.

ii. Exchange of researchers

With the objective of strengthening ties through joint projects and research activities of both institutes, the MOU allows for the creation of researcher exchange. The following conditions will apply.

a. The researchers will maintain their status as research scholars at their home institution for the duration of the exchange.

b. The researchers will be allowed to make use of the instruments and other research facilities available in various departments of these institutes after prior approval of the visiting schedule.

c. The appropriate departments and administrative offices will assist in securing housing and other necessary arrangements for living in the host institutions city.

iii. Research and resources

Noble Alchem Pvt. Ltd., Sanwer Road, Indore, (M.P.) and **Department of Biochemistry, Govt. Holkar (Model, Autonomous) Science College Indore(M.P.)** remote research and realize collaborative projects, giving priority to interdisciplinary works

प्राचार्य
शासकीय आदर्श स्वशासी
होलकर विज्ञान महाविद्यालय,
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e-mail : principalhsc@rediffmail.com, Web Address: www.collegeholkar.org

(Re-accredited 'A' Grade by NAAC)

Date:-

4. DURATION AND RECINDENCE OF MOU

a. The agreement shall come into effect on From 3-10.18 - 10.02.21 - 24.03.10.24 changes to this agreement shall be made by mutual consent between both institutions. In cases of disagreement, the Institute wishing to depart from the agreement shall, wherever possible, give two months' notice of its intention to do so. The agreement shall be reviewed after a period of five years.

b. This MOU is being signed purely with the intention of academic and scientific cooperation

This MOU is signed by,

For Noble Alchem Pvt. Ltd.

Authorised Signatory

Head

Department of Biochemistry

(Noble Alchem Pvt. Ltd., Sanwer Road, Indore, M.P.)

Head

Department of Biochemistry

Govt. Holkar (Model, Autonomous) Science College Indore (M.P.)

Principal

Govt. Holkar (Model, Autonomous) Science College Indore (M.P.)

प्राचार्य
शासकीय होल्कर स्वशासी
होलकर विज्ञान महाविद्यालय,
इन्दौर (म.प्र.)

In presence of the following witnesses:

1. .....

2. .....

Department of Biochemistry

S. No	Component/Activities	Details of event
1	Name of the Department / Unit / Agency:	Biochemistry
2	Name of the Sponsor:	Noble Alchem Pvt. Ltd. Sanwer Road, Indore, Bioenzyme Academy, Bangalore
4	Date and Year of the Activity:	28 March 2022- 29 March 2022
5	Number of Students Participated in the activity:	88 participants
6	Photo of Activity:	  **Department of Biochemistry**

		
7	Media Report of Activity:	
8	Poster of Activity	


Invitation
Guest Speakers


Organizing Committee
Guest of Honor
Organizing Secretary
Mr. Nagesh Vyas
Dr. Anil Kothari


Collaboration
Mobis Alchem Pvt. Ltd.
Mr. Nagesh Vyas
Special thanks
The Department

9	List of Participants	**GOVT. HOLKAR SCIENCE COLLEGE, INDORE (M.P.)** **workshop on "Ecofriendly plant stress Relievers in Presni Scenario"**

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Government Holkar Science College, Indore (MP)

Department of Biochemistry

Certificate of Collaboration

This is to certify that the **Department of Biochemistry, Govt. Holkar Science College, Indore, and Noble Alchem Pvt. Ltd. (Agribooster), Sanwer Road, Indore, M.P.** have signed MOU for Mutual collaborative work. Under this collaboration, a Workshop on **"Eco-friendly plant stress relievers in present scenario"** has been successfully conducted in the year 2022.



Head

Department of Biochemistry

Workshop On "Eco-friendly Plant Stress Relievers in Present Scenario"

Date : 28th & 29th March 2022



Organized by

Govt. Holkar (Model, Autonomous) Science College, Indore

Department of Biochemistry

In Collaboration with

Noble Alchem Pvt. Ltd., Indore

Photo Gallery



A Manual of Workshop
On
"Eco-friendly Plant Stress Relievers in Present Scenario"

Date : 28th & 29th March 2022

EDITOR

Dr. A. Bafna, Associate Professor and Head
Biochemistry Department

CO-EDITORS

Prof. Tasneem Rangwala, Asst. Professor, Biochemistry
Prof. Sheetal Uikey, Asst. Professor, Biochemistry
Mr. Nagesh Vyas, Project Director, Agri Booster
Mr. Rohan Gupta, Marketing Director, Noble Alchem Pvt. Ltd.

Department of Biochemistry
Govt. Holkar (Model, Autonomous)
Science College, Indore (M.P.)
In Collaboration with Noble Alchem Pvt. Ltd., Indore

Year - 2022

ORGANIZING COMMITTEE

Patron

Dr. Suresh T. Silawat

Additional Director, Higher Education, Indore Division &
Principal, Govt. Holkar Science College, Indore

Director

Dr. Angurbala Bafna

Associate Professor : Dept. of Biochemistry
Govt. Holkar Science College, Indore

Dr. G.D. Gupta
Vice-principal

Dr. R.C. Dixit
Administrative officer

Organizing Committee

Convener
Prof. Tasneem Rangwala

Co-Convener
Prof. Sheetal Uikey

Organizing Secretary

Dr. Bhavna Sharma
Prof. Deepak Choudhary
Prof. Shanti Patidar

Collaboration

Noble Alchem Pvt. Ltd.

Mr. Rohan Gupta
Mr. Nagesh Vyas
Mr. Satish Jain, Sak Bioenz, Raipur (CG)

Guest Speakers



Mrs. Priti Rao
Founder: Soil and
Soul Foundation
Bioenzyme
Entrepreneurs
Academy of India, Bangalore



Dr. C. Arun
Associate Professor
Department of
Biotechnology
K L Deemed to be
University of Guntur



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Institute Cuttack

Guest of Honor



Dr. Anil Kothari
Director-General
MPCST



Mr. Nagesh Vyas
Project Director
Agribooster
Indore (M.P.)



Mr. Rohan Gupta
Marketing Director
Noble Alchem Pvt. Ltd.
Sanwer Road,
Indore (M.P.)

Workshop on
"Eco-friendly Plant Stress Relievers In Present Scenario"

Organized by
Department of Biochemistry
Govt. Holkar Science College, Indore

In Collaboration with Noble Alchem Pvt. Ltd., Indore

28th & 29th March 2022

Detailed Programme

Date	Time	Program
28/3/22	11:00 AM	Inauguration Guest Speech- 1) Mr. Rohan Gupta 2) Mr. Nagesh Vyas
	11:30 AM	Lecture by Mrs. Priti Rao Topic- "Bioenzyme-Potentials, Experiences and Challenges"
	12:30 PM	Lecture by- Dr. (H) Joean Oon Siew Kee Topic – "Bioenzyme-Around the world and Medicine"
	01:30 PM	Lecture by Dr. C. Arun Topic- "Bioenzyme- Research & Data"
	02:30-03:00PM	Lunch Break
	03:00-04:00 PM	Practical Session on Proline estimation
	04:00-05:00 PM	Practical Session on MDA estimation
29/3/22	11:00 AM	Lecture by- Dr. Annamalai M. Topic- "Elicitors as an Eco-friendly plant insect pest stress reliever: Opportunities and Challenges".
	12:00 PM	Lecture by Dr. Kannabiran Balasubramaniyam Topic- "Bioenzyme-Quality and optimization"
	01:00-02:00 PM	Valedictory Session Guest of Honor- Dr. Anil Kothari
	02:00-03:00PM	Lunch Break
	03:00-04:00 PM	Practical Session on Total Phenol Estimation
	04:00-05:00 PM	Practical Session on Peroxidase Activity Determination.

- **Venue for Inaugural Function: Biochemistry Department**
- **Venue for Lectures: Online Google Meet**
- **Venue for Practical Sessions: Biochemistry Department**



संदेश

हर्ष का विषय है कि ''Eco-friendly Plant Stress Relievers in Present Scenario'' विषय पर जीवरसायन विभाग शा. होलकर विज्ञान महाविद्यालय इन्दौर, नोबल अल्केम प्रा. लि. के सहकार्यता से दो दिवसीय कार्यशाला आयोजन कर रहा है। आयोजित कार्यशाला में देश-विदेश के कृषि क्षेत्र से जुड़े वक्ता अपने विचारों को व्यक्त करेंगे।

इस अवसर पर प्रकाशित पुस्तिका के माध्यम से मैं, प्रतिभागियों एवं आयोजनकर्ता टीम को बधाई देते हुए कार्यशाला की सफलता हेतु अग्रिम हार्दिक शुभकामनाएं प्रेषित करता हूँ।

डॉ. मोहन यादव
मंत्री, उच्च शिक्षा, म.प्र. शासन, भोपाल



संदेश

यह जानकर प्रसन्नता है कि जीव रसायन विभाग शा. होलकर विज्ञान महाविद्यालय इन्दौर, नोबल अल्केम प्रा. लि. के सहकार्यता से "Eco-friendly Plant Stress Relievers in Present Scenario" पर दो दिवसीय कार्यशाला आयोजित कर रहा है। जिसमें कई शिक्षक एवं शोधार्थी भाग ले रहे है।

यह कार्यशाला कृषि क्षेत्र में आने वाली चुनौतियों को हल करने के लिये एक सशक्त पहल करेगी।

इस आयोजन की सफलता के लिये हार्दिक शुभकामनाएं।

तुलसीराम सिलावट
मंत्री, जल संसाधन, म.प्र. शासन, भोपाल

उषा बाबू सिंह ठाकुर
मंत्री
संस्कृति, पर्यटन, धार्मिक न्यास एवं धर्मस्व
मध्यप्रदेश



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भोपाल, दिनांक 24/03/22

संदेश

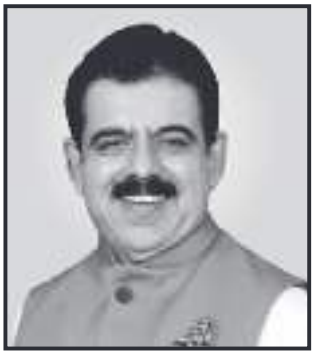
यह जानकर अति प्रसन्नता हुई कि जीव रसायन विभाग शा. होलकर विज्ञान महाविद्यालय इंदौर, नोबल अल्केम प्रा. लि. के सहकार्यता से "Ecofriendly Plant Stress Reliever In Present Scenario" पर 28–29 मार्च 2022 को दो दिवसीय कार्यशाला आयोजित कर रहा है।

मुझे विश्वास है कि इस कार्यशाला में विषयवस्तु पर गंभीरता से विचार विमर्श होगा तथा इससे महाविद्यालय के छात्र, शोधार्थी एवं शिक्षक लाभांवित होंगे।

मैं कार्यशाला के सफल आयोजन एवं प्रकाशित होने वाली पुस्तिका के सफल प्रकाशन हेतु शुभकामनाएं ।

(उषा बाबू सिंह ठाकुर)

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संदेश

अत्यन्त प्रसन्नता का विषय है कि जीवरसायन विभाग शा. होलकर विज्ञान महाविद्यालय इन्दौर, नोबल अल्केम प्रा. लि. के सहकार्यता से 28-29 मार्च 2022 को ''Eco-friendly Plant Stress Relievers in Present Scenario'' विषय पर पर दो दिवसीय कार्यशाला आयोजित कर रहा है।

महाविद्यालय द्वारा आयोजित इस कार्यशाला से न केवल महाविद्यालय के छात्रों में ही पर्यावरण के प्रति जागरूकता होगी अपितु भविष्य में सम्पूर्ण जैविक प्रजाति को इसका लाभ मिलेगा।

शंकर लालवानी
सांसद, इन्दौर

देवी अहिल्या विश्वविद्यालय, इन्दौर
Devi Ahilya University, Indore

प्रो. रेणु जैन
कुलपति

Prof. Renu Jain
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संदेश

मुझे यह जानकर अत्यन्त प्रसन्नता हो रही है कि शासकीय होल्कर विज्ञान महाविद्यालय, इन्दौर में नोबल अल्केम प्रा.लि. की सहकार्यता से दो दिवसीय कार्यशाला दिनांक 28–29 मार्च 2022 को विषय "**Ecofriendly Plant Stress Reliever in Present Scenario**" पर आयोजित है।

वर्तमान में कृषि क्षेत्र को उन्नत बनाने के लिये ऐसी कार्यशाला अत्यन्त महत्व रखती है। मुझे विश्वास है कि इस कार्यशाला के आयोजन से इस विषय के ज्ञान का आदान–प्रदान एक सार्थक परिणाम देगा।

इस कार्यशाला के सफल आयोजन हेतु विश्वविद्यालय परिवार की ओर से मैं सभी प्रतिभागियों को हार्दिक बधाई देती हूँ एवं उनके उज्ज्वल भविष्य की कामना करती हूँ।

(डॉ. रेणु जैन)

इन्दौर
दिनांक : 25.03.2022

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MESSAGE



I am very pleased to know that Department of Biochemistry Govt. Holkar Science College Indore in collaboration with Noble Alchem Private Limited is going to organize a two day workshop on **"Eco-friendly plant stress relievers in present scenario".**

I firmly believe that this workshop will enrich the knowledge of participants and will be beneficial in developing research aptitude. I would like to give best wishes to the organizers for successful conduction of workshop and for publishing a workshop manual.

(Dr. Anil Kothari)

Foreword



Government Holkar (Model, autonomous) Science College, Indore is NAAC "A" grade accredited and centre for excellence. It was established in 1891 and has successfully completed 131 years of its journey with golden heritage of teaching, learning, research and training. The Department of Biochemistry is also very old and have graduate, postgraduate courses along with Ph.D. It was great pleasure to know that Department of Biochemistry in collaboration with Noble Alchem Pvt. Ltd. is organizing a workshop on "Ecofriendly Plant Stress Relievers in Present Scenerio". I am sure this workshop will certainly boost enthusiasm for research among participants and develop research aptitude.

It gives immense delight to know that organizers are also publishing a manual on Ecofriendly Plant Stress Relievers in Present Scenerio. The manual includes introduction to plant stress and will be beneficial for experimental analysis of oxidative stress in plants. It also covers the research work carried out with collaborative efforts of Department of Biochemistry and Noble Alchem Pvt. Ltd.

I congratulate Dr. Angurbala Bafna, Mr. Rohan Gupta, Mr. Nagesh Vyas and their team for conducting such a useful event. I extend my best wishes for the grand success of this workshop.

Dr. Suresh T. Silawat
Principal

Preface

NAAC accredited "A" grade Govt. Holkar Science College, Indore was established in 1891. The Department of Biochemistry was established in 1968 for post graduate studies. It enjoys the reputation of being the oldest in the state and providing excellent education from B.Sc. to Ph.D. It regularly organizes workshops and seminars for teachers and students.

This department in collaboration with Noble Alchem Pvt. Ltd. is organizing a workshop on Ecofriendly plant stress relievers in the present scenario from 28th to 29th March, 2022 to impart social awareness in students regarding agricultural problems and to suggest ways to solve them. The objective of this workshop is to enrich the participants with knowledge of ecofriendly product can be used in the field of agriculture and to inculcate research aptitude.

Agriculture is strongly influenced by weather and climate. Different crops show different sensitiveness towards climatic changes. Climatic variability may have effects on crop yields. To minimize crop responses to adverse effects of climatic changes or stress on growth, development and eventual yield, nowadays research is emphasized on use of eco-friendly stress relievers in the field of agriculture. Bioenzymes are prepared by using vegetable and fruit peels. Its various applications especially in the agriculture field will enable students to develop entrepreneurs' skills. Research scholars

of the Department are already working on ecofriendly product soluble silica. It has been established by their series of research that soluble silica is a potent stress reliever. It enhances stress resistance in plants and also improve quality of soil. In the upcoming workshop impact of soluble silica on different parameters will also be discussed by the experts.

Organizing committee on this occasion also prepared a manual which will help the readers to understand and perform the experiments with greater degree of clarity and precession.

We are extremely happy to extend our warm greetings and hearty welcome to all esteemed invited speakers. We firmly believe that this workshop will enrich the practical knowledge of participants. We would also like to extend our sincere thanks to Principal Dr. Suresh T. Silawat, faculty members and the entire organizing team.

- Dr. Angurbala Bafna

- Mr. Rohan Gupta

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GUEST SPEAKERS

BIOENZYME - Potential, Experience & Challenges

Mrs. Priti Rao
Social Entrepreneur

About the Speaker:

A Postgraduate in Marketing from Bangalore University, Priti is the Founder & driving force behind Soil and Soul Foundation (www.soilandsoul.info) and Bioenzyme Entrepreneurs Academy (www.beacademy.in). With two decades of work experience, Priti wears multiple hats - Entrepreneur, Change maker, Sustainability practitioner and Yoga teacher. She has been experimenting with Bioenzymes for over a decade now & has open sourced the knowledge about Bioenzymes. Her work has been covered by print & electronic media in India.

Abstract:

The topic is designed to bring awareness about Bioenzymes and its potential. Right from the basics to how Bioenzymes can be of help in reducing the global climate change. This foundation session will introduce the audience to Bioenzymes, its application, use cases, market opportunities, consumer behavior, career paths, etc. Mrs. Priti Rao will share her journey including insights, success stories & challenges.

BIOENZYME - Around the world and Medicine

Dr. (H) Joean Oon Siew Kee
M.D. (M.A). D.N.M, BHMS
Medical Practitioner & Environmentalist

About the Speaker:

Known for her public talks on environment and alternative medicine, Dr Joean is a medical consultant and physician, based out of Malaysia (www.enzymesos.com). She credits her learning about Bioenzymes to Dr Rosukon of Thailand. Dr. Joean has been using Bioenzymes to help cancer patients and community. She carries a wealth of experience having used Bioenzymes to solve some of the pressing environmental issues in Malaysia, China, Indonesia, Singapore, Taiwan & Hong Kong.

Abstract:

This session is expected to expand the audience knowledge on wide variety of use cases for Bioenzymes. The participants will learn how already many countries are adopting Bioenzymes based solutions to solve some of their local civic issues. Dr. Joean, a qualified medical practitioner, will share her experience from around the world on mitigating some of the environmental issues and medical conditions using Bioenzymes.

BIOENZYMES - Quality & Optimization

Dr. Kannabiran Balasubramaniyam
B Pharm, MBA, Ph.D.
Pharmaceutical & Biotech formulation Expert

About the Speaker:

Dr. Kannabiran a Pharma & Biotech expert and founder of Arani Biotech (www.aranibio.com). With more than 20 years of global experience, he specializes in pharma production & plant operation. With his unique background, he has documented the entire lifecycle of Bioenzyme Production, Quality Control and Assurance.

Abstract:

Understanding the harmful effect of chemicals, we use in our daily lives on our health and ecology. Eventually, understanding the Bioenzyme and its wide applications to bring the balance in ecology. Importance of Quality Assurance, Research & Development and optimization of the process to commercialize these products on large scale.

BIOENZYME - Research and Data

Dr. Arun C
MTech, PhD
Research Scholar & Professor (KLEF, Guntur)

About the Speaker:

Dr. Arun is a Research Scholar and specializes in Bioenzymes. His research work includes - investigation of the characterization, production and optimization of garbage enzyme produced from pre-consumer organic waste and subsequently, identify the effect on anaerobic digestion of dairy waste-activated sludge.
Dr. Arun studied Industrial biotechnology at PREC, Thanjavur and Environmental science and technology (Department of chemical engineering) at AC Tech, Anna university, Chennai & worked as Environmental consultant. His contribution in research about environmental & sustainable applications of Bioenzymes is commendable.

Abstract:

The huge production of sludge and decomposable organic solid waste from food processing industries is increasing linearly with the growth of population. Solid organic waste sludge needs to be alleviated necessarily to reduce odour, organic content, and pathogen before disposing and further utilization. An environment-friendly and sustainable technology at low cost is needed for the proper management and reuse of pre-consumer organic wastes. Preconsumer organic waste can be utilized to produce value added bio-product which in turn reduces the production of greenhouse gas. Garbage enzyme was one of such products produced by fermentation of fruits and vegetable waste. During this session, Dr. Arun sheds light on his technical research with respect to garbage enzyme, its enzyme activity and potential.

Elicitors as an eco-friendly plant insect pest stress reliever: Opportunities and Challenges

Annamalai M

Scientist, Crop Protection Division,
ICAR-National Rice Research Institute, Cuttack

Pesticide-based plant protection resulted in resistance and resurgence of insects and increased risks to biodiversity and human health due to frequent or indiscriminate use is a great havoc in recent days which sensitized consumers to prefer increasingly foods with low or even no pesticide residues. So, there always a look on efficient, economical and less environmental-impact option to control insect exists. One such a potential approach is the plant defense elicitors usage either alone or in combination with other control strategies like pesticides or beneficial microorganisms (Walters et al., 2013). Over the last two decades after in-depth exploration many researchers described several resistance elicitors and all have been majorly classified into two main groups, one is the molecules that are phytohormones such as salicylic acid (SA) and jasmonic acid (JA) (Pieterse et al., 2009) or its mimics like 2,6-dichloroisonicotinic acid (INA) or benzothiadiazole (BTH) which by exogenous application activates induced systemic resistance in plants and another group is the 'pathogen-associated molecular patterns' (PAMPs) or 'microbe associated molecular patterns' (MAMPs) or 'damage-associated molecular patterns' (DAMPs) like molecules that resemble the presence of a plant enemy thereby activating the plant's induced systemic resistance (Heil, 2014). Apart from the two aforementioned plant elicitors group, also present the third group of elicitors comprising compounds like mineral nutrients such as phosphorus (P), potassium (K), and silicon (Si), fertilizers containing phosphate (phosphorous acid) and some of the non-protein amino acids etc. (Reglinskietal.,2014). Use of these products for inducing resistance in plants is gaining importance in the control of insect pest. Among the elicitors employed in insect control, silicon has attracted the researchers' attention and interest and found to be used either in the form of inorganic sources viz., bagasse furnace ash or fly ash, sodium silicate (Na_2SiO_3), potassium silicate (K_2SiO_3), calcium silicate or organic sources in the form of rice husk ash etc. for the management of insect-pests. Apart from conferring resistance in plants it also provides nutritional benefits to plants resulting in increased production and quality of agricultural products. Numerous reports available on the use of silica based materials for management of field, horticultural, plantation and greenhouse pests of various crops and also the stored-product insect pests. Reports of synthesizing silica nanoparticles and testing their efficacy was also gaining the momentum. Silica as a carrier material to encapsulate insecticidal compound and their use in insect pest control also received considerable attention. Interestingly silica supplementation to plants found to cause changes in herbivore-induced plant volatiles (HIPVs) which in turn modifies the third guild i.e., natural enemies' recruitment. Though great opportunities available in employing silica material in insect pest management the main limitation is the application of silica in large quantity is not an attracting point for the researchers which induced them to test the efficacy of foliar spray application of silica in liquid form which requires less quantity and easy to apply and found encouraging results in many crops. Thus, silver bullet silica will be a growth promoter, pest reducer and yield increaser in many crops.

Introduction

Stress

In the widest biological sense, stress can be any factor that may produce an adverse effect in a living system. Stress is also defined as the overpowering pressure that affects the normal functions and prevent individual from fully expressing their genetic potential for growth, development and reproduction. If the stress is for short duration, then can be managed by the individual itself without having adverse effects. Moreover, long term exposure to stress can even lead to death.

Classification of Stress

It has become traditional for ecologists, physiologists, and agronomists to divide stresses experienced by plants into two major categories: biotic and abiotic. Biotic stresses originate through interactions between organisms, while abiotic stresses are those that depend on the interaction between organisms and the physical environment. In today's scenarios sudden climate change exposes plants to episodes of abiotic stresses such as drought, salinity, elevated temperature, metal toxicity, submergence, nutrient deficiencies, and biotic stress such as virus, fungi attack. These stresses limit crop production.

Abiotic Stress –

Abiotic stresses include Salinity, Drought, Flooding, Metal toxicity, Nutrient deficiency, High temperature and Low temperature. Abiotic stress management is one of the most important challenges faced by agricultural system. Abiotic stress can persistently limit choice of crops and agricultural production over large areas and extreme events can lead to total crop failures. Abiotic stresses adversely affect the livelihoods of individual farmers and their families as well as national economies and food security.

Plants can experience abiotic stress resulting from the shortage of an essential resource or from the presence of high concentrations of a toxic or antagonistic substance. In some cases, such as the supply of water, too little (drought) or too much (flooding) can both impose stress on plants. In reality, abiotic and biotic stresses are often inextricably linked.

Major Abiotic Stresses Limiting Crop Yield

Drought stress

Among the environmental stress factors, water is one of the most widely limiting factor for crop production on a global basis. Severe droughts occur periodically in several major food-producing countries, having far-reaching impacts on global food production and supply. The global production of grain has, in some years, been reduced by 5 percent or more as a result of severe droughts in key countries.

Effects of drought stress on crops ·

- Reduced seed germination and seedling development
- Poor vegetative growth
- Reduced photosynthesis
- Reduced stomatal conductance.

Salinity stress

Salinity is defined as the presence of excessive amounts of soluble salts that hinder or affect the normal functions of plant growth. It is measured in terms of electrical conductivity (ECe), with the exchangeable sodium percentage (ESP) or sodium adsorption ratio (SAR) and pH of a saturated soil paste extract.

Salinity is predominantly a problem of arid and semiarid regions of the world. In India alone, 7 million hectares of land are salt affected. The impact of salinity on the economic exploitation of land for agriculture and forestry is very severe.

There are two main sources of salinity:

(i) Primary or natural sources resulting from weathering of minerals and the soils developed/derived from saline parent rocks.

(ii) Secondary salinization caused by human factors such as irrigation, deforestation, overgrazing, or intensive cropping.

Effects of salt stress on plants

- Reduces the plant's ability to take up water, and this leads to slower growth.
- Salts enter the transpiration stream and eventually injure cells in the transpiring leaves, further reducing growth·
- Plants grown in alkaline soils often display a characteristic yellow color on the new growth.
- High salts can cause leaf burn, inhibit water uptake, and can interfere with uptake of certain essential elements (e.g. calcium).

High Temperature Stress

High temperature causes excess respiration over photosynthesis which lead to loss of reserves and produces starvation condition within plants influencing overall growth.

Low Temperature Stress

Low temperatures can damage plants both by a chilling effect, leading to physiological and developmental abnormalities, and by freezing, causing cellular damage directly or via cellular dehydration. Commonly visible symptoms of low-temperature injury to the leaves include wilting, bleaching due to photooxidation of pigments, waterlogging of the intercellular spaces, browning, and eventually leaf necrosis and plant death.

Effects of Heat stress on Plants

- Seedling establishment is hampered
- Drying of leaf margins and scorching effect on leaves
- Reduction in plant growth
- Alteration in photosynthesis
- Total biomass is reduced
- Grain and fruit development and quality is affected.

Biotic stress

Biotic stress in plants is caused by living organisms such as viruses, bacteria, fungi, nematodes etc. The agents causing biotic stress directly deprive their host of its nutrient can lead to death of plants. Biotic stress can become major because of pre and postharvest losses. Despite lacking the adaptive immune system plants can counteract biotic stresses by evolving themselves to certain sophisticated strategies. The biotic stress affect photosynthesis as chewing insects reduces leaf area and virus infections reduce the rate of photosynthesis per leaf area.

Oxidative stress

Oxidative stress, defined as a disturbance in the balance between the production of reactive oxygen species (free radicals) and antioxidant defenses.

Plants are subjected to various environmental stresses throughout their life cycle. Reactive oxygen species (ROS) play important roles in maintaining normal plant growth, and improving their tolerance to stress.

Some of the markers are present in plant cell which helps to determine the level of stress. When plants are exposed to various stress conditions particularly drought results in the accumulation of certain substances such as proline which provide strength to tolerate stress. Malondialdehyde, a product of peroxidation of membrane phospholipid is an important marker of increased ROS production. Plants exposed to adverse environmental conditions produce free radicals in an excessive amount which ultimately results in peroxidation of lipid membrane thereby increasing the MDA content of the cell. Hydrogen peroxide has a dual role in plants. At a lower concentration, it is beneficial in the form of an intracellular signaling agent but higher concentrations become toxic by oxidizing cysteine and methionine residues of the active site of different enzymes involved in various metabolic processes.

ROS scavenging mechanisms can be classified into two types: enzymatic and non-enzymatic antioxidant defense systems, which work synergistically and interactively to neutralize free radicals. The enzymatic systems mainly include SOD, catalase (CAT), ascorbate peroxidase (APX) and glutathione peroxidase (GPX). Hydrogen peroxide generated by the activity of superoxide dismutase on superoxide which is an ROS is further broken into water and oxygen by the action of catalase and peroxidases. In reducing hydrogen peroxide, ascorbate peroxidase uses ascorbate as an electron donor. Ascorbic acid on oxidation is converted into dehydroascorbic acid which is reduced again to ascorbic acid by enzyme dehydroascorbic acid reductase (DHAR). For this process, electrons are obtained by the oxidation of glutathione. Glutathione reductase (GR) again reduces oxidized glutathione by utilizing reducing equivalent released by NADPH. This cycle is involving all these enzymes for regeneration of ascorbic acid and reduced glutathione is known as Halliwell-Asada pathway.

The non-enzymatic systems are mainly mediated by low molecular mass antioxidants, such as glutathione, ascorbic acid (AsA) and flavonoids, which are known to remove hydroxyl radicals and singlet oxygen. Phenol is a secondary metabolite that not only scavenges the plants from harmful ROS but also is beneficial for the humans and animals that eat products containing phenol. Glutathione is a tripeptide that plays many important roles in the differentiation and growth of the cell, cell death, removal of ROS, etc. All of these functions of reduced glutathione are due to its reducing property. Ascorbic acid is an important antioxidant because it tends to reduce various substrates involved in various enzymatic and non-enzymatic reactions.

When ROS levels in the cell exceed the range of the scavenging systems, cells enter the oxidative state, resulting in oxidative modification and cell damage which can lead to death. When ROS levels are low, the cells are in the reduced state, and ROS can be used as second messengers that participate in stem cell maintenance, cell division, and differentiation, organogenesis, and biotic and abiotic responses, etc.

Stress reliever

To improve yield and increase production, farmers are using various products without concerning for quality of soil as well as of product. Due to continuous hazardous effects of chemical fertilizer and pesticides on environment, a major interest is being shown for the use of eco-friendly bio-products to regulate the plant growth and development. The challenges to make cost-effective and eco-friendly products with desired properties and long life is major concern raised by society.

Recent research has been proved that silica is a stress reliever for plant. Although silicon is not considered as an essential element for higher plants since it is present in abundant amount in soil but due to its limited solubility is not easily uptake by plants. Silica is beneficial for plants, especially when they are subjected to environmental stresses. Silicon (Si) is one of the most prevalent macro elements, performing an essential function in healing plants in response to environmental stresses. The purpose of using Si is to induce resistance to distinct stresses, diseases, and pathogens. Additionally, Si can improve the condition of soils, which contain toxic levels of heavy metals along with other chemical elements. Silicon minimizes toxicity of Fe, Al, and Mn, increases the availability of P, and enhances drought along with salt tolerance in plants through the formation of silicified tissues in plants. Silicon in the form of liquid silica maximize the availability of silicon as a ecofriendly product which enhances stress resistance of plants.

Different mechanisms have been proposed for silicon mediated drought tolerance. These include prevention of transpiration water loss, activation of plant antioxidant defense, keeping mineral balance, enhancing water uptake by roots, stimulating osmolyte accumulation, increasing the activity of photosynthetic enzyme and regulating growth substance levels.

The bioenzyme is an eco-friendly non-toxic organic storehouse of naturally occurring nutrients like many growth promoting hormones like auxin, gibbrellins, trace elements, vitamins, amino acids and micronutrients. It is highly compatible with fertilizers and pesticides, it also increases the resistance of plants against various pests, diseases and climatic stress, primary and secondary nutrients (Mg, Fe, B, Mn, Zn, Cu, and Mo) of bioenzyme provide nourishment required for healthy plant development. These nutrients are naturally chelated and readily assimilated by plants to improve cell division and enlargement, chlorophyll content and plant natural self - defence against pest pressure.

Preparation Of Bio Enzyme:

Ingredients:

- Jaggery (Gud) or Black Strap Molasses – 1 portion
- Citrus peels - 3 portions (Orange, Sweet lime, Lemon)
- Water - 10 portions
- Quarter (1/4) teaspoon dry yeast
- 1:3:10 ratio of Jaggery: Citrus peels: water

Steps:

- Add everything together.
- Ferment for one month in anaerobic conditions.
- With yeast, Bio Enzyme will take one month to be ready. Without yeast, Bio Enzyme will be ready in 3 months.

Applications of Bioenzyme

- A bio enzyme is a multipurpose cleaner that can be used to clean your floor by adding 50ml of Bio Enzyme to a bucket of water to mop the floor.
- Use Bio Enzyme liquid to clean the kitchen and bathroom sink, Bathroom tiles, the Toilet bowl. Sprinkle the Bio Enzyme liquid, leave it for 20 minutes and scrub it.
- By adding soap nut liquid, Bio Enzyme liquid can be used to clean dishes, laundry etc,
- The use of chemical cleaning liquids contaminates our lakes, groundwater and soil. Instead, use a homemade Bio Enzyme to protect our environment.
- The post-usage discharge is completely natural and even beneficial to the soil and water. The same water can be used to water your plants
- Make your own cleaner at home, save our environment. It is very effective.
- Diluted Bio Enzyme is also used as a liquid nutrient or liquid fertilizer for plants.
- It is easy to make and easy on your pocket



EXPERIMENTAL PROCEDURES

A) Oxidative stress Markers

I. Hydrogen peroxide content

It is determined using the method given by Jana and Choudhury (1981).

Reagent

1) 0.1 % Titanium sulphate
2) 0.05 M Phosphate buffer (pH 6.5)
   A) Dissolve 1.816 g of KH_2PO_4 in water and dilute to 200 ml.
   B) Dissolve 2.322 g K_2HPO_4 in water and dilute to 200 ml.
   Mix 188.8 ml of A and 11.2 ml of B.

Extraction:

1. 3 ml of 0.05M phosphate buffer is used to homogenize 0.1 g of sample.
2. It is then centrifuged at room temperature for 25 min at 6000 rpm.
3. The supernatant obtained is used for the estimation of hydrogen peroxide.

Estimation:

1. 1 ml of supernatant is mixed with 1 ml of 0.1 % titanium sulfate and centrifuged for 15 min at 7000 rpm.
2. The absorbance of the yellow-colored product is measured at 410 nm using a visible spectrophotometer.
3. A standard curve prepared by using 20-200 nmoles of hydrogen peroxide is used for the estimation of hydrogen peroxide in the test sample.

II. MDA (Malondialdehyde)

One of the important products of liquid peroxidation in the membrane is malondialdehyde which is determined in samples using the method given by Heath and Parker (1968). The level of lipid peroxidation is measured by estimating MDA, a decomposition product of peroxidised polyunsaturated fatty acids of membrane lipid, using thiobarbuturic acid (TBA) as the reactive material.

Reagents

1. Trichloroacetic acid (TCA) - 10 gm of TCA in 100 ml of distilled water (10 %).
2. Thiobarbituric acid (TBA) – 0.5 gm of TBA in 100 ml of 20% TCA

Extraction:

1. 100 mg of material is homogenized with 4 ml of 10% trichloroacetic acid.

Estimation:

1. In a test tube 4 ml of thiobarbituric acid is added in 1 ml of homogenate and the mixture is kept in the water bath for 30 min at 95°C.

2. The tube is then quickly cooled using an ice bath and centrifuged at 1900 rpm for 10 min.
3. The absorbance of the yellow orange colored solution obtained is read at 532 nm using visible spectrophotometer.
4. The blank is prepared in the similar manner with 1 ml of 10% TCA instead of homogenate.
5. The concentration of MDA is calculated by using the extinction coefficient of 155 mM cm^{-1} for MDA at 532nm using the formula.

$$A = \varepsilon l c$$

Where, A= Absorbance at a specific wavelength.

ε = Extinction coefficient.
l= length of cell (1 cm)
c= concentration.

III. Proline

The proline content is estimated using acid ninhydrin reagent based on the method given by Bates et al (1973). During selective extraction with aqueous sulphosalycylic acid, proline is precipitated as a complex. Other interfering materials are also presumably removed by absorption to the protein-sulphosalycylic acid complex. The extracted proline is made to react with ninhydrin in acidic condition (pH 1.0) to form the chromophore (red colour) and read the absorbance at 520 nm.

Reagents

1. 3% sulphosalicylic acid – 3 gm of sulfosalicylic acid in 100 ml of distilled water.
2. Glacial acetic acid
3. Acid ninhydrin – 1.25 g of ninhydrin is dissolved in a warm mixture of 30 ml glacial acetic acid and 20 ml of 6 M phosphoric acid with agitation. The reagent is stable for 24 h when stored at 4ºC.
4. Toluene.
5. Standard proline – 5 mg of proline is dissolved in 10 ml of 0.1 N hydrochloric acid (0.1-36 µmole).
6. Orthophosphoric acid (6M) – 38.1 ml of orthophosphoric acid is taken and volume is made to 100 ml, using distilled water to get 6M orthophosphoric acid.

Extraction:

1. 0.5 g of sample is homogenized using 10 ml of 3% sulphosalicylic acid and filtered through Whattman no. 2 filter paper.
2. Extraction is repeated and filtrates obtained were pooled.

Estimation:

1. To 2 ml extract, 2 ml glacial acetic acid and 2 ml of acid ninhydrin are added and mixed.
2. The reaction is started by keeping the tube in a boiling water bath and after 1 hr reaction is terminated by placing tube in the ice bath.
3. After removing the tube from the ice bath, 4 ml toluene is added and mixed vigorously for 20-30 sec.

4. Chromophore (toluene) layer containing red color is separated using separating funnel and absorbance is read at 520 nm against reagent blank in a visible spectrophotometer.
5. The same estimation procedure is repeated with standard proline (0.1-36 µmole).

Proline is calculated using the formula below

Proline content (µmoles/g) = [µg proline per ml/115.5] ×ml toluene × [5/g sample]

where 115.5= molecular weight of proline.

B) Non enzymatic antioxidants:

I. Total phenolic content

Total phenolic content is determined by the method of Singleton and Rossi, 1965.

Reagents

1. 70% acetone – 70 ml of acetone diluted to 100 ml with distilled water, prepare fresh.
2. Folin Ciocalteau reagent (FCR)
3. 20% sodium carbonate – 20 gm of sodium carbonate dissolved in 100 ml of distilled water.
4. Propyl gallate- 20 mg in 100 ml distill water.

Extraction:

1. 0.2 g of sample is extracted using 3 ml of 70% acetone and kept overnight at room temperature in dark.
2. After incubation, the homogenate is centrifuged for 10 min at 3000 rpm and the supernatant is collected in a dark clean vial.

Estimation:

1. 0.05 ml extract is taken and mixed with Folin Ciocalteau regent (0.5ml) and 20% sodium carbonate (0.5ml).
2. The content of the tube is diluted up to 5ml with distilled water and incubated for 30 min at room temperature.
3. After incubation absorbance is measured at 700 nm in a visible spectrophotometer using distilled water as blank.
4. Gallic acid equivalent (mg GAI/g fresh wt.) is used to express total phenolic content

$$\text{TPC (mg GAE per g FW)} = \text{Graph value (mg)} \times \frac{\text{Total volume of extract}}{\text{Volume of extract}} \times \frac{1}{\text{Weight of sample (g)}}$$

Where, A sample is the absorbance of the sample and A standard is the absorbance of the standard gallic acid concentration.

II. Ascorbic acid

The estimation of ascorbic acid is based on redox titration using iodine solution. As ascorbic acid is a

potent antioxidant, it gets oxidized to dehydroascorbic acid while iodine gets reduced to iodine ions. The excess of iodine is estimated using a starch indicator which forms a blue color complex at the endpoint of the titration.

Extraction:

1. The sample is weighed (100g) and cut into small pieces.
2. It is crushed in mortar and pestle using distilled water.
3. The procedure is repeated several times and the liquid is collected in 100 ml volumetric flask.
4. The final extract is made up to 100 ml with distilled water.

Estimation:

1. 20 ml of the above extract was taken in 250 ml conical flask and mixed with 150 ml distilled water.
2. 1 ml starch solution was added as an indicator.
3. The above mixture was titrated with 0.005 mol/L iodine solution until blue-black color appeared.
4. Titration was repeated until concurrent readings were obtained.
5. The amount of ascorbic acid was calculated by determining moles of reacting iodine by using the below equation

   Ascorbic acid + I^2 -------- $2I^-$ + Dehydroascorbic acid

C) Enzymatic antioxidants

I. Catalase

Catalase (EC 1.11.1.6) activity is determined according to the method of Aebi (1984). Catalase activity is assayed in terms of reduction in absorbance at 240 nm due to the decomposition of hydrogen peroxide into water and oxygen.

Reagents

1) 0.05 M Phosphate buffer (pH 7.0)- Dissolve 0.2651 g of NaH_2PO_4 and 0.8253 g Na_2HPO_4 in 100 ml of distill water and add 0.372 g EDTA.

Extraction:

1. 1 ml of 50 mM phosphate buffer (pH 7.0) containing 1 mM EDTA is used to homogenize 0.1g of sample in ice-cold condition.
2. It is centrifuged for 20 min at 4°C in a cooling centrifuge at 8000 rpm.
3. After centrifugation, the supernatant is collected and used as enzyme source.

Estimation:

1. The reaction mixture is prepared from 3 ml 50 mm phosphate buffer containing 1 mm EDTA and 40 mm H_2O_2.
2. 0.2 ml enzyme source was used to initiate the reaction and a decrease in absorbance at 240 mm was recorded for 3 min after initiating the reaction.

3. Extinction coefficient ($\varepsilon = 39.4\ mM^{-1}cm^{-1}$) was used to calculate activity of catalase.
4. One mole of H_2O_2 decomposed per min constituted one unit of enzyme activity.

II. Peroxidase (POD) activity:

Peroxidase activity was measured according to Summer et.al., (1943).The enzyme activity assayed using o-dianisidine as hydrogen donor and H_2O_2 as electron acceptor. The rate of formation of yellow orange colored dianisidine dehydrogenation product is a measure of peroxidase activity and can be assayed spectrophotometrically at 430 nm.

Reagents:

1) Potassium phosphate buffer (pH- 6.0)-

   0.2 M KOH - Weigh 11.2 gm KOH in H_2O and make upto 1000 ml.

   0.2M KH_2PO_4- Weigh 27.22gm KH_2PO_4 in H_2O and make upto 1000 ml.

   Mix 5.8 ml of KOH and 50 ml KH_2PO_4 and dilute upto 100ml with d/w.

2) 0.01M orthodianisidine (prepare fresh) - 24 mg ortho dianisine in 100ml methanol.
3) 0.2 M H_2O_2 - Dilute 0.227ml of 30% H_2O_2 to 100 ml.
4) 2N H_2SO_4 – 5.5ml H_2SO_4 diluted upto 100ml.

Extraction:

1. Homogenize the material in ice cold 0.1M phosphate buffer, pH 6 in a chilled pestle and mortar.

2. Centrifuge the homogenate at 16000g for 20 min. at 4^0C. Use the supernatant as enzyme source.

Enzyme assay:

1. Pipette out 1 ml of o-dianisidine, 0.5 ml of H_2O_2, 1 ml of phosphate buffer and 2.4 ml distilled water into testtube.

2. For Blank, exclude H_2O_2 but add additional volume of water.

3. Incubate at 30^0C and start the reaction by adding 0.2 ml of enzyme.

4. After 5 min, stop the reaction by adding 1 ml of 2N H_2SO_4.

5. Read the absorbance at 430 nm.

Calculation

Express the specific activity of enzyme as unit/min/mg of protein or per g of sample considering one unit enzyme as increase in OD by 1.0 under standard condition.


शासकीय होलकर (आदर्श, स्वशासी) विज्ञान महाविद्यालय, इन्दौर
विजय पांडुरंग भाटकर भवन



COLLABORATIVE RESEARCH OUTCOMES

LIST OF PUBLICATIONS

S.No.	Paper Published	Journal with year
1.	**Role of soluble silica in reducing oxidative stress in *Trigonella foenumgracum* (Methi) grown hydroponically in sewage water** Jaiswal P., Bafna A., Rangwala T., Vyas N., Gupta R.	International Journal of Agriculture Innovations and research, 2017
2.	**Soluble Silica As A Boon For Alleviationg Toxic Effects Of Heavy Metals On *Vigna Radiata* Grown Hydroponically In Sewage** Harsha Goyal, Angurbala Bafna, Tasneem Rangwala, Nagesh Vyas and Rohan Gupta	International Journal of Agricultural Science and Research, 2017
3.	**Role Of Soluble Silica in Alleviating Oxidative Stress in Soybean Crop** T. Rangwala, A. Bafna, N. Vyas and R. Gupta	Indian Journal of Agricultural Research. Agricultural Research Communication Centre, 2018
4.	**Role of soluble silica in counteracting lead toxicity in wheat (*Triticum aestivum*)** Sandhya Sharma, Angurbala Bafna, Nagesh Vyas and Rohan Gupta	Indian Journal of Agricultural Biochemistry, 2018
5.	**Beneficial role of soluble silica in enhancing chlorophyll content in onion leaves** Tasneem Rangwala, Angurbala Bafna, Nagesh Vyas and Rohan Gupta	Current Agriculuture Research, 2019
6.	**Effect Of Soluble Silica Fertiliser on Total Sugar, Protein, Starch Content Along with Amylase and Cellulase Activity In Banana** Tasneem Rangwala, Angurbala Bafna, Nagesh Vyas and Rohan Gupta	Plant Science Today, 2021

7.	**Comparative study of Routine Fertilizer V/S Soluble Silica Fertilization** Tasneem Rangwala, Angurbala Bafna, Nagesh Vyas and Rohan Gupta	Holkar Research Spectrum, 2021
8.	**Effect of pre sowing seed treatment with silica and fungicide on growth, photosynthetic pigments and oxidative stress parameters of Mung Bean (*Vigna Radiata*)** Angurbala Bafna, Shanti Patidar, Tasneem Rangwala, Nagesh Vyas and Rohan Gupta	International Journal of Agricultural Science and research (IJASR), 2021
9.	**Alleviation of Lead Induced Stress in Arhar (*Cajanus cajan*) by Application of Soluble silica** Sandhya Sharma, Angurbala Bafna, Nagesh Vyas and Rohan Gupta	Agriculture Research Journal, 2021

LIST OF PRESENTATION

S.No.	Presentation Title	Presented at	Date
1.	Beneficial role of Soluble Silica on carbohydrates, protein and oil content of soybean seed	International conference on Ecosytem Responses to Global Environmental Changes and Their impact organized by School of Life Sciences, Devi Ahilya Vishwavidyalaya Indore (M.P.)	16-18 Feb 2017
2.	Effect of Environmental stress on Chlorophyll content counteracted by soluble silica	National Seminar on "Recent Trends in Basic Sciences – RTBS 2018" organized by the Department of Chemistry, Govt. Holkar Science College, Indore.	3rd and 4th October 2018
3.	Effect of soluble silica on growth parameters and chlorophyll content in wheat (*Triticum Aestivum* L.) grown under lead toxicity	Workshop on Changing Environmental Scenario: Problems and solutions organized by Department of Botany, Mata Jija Bai Govt. PG Girls College, Indore	4-10 September 2019
4.	Enhancement in Productivity and Mineral content of Banana using soluble silica	National Seminar on Cardiac Health and Fitness organized by the Department of Biochemistry, Mata Jija Bai Govt. PG Girls College, Indore	16-17 September 2019
5.	Effect of soluble silica fertilization on Quality and yield of Banana	International Conference on Recent Advances in Life Sciences for Betterment of Environment and Human Health organized by Govt. Holkar Science College, Indore	14-15 December 2019
6.	Role of soluble silica in counteracting lead toxicity in wheat (*Triticum aestivum* L.)	International Conference on Scientific Impact of Music, Environment and sustainable development organized by DAVV Indore	7-9 January 2018
7.	Soluble silica a growth enhancer in crop grown under heavy metal stress	National Seminar on "Recent Trends in Basic Sciences – RTBS 2018" organized by the Department of Chemistry, Govt. Holkar Science College, Indore.	3rd and 4th October 2018
8.	Effect of Soluble silica on growth of Arhar grown under heavy metal stress	National Seminar on "Cardiac Health and Fitness" organized by the Department of Biochemistry, Mata Jija Bai Govt. PG Girls College, Indore and secured first position.	16 to 17 September 2019

9.	Alleviation of heavy metal toxicity in Arhar by use of soluble silica	National Seminar on "Recent Trends in Conservation of Natural Resources" from organized by the Department of Botany, Mata Jija Bai Govt. PG Girls College, Indore.	10 – 20 November 2019
10.	Mitigating effect of Soluble Silica in Wheat (*Triticum aestivum* L.) Grown under heavy metal Lead Toxicity	International Conference on "Recent Advances in Life Sciences for betterment of environment and Human Health" organized by Govt Holkar Science College, Indore in association with the National Academy of Sciences, Indore.	14 -15 December 2019
11.	Role of soluble silica (Si) in alleviating toxic effects of salt stress on the growth and Biochemical constituents of *Vigna radiata* (Mungbean)	3rd International Conference on Environmental, Agricultural, Chemical and Biological Sciences organized by Voice of Indian Concern for the Environment (VOICE) in association with CAFRe & LINK CAFRE, University of Pisa, Pisa, Italy	22,23, 26 January 2022
12.	Interactive effect of Silicon (Si) and Zinc (Zn) on the growth, biochemical constituents and pungency of the garlic bulb (*Allium sativum*) against drought stress	2nd International Conference on Environmental, Agricultural, Chemical and Biological Sciences organized by Voice of Indian Concern for the Environment (VOICE) in association with CAFRe & LINK CAFRE, University of Pisa, Pisa, Italy	24-26 January 2021
13.	Soluble silica as a beneficial nutrient for alleviating adverse effects of toxic metals on *Vigna radiata* (Mungbeans) plants grown hydroponically in sewage	International Conference on Recent Advances in Life Sciences for Betterment of Environment and Human Health organized by Govt. Holkar Science College, Indore	14-15 December 2019
14.	Comparison of seed priming efficiency of soluble silica with fungicide	International Conference on Recent Advances in Life Sciences for Betterment of Environment and Human Health organized by Govt. Holkar Science College, Indore	14-15 December 2019

Photo Gallery









Arise Graphics # 98270 63937

Govt. Holkar (Model, Autonomous) Science College, Indore

Department of Biochemistry
In Collaboration with
Noble Alchem Pvt. Ltd., Indore

7B

Activity Title:

Collaborative research work on "Effect of pre-sowing seed treatment with silica and fungicide on growth, photosynthetic pigments, and oxidative stress parameters of mung bean (Vigna radiata) with Noble Alchem Pvt. Ltd., Indore

Government Holkar Science College, Indore (MP)

Department of Biochemistry

Certificate of Collaboration

This is to certify that the **Department of Biochemistry, Govt. Holkar Science College, Indore, and Noble Alchem Pvt. Ltd. (Agribooster), Sanwer Road, Indore, M.P.** with the mutual collaborative work have successfully published a Research Paper entitled **"Effect of pre-sowing seed treatment with silica and fungicide on growth, photosynthetic pigments and oxidative stress parameters of mung *bean (vigna radiata)*"** in the session 2020-21.



Head

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5555Original Article

EFFECT OF PRE-SOWING SEED TREATMENT WITH SILICA AND FUNGICIDE ON GROWTH, PHOTOSYNTHETIC PIGMENTS AND OXIDATIVE STRESS PARAMETERS OF MUNG BEAN *(VIGNA RADIATA)*

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ABSTRACT

In the present scenario, farmers deal with increasingly volatile weather and their productivity and quality are affected by it.With the growth of new techniques in farming,a large number of methods are there to solve the above problem but the outcomes are not always positive because each field is having different conditions. Seed pretreatment is one of the good findings for them. The present study was carried out to investigate the efficacy of soluble silica and fungicide in the pretreatment of seed before sowing.A highly significant increase inheight of plants, photosynthetic pigments and a highly significant decrease in duration of germination, MDA content and peroxidase activitywere observed in the leaves of mung bean seedlings when seeds were pretreatedwith silica powder.Although a combination of silica powder pretreatment and foliar spray of soluble silica resulted in better growth and reduced oxidative stress. Insignificant changes in studied parameters were observed with fungicide pretreatment. However, liquid soluble silica application through foliar spray along with fungicide pretreatment showed significant changes in improving growth and reducing oxidative stress. It can be concluded from the present study that pretreatment of mung bean seeds with solublesilica powder resulted in enhanced growth and photosynthetic pigments concentration along with the reduction in oxidative stress. Foliar spray of soluble silica applied after the emergence of seedlings gives more pronounced results.

KEYWORD: Agribooster®, Germination, Malondialdehyde, Peroxidase Activity & Soluble Silica Powder

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1. INTRODUCTION

Germination and emergence of seedlings are the deciding processes for plant growth. Any abnormalities during the emergence of the seedling can restrain the yield and production of a crop (Singh et.al, 2015). Owing to ever-changing climatic and soil conditions, the yield of crops reduces as they are important factors for determining crop production (Mwale et.al. 2003). Several studies have been carried out for reducing time after sowing to the emergence of a seedling. The seed priming technique is one of the important developmental tools related to this field (Heydecker 1973). Seed priming techniques include different treatments that have an impact on metabolic,biochemical and enzymatic activities of seed, thus preparing it to better play their biological functions, such as early germination and seedling establishment (Demir &Mavi 2004).

Seed pretreatment is the process in which some physical, chemical and biological agents are applied before planting to provide effective protection against many seeds and soil-borne plant pathogens (Forsberg *et al.*, 2003). It can be a boon for the farmers having poor resources as it is easy to use and is also economical (Harries 1996).

Different insecticides and fungicides are often used for seed pretreatment to reduce damage caused by many pathogens (Lakhani).Seed pretreatment with different agents that are more environmental and crop friendly compared to commercial treatment in improving the early stages of seedling growth is in great demand (Sehwinn et al;1994). In the present scenario, seed pretreatment has a significant economic impact on markets as it is cost-effective in enhancing productivity (Research and Market, 2013).

Over the last few decades, several authors have observed the significant role of silicon (Si) to induce tolerance against biotic and abiotic stresses, including salinity, high temperature, chilling, drought, etc. It is accelerating seed germination and enhances plant growth and crop yield. It acts as a plant protectant and biostimulant under a range of stress conditions(Zhu& Gong 2014). It also improves the water status and water use efficiency of plants and reduces lipid peroxidation under drought stress (Hasanuzzaman et al; 2018, Liu et al;2019). It could regulate osmolyte accumulation and readjust osmotic potential under water-deficit conditions. It redirects the primary metabolism by acting as a signaling factor under unstressed conditions (Pang et al., 2019; Mohanty et al., 2020). Si is an imperative non-essential plant nutrient that can boost plant resistance against abiotic stresses (Ahmed et al., 2011).

Mung bean (Vigna radiata L. Wilkzek) is a pulse crop with a short duration (70-90 days) and high nutritive value. The seeds contain 22-28% protein, 60-65% carbohydrates, 1-1.5% fat, 3.5-4.5% fibers and 4.5-5.5% ash. (Mohamed and Karamany 2005). It is a cheap protein source for direct human consumption (Mubarak 2005).

Keeping the above facts in mind, the present experiment was designed to evaluate the potential of silica as a seed pretreatment agent to improve seed emergence, photosynthetic pigments and reduce oxidative stress parameters of mung bean seedlings.

2. MATERIALS AND METHODS

Mung bean (*Vigna radiata*) seeds MI731-3 variety was purchased from Indian Agriculture Research Institute (IARI) Indore, Madhya Pradesh. Fungicide (Vitavax) @ 2 gm/kg and silica in powdered form (Agribooster® Soluble Silicon Powder) @ 5 gm/kg were used as priming agents. For seedbed preparation and better germination of the crop, the soil was cultivated 2 times with a tractor-mounted cultivator followed by planking each time. Pre-sowing irrigation was applied. Fungicide and soluble silica powderwere mixed with seeds separately and kept for 15 minutes After pretreatment seeds were sowed in a block of area 2m × 2m(4 sq.m) in the field located in the village Loharpipliya, District Dewas. A randomized block design was used and each block represented a single treatment. Foliar spray of liquid silica (10ml/L)in the form of potassium silicate under the trade name Agribooster®was applied twice at the interval of 15 days after sowing.

Following treatments were designed for the study:-

1	T1	Without any pretreatment
2	T2	Fungicide pretreated
3	T3	Fungicide pretreated + Foliar spray of Liquid silica (10ml/L)
4	T4	Soluble silica Powdered pretreated
5	T5	Soluble silica Powdered pretreated + Foliar spray of Liquid silica (10ml/L)

Vegetative, Biochemical and oxidative stress parameters were estimated in leaves of *Vigna radiata* at an interval of 15 days after each treatment. After 15 days of sowing only samples from T1, T2 and T4 were collected.

2.1 Vegetative Parameters Studied in *Vigna radiata*

- **Duration of Germination:** It was noted onthe day when seedlings emerge above the ground.
- **Height of plant:** It was recorded using a standard centimeter scale.

2.2 Biochemical and Oxidative stress parameters studied in leaves of *Vigna radiata* seedlings

- **Chlorophyll and Carotenoid content:** Fresh leaf samples were extracted with 80% acetone. For spectrophotometric determination of chlorophyll a, chlorophyll b and carotenoid contents, the absorbance of the extracts were measured at 645 and 663 nm and 470nmfollowing the method by Lichtenthaler and Wellburn 1983 and calculated using the following formula:

  Chlorophyll (a) in (mg/g) = 12.7(A663) – 2.69(A645) × V/1000 × W

  Chlorophyll (b) in (mg/g) = 22.9(A645) – 4.68(A663) × V/1000 × W

  Carotenoid (mg/g) = [1000(A470)-3.27 (Chl a)- 104 (Chl b)]/229

- **Malondialdehyde content:** The level of lipid peroxidation as an indicator of oxidative stress was measured by using malondialdehyde (MDA), a decomposition product of the polyunsaturated fatty acid present in membrane lipids. It was estimated using thiobarbituric acid (TBA) as the reactive material and measuring absorbance spectrophotometrically at 532 nm.

  Using an extinction coefficient of 155 mM-1 cm-1 following the method of Heath and Packer, (1968).

- **Peroxidase activity**: The enzyme activity was assayed using o-dianisidine as hydrogen donor and H_2O_2 as electron acceptor. The rate of formation of yellow orange colored dianisidine dehydrogenation product was used as a measure of peroxidase activity and assayed spectrophotometrically at 430nm in units/min/g according to Summer and Gjessing, (1943).

3. RESULTS

Table 1: Effect of seed Pretreatment on Parameters Collected after 15 days of sowing

Treatment	Height of plant (cm)	Durationof germination (day)	Chlorophyll a(mg/g)	Chlorophyll b(mg/g)	Carotenoid(mg/g)	MDA(nmoles/gm)	Peroxidase (units/min/g)
T1	6.4 ± .1	4.3±.5	.20±.005	.09±.01	7.90±.02	0.06 ± 0	2.80 ± .05
T2	6.43±.05a^{ns} (.46%)	3.3±.5a^{ns} (23.25%)	.21±.02a^{ns} (5%)	.13±.02a^{ns} (44.44%)	7.96±.45a^{ns} (.75%)	0.07±.01a^{ns} (16.66%)	0.93±.04a** (-84%)
T4	8.3±.1a**b *(29.68%)	2± 0a**b** (-53.48%)	.22 ± 0a** b^{ns} (10%)	.15±.01a** b^{ns} (66.66%)	8.32±.005a**b ** (92.30%)	0.04±.005a** b** (33.33%)	0.81±.02a** b* (-86.15%)

* Indicates p value < 0.05 and is significant.** indicates p value < 0.01 and is highlysignificant.*** indicates p value < 0.001 and is extremely significant.a indicates comparison to T1. b indicates comparison to T2.Parenthesis indicates percent increase or decrease

As shown in table 1, the height of the plant and content of photosynthetic pigments as observed after 15 days of pretreatment showed an insignificant change in fungicide pretreatment. Silica powder pretreatment resulted in a highly significant increase in height of mung bean seedlings and photosynthetic pigments concentration. With the application of silica powder during pretreatment highly significant decrease was resulted in MDA and peroxidase activity as compared to control and fungicide pretreatment. No significant change was observed in the duration of germination on pretreatment with fungicide but a highly exceptional decrease was found in silica pretreatment.

Table 2: Effect of Pretreatment along with Foliar Spray of Soluble Silica on Plant height

Treatment	Height of Plant (cm)	
	After 15 days of first foliar spray	After15 days of second foliar spray
T1	11.6 ± .65	21.11± .32
T2	12.06 ± .81a^{ns}(3.95%)	23.43 ± 1.28a^{ns}(10.99%)
T3	15.23 ± .56 a** b**(31.29%)	25.86 ± .81a***b*(22.50%)
T4	16.17 ± .35a*** b**(39.39%)	26.93 ± .51a***b**(27.56%)
T5	19.46 ± 1.05a*** b**(67.75%)	27.33 ± 1.15a***b**(29.46%)
* Indicates p value < 0.05 and is significant.** indicates p value < 0.01 and is highly significant.*** indicates p value < 0.001 and is extremely significant.a indicates comparison to T1. b indicates comparison to T2.Parenthesis indicatespercent increase or decrease		

As shown in table 2, the height of theplant as observed after 15 days of first and second foliar spray showed no significant change in T2(pretreated with fungicide). However, the application of soluble silica through the foliar spray in fungicide pretreated seedlings (T3) showed a significant increment in height of the plant. Silica powder pretreatment(T4) alone and along withfoliar spray of silica also resulted in a remarkable increase in plant height as compared to control (T1) and only fungicide pretreatment (T2).

Table 3: Effect of Pretreatment along with Foliar spray ofSoluble silica on Photosynthetic Parameters

Treatment	Chlorophyll a (mg/g)		Chlorophyll b (mg/g)		Carotenoid (mg/g)	
	After 15 days of first foliar spray	After15 days of second foliar spray	After 15 days of first foliar spray	After15 days of second foliar spray	After 15 days of first foliar spray	After15 days of second foliar spray
T1	0.22±.005	0.15± .015	0.13±.005	0.07± .005	7.46±.35	5.53±.28
T2	0.24±.01 (9.09%) a^{ns}	0.17±.0 (13.33%) a^{ns}	0.15±.01 (15.38%) a^{ns}	.072±.005 (2.8%) a^{ns}	8.26±.35 (10.72%) a*	5.33±.13(-3.61%) a^{ns}
T3	0.26±.02 (18.18%) a*** b*	0.18± .01 (20%) a* b^{ns}	0.21±.01 (61.53%) a** b**	0.08 ± 0 (14.28%) a** b*	8.15± .04 (9.24%) a** b^{ns}	6.25±.03 (13.01%) a** b**
T4	0.26±.01 (18.18%) a*** b**	0.19± .0 (26.66%) a** b**	0.25±.005 (92.30%) a** b**	0.13±.02 (85.71%) a** b**	8.26± .01 (10.72%) a** b^{ns}	6.31± 04 (14.10%) a*** b***
T5	0.27±.0 (5%) a*** b**	0.20± .01 (33.33%) a*** b**	0.31±.005 (138.4%) a***b***	0.16±.005 (128.5%) a***b**	9.75± .10 (30.69%) a*** b*	6.77± .07 (22.42%) a***b***
* Indicates p value < 0.05 and is significant.** indicates p value < 0.01 and is highly significant.*** indicates p value < 0.001 and is extremely significant.a indicates comparison to T1. b indicates comparison to T2.Parenthesis indicates percentincrease or decrease						

Photosynthetic pigments as observed after foliar spray with soluble silica at the interval of 15 days showed insignificant change in the leaves of T2 (pretreated with fungicide only). As shown in table 3, a highly significant increase in chlorophyll a, chlorophyll b and carotenoid concentration was found in T3 (pretreated with fungicide along with foliar spray), T4 (Pretreated with solublesilica powder alone) and T5 (pretreated with solublesilica powder along with foliar spray).

Table 4:Effect of seed Pretreatment along with Foliar Spray ofsoluble silica on Oxidative Stress Parameters

Treatment	MDA (nmoles/gm)		Peroxidase (units/min/g)	
	After 15 days of first foliar spray	After 15 days of second foliar spray	After 15 days of first foliar spray	After 15 days of second foliar spray
T1	.05 ± .02	0.03 ± .006	5.45 ± .27	6.22 ± .06
T2	.03 ± .02 a^{ns} (- 40%)	0.019± .01 a^{ns} (-36%)	2.61 ±.01 a*** (-76.07%)	2.84 ±.23a***(-65.49%)
T3	.018±.004 a* b^{ns} (-64%)	0.012± .004 a^{*} b^{**} (-60%)	2.53 ±.12 a*** b^{**} (-76.81%)	2.48 ± .026 a*** b^{**} (-69.86%)
T4	.017± .002 a** b^{ns} (-66%)	0.013± .004 a** b^{ns} (-56%)	1.92 ± .04 a*** b^{**} (-82.40%)	1.54 ±.07 a*** b^{**} (-81.28%)
T5	.009± .0005 a*** b^{*} (-82%)	0.007± .001 a^{**} b^{***} (-76%)	1.89 ± .07 a*** b^{**} (-82.62%)	1.29 ± .05 a*** b^{**} (-84.32%)
* Indicates p value < 0.05 and is significant.** indicates p value < 0.01 and is highly significant.*** indicates p value < 0.001 and is extremely significant.a indicates comparison to T1. b indicates comparison to T2.Parenthesis indicates percentincrease or decrease				

As shown in table 4, application of silica through the foliar spray twice at the interval of 15 days showed an insignificant reduction in MDA content and activity of peroxidase enzyme in the leaves of mung bean seedlings obtained from T2 (fungicide pretreated) and a highly significant decrease was observed in T3 (pretreated with fungicide along with foliar spray), T4 (Pretreated with solublesilica powder alone) and in T5 (pretreated with solublesilica powder along with foliar spray).



Figure 1: Effect of Pretreatment with Fungicide and Silica along with Foliar Spray of Silica on Plant height og Mung Bean.

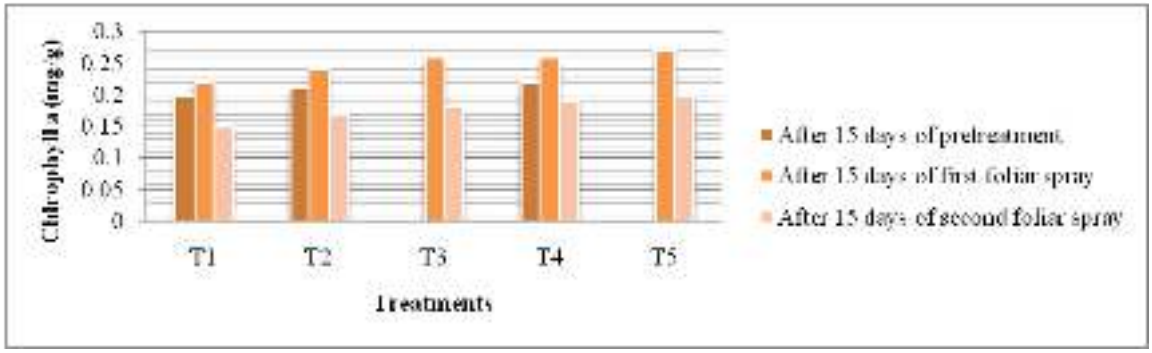


Figure 2: Effect of Pretreatment with Fungicide and Silica along with Foliar Spray of Silica on Chlorophyll 'a' Content in Leaves of Mung Bean.

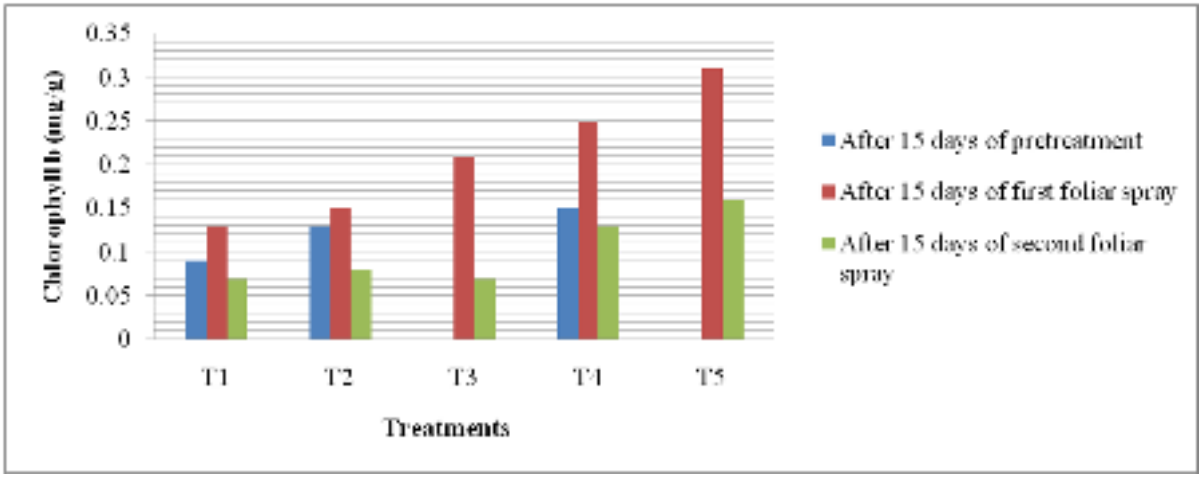


Figure 3: Effect of Pretreatment with Fungicide and silica along with Foliar Spray of Silica on Chlorophyll 'b' Content in Leaves of Mung Bean.

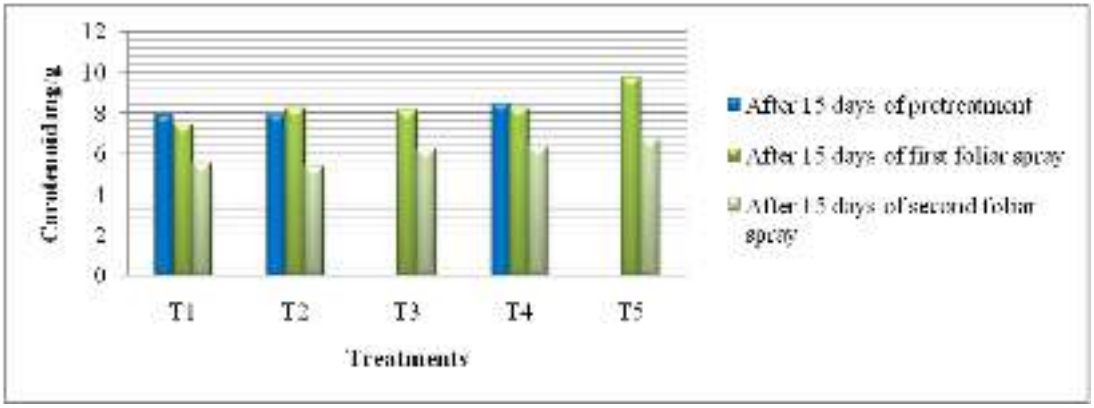


Figure 4: Effect of Pretreatment with Fungicide and Silica along with Foliar Spray of Silica on Carotenoid Content in Leaves of Mung Bean.

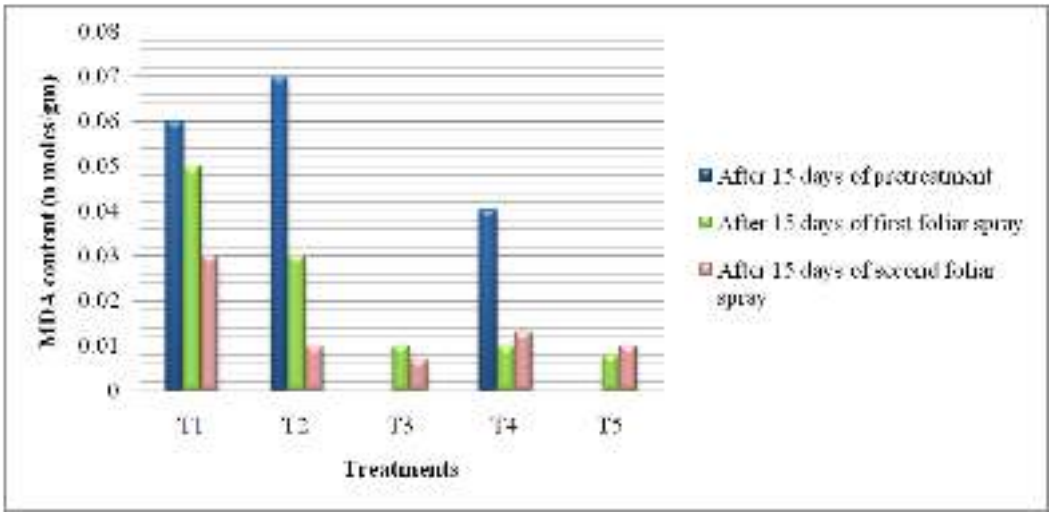


Figure 5: Effect of Pretreatment with Fungicide and Silica along with Foliar Spray of Silica on MDA Content in Leaves of Mung Bean.

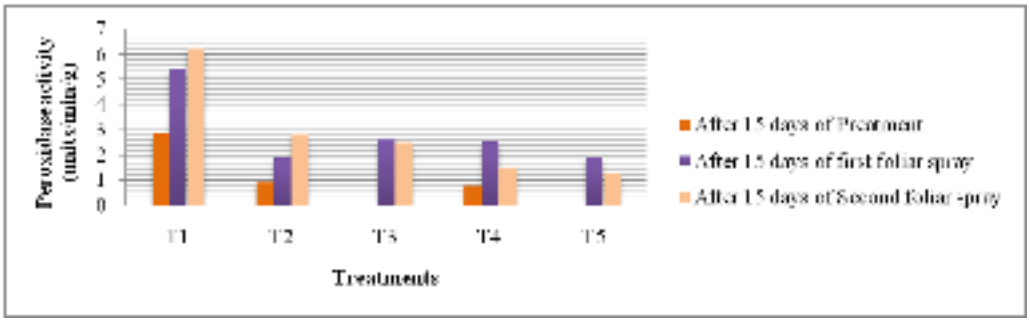


Figure 6: Effect of Pretreatment with Fungicide and (Soluble) Silica along with Foliar Spray of Silica on Peroxidase Activity in Leaves of Mung Bean.

4. DISCUSSIONS

4.1 Vegetative Parameters

Proper germination is very essential for the continued growth and yield of the crop. From the result obtained, solublesilica supplementation in pretreatment significantly enhanced the germination of mung beans. Siddiqui, etal., 2014 &Foltete et al., 2011 also reported increased seed germination, mean germination time, germination index and seed vigor index in tomato with the application of silicon. In water deficit conditions increased germination of seed was observed with the supplementation of calcium silicate (Zarger et al. 2013). Reasons behind this elevation as reported by (Lei et al 2008) is improved ability of seed for absorbing and utilizing water and fertilizer in presence of silicon which promotes seed antioxidant system, reduces stress by reducing superoxide radicals and increasing activity of some enzymes such as superoxide dismutase, ascorbate peroxidase, guaiacol peroxidase, and catalase in spinach.

The application of soluble silica powder as a pretreatment agent before sowing significantly increased the height of the plants of *Vigna radiata*in comparison to control (Figure 1). Likewise, THE results shownby Janmohammadi et al., 2015 on the pre-hydration treatment of seed with the colloid solution of silica nanoparticles before germination significantly improvedheight parameters insunflower (*Helianthus annuus L.*).

4.2 Photosynthetic Pigments

The role of chlorophyll and carotenoids in photosynthesis stabilization of membranes and energy transformation has been studied widely (Zang 2003,Jiang et al., 2017). The chlorophyll production is mainly dependent on the penetration of sunlight and it is the main component for photosynthesis (Srichaikul et al; 2011). It is influenced by different stress factors.Silicon provides rigidity and strength, enables erectness of leaves, which results in enhanced light absorption and improved photosynthesis, photo assimilation, growth and final yield of the plant (Saud et al. 2014).

Reduced chlorophyll content of tomato leaves due to drought stress was significantly increased by the addition of silicon which resulted in enhanced activity (Song et al., 2014). Underwater stress, silicon-mediated improvement in chlorophyll content may be due to reduced production of ROS in presence of silicon leading to improved antioxidant defense (Shi et al.2016).Results similar to the present study were observed in coriander leaves supplemented with silicon under water-deficient stress. Silicon supplementation led to the elevated growth rate of photosynthesis, yield and water using capacity of plants grown under reduced water availability(Gao et al., 2005). Silicon is likewise recognized to improve the resistance of plants towards drought through enhancing photosynthetic performance, maintaining plant water equilibrium and straightness of leaves (Yin et al.2013). Silicon increased expression of genes which encodes for enzymes involved in the synthesis of precursors for chlorophyll (protoporphyrin IX, Mg-protoporphyrin IX and protochlorophyllide) under nitrate stress may be the reason for the improvement in chlorophyll content is the presence of silica. (Candan&Tarhan2003; Taiz & Zeiger 2009). Our study results also showed improvement in content of chlorophyll a, chlorophyll b and carotenoid in the leaves of mung seedlings pretreated with soluble silica powderbefore sowing along with foliar spray of soluble silica twice at the interval of 15 days after sowing (Figure 2, 3,4).

4.3 Oxidative Stress

In open field everchanging climatic conditions exposes plants to stress factors which lead to the production of many ROS in the course of photosynthesis and respiration (Milttler 2002, Arbona et al., 2003).For maintenance of homeostasis in plants, two mechanisms for detoxification are observed which include enzymatic and non enzymatic antioxidants(Sytar et al., 2013, Wuet et al., 2017). In stress caused due to salinity, significant reduction in the content of peroxidase, catalase activity was also observed by (Tarabi et al.2015, Kim et al.,2016 and Tripathi et al., 2017). Oxidative stress marker in terms of MDA was reduced and peroxidase activity was increased with pretreatment of mung seeds with soluble silica powder before sowing. Application of soluble silica through foliar spray after sowing further reduced content of MDA and enhanced activity of peroxidase indicating decrement in oxidative stress (Figure 5, 6). Similar results with supplementation of silicon indicating a decrease in MDA content in salt-stressed Barley, maize and grapevine rootstock was reported which maintained integrity of membrane and reduced permeability.

5. CONCLUSIONS

Seed pretreatment with silica is an environmentally safe and new wave that can be easily adopted by resource-poor farmers and benefited the farmers in various ways. It may indeed be considered as a valuable strategy to improve stand establishment under adverse agro-climatic conditions (rainfed, dry farming and dryland farming regions) with enhanced yield, increased tolerance to stress situations, increased resistance against diseases, enhanced crop competitiveness against weeds and increased water use efficiency. The pretreatment with Soluble silica powder was more beneficial in improving vegetative growth and photosynthetic pigment than fungicide. The farmers are advised to use Soluble silica powder for the

pretreatment of seeds as it results in better germination and growth of the seed. Thepretreatment with soluble silica powder along with foliar spray with soluble silica can further enhance quality by enhancing growth and reducing oxidative stress. Thus in addition to silica pretreatment, foliar spray with soluble silica is also suggested to the farmers to increase their productivity.

6. ACKNOWLEDGEMENT

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7C

Activity Title:

Collaborative research work on the effect of Soluble Silica on the Plant Growth, leaf Chlorophyll content, and Bulb Quality of garlic (Allium sativum L.) against Drought Stress with Noble Alchem Pvt. Ltd., Indore

Government Holkar Science College, Indore (MP)

Department of Biochemistry

Certificate of Collaboration

This is to certify that the **Department of Biochemistry, Govt. Holkar Science College, Indore, and Noble Alchem Pvt. Ltd. (Agribooster), Sanwer Road, Indore, M.P.** with the mutual collaborative work have successfully published a Research Paper entitled **"Effect of Soluble Silica on the Plant Growth, Leaves Chlorophyll Content and Bulb Quality of the Garlic (*Allium sativum L.*) against Drought Stress"** in the session 2019-20.



Head

Department of Biochemistry

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RESEARCH ARTICLE Indian Journal of Agricultural Research, Volume Issue : ()

Effect of Soluble Silica on the Plant Growth, Leaves Chlorophyll Content and Bulb Quality of the Garlic (*Allium sativum* L.) against Drought Stress

Harsha Goyal[1], Angurbala Bafna[1], Nagesh Vyas[2], Rohan Gupta[2]

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ABSTRACT

Background: Garlic is an aromatic spice with nutritional and medicinal values. Climatic variations such as drought, adversely affect Garlic's morpho-physiological, biochemical attributes and diminish its bulb quality. Soluble silica is a plant-available form of silicon (Si). Silica is beneficial for plant's healthy growth especially against stress conditions. The present study was aimed to evaluate the effect of soluble silica on the garlic plant growth, leaves chlorophyll content and bulb quality against drought stress.

Methods: Garlic was cultivated during the *Rabi* season (2019-2020) in the experimental field Lohar pipliya (Dewas), India. Randomized experimental blocks consisted of six treatments as follows: T_1- Control (well-watered), T_2- Drought stress (water supply reduced by about 50%), T_3- Drought + a basal dose of NPK fertilizers (BDF) in soil, T_4, T_5, T_6- Drought + BDF + foliar sprays of 7.5, 10 and 12.5 ml L^{-1} soluble silica respectively. Silica sprays were applied seven-time at a regular interval of 15-days. After 120-days of sowing, plant growth in terms of plants height and number of leaves $plant^{-1}$ were measured. 120-days leaves chlorophyll, MDA and proline content were estimated. Garlic bulb's quality in terms of fresh-dry weight and diameter were recorded at the final harvest.

Result: Results revealed that drought significantly reduced Garlic's plant height, bulb quality (weight and diameter), chlorophyll (Chl-*a* and Chl-*b*) and increased MDA, proline content in contrast to the well-watered garlic. Fertilizers (BDF) feebly improved garlic bulb quality. However, fertilizers (BDF) supplemented with soluble silica sprays (7.5 ml L^{-1}<12.5 ml L^{-1}<10 ml L^{-1}) significantly increased plant height, bulb weight and diameter, leaves chlorophyll, proline and reduced MDA content over the drought-stressed Garlic. Fertilizers (BDF) supplemented with Soluble silica maintained plant water content, reduced oxidative stress and increased leaves chlorophyll content. These resulted in good quality garlic bulbs in terms of weight and diameter despite the drought stress.

Key words: Chlorophyll, Drought stress, Garlic bulb quality, MDA, Proline, Soluble silica.

INTRODUCTION

Garlic (*Allium sativum* L., Family Alliaceae) is the second-largest bulbous crop that originated 5000 years ago in Central Asia (Benke *et al*., 2020). India (5.3%) is the second principal producer of Garlic after China (79.8%) and exports it in the fresh-dehydrated form to other countries such a Bahrain, Germany and Japan (Lawande *et al*., 2009). Garlic is widely used as a spice in flavoring food because of the distinctive aroma of organosulphur compounds like allicin (diallyl thiosulphate) (Bhatia *et al*., 2020). Garlic has various health benefits; it is used as a natural antibiotic for the common cold, fever, bronchitis and lowers serum cholesterol and triglycerides in cardiovascular diseases (Reyes *et al*., 2018, Morales-Gonzalez *et al*., 2020, Vijaya *et al*., 2020).

Garlic production solely depends on the irrigation water supply because of its shallow roots and water-sensitive nature. Adverse climatic variations such as drought severely affect garlic growth, quality and yield in drylands (Sattar *et al*., 2020). Water scarcity inhibits seed germination and seedling growth (Maksimovic *et al*., 2021), causes cellular dehydration, stomatal closure and imbalance in reducing equivalents in plants (Hussain *et al*., 2019). These trigger synthesis of reactive oxygen species (ROS) in cellular organelle like mitochondria, chloroplast, peroxisome. ROS damage membrane lipid, protein, nucleic acid and negatively affect plant growth and development (Chung *et al*., 2020, Hasanuzzaman *et al*., 2020).

Routinely used agriculture practices and fertilizers were not enough for the plants to cope with the climatic adversities and require additional growth nutrients. Silicon (Si) is a quasi-essential (Zargar *et al*., 2019), an anti-stress agent against abiotic and biotic stresses (Malhotra and Kapoor, 2019). Although Si is abundant in soil, plants are not able to utilise its complex form (Zargar *et al*., 2019). Soluble silica (Agribooster™) a new water-soluble form of silicon, that can be utilised directly by plants and exhibits numerous beneficial effects on plant growth, quality and yield against climatic

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adversities. Previous studies suggested that soluble silica mitigated heavy metal (Pb) toxicity on *Vigna radiata* (Goyal *et al*., 2017), *Triticum aestivum* (Sharma *et al*., 2018). Si mitigated salt stress in Soybean (Chung *et al*., 2020), drought stress in Maize (Parveen *et al*., 2019), sudden environmental stress (Rangwala *et al*., 2018) and elevated temperature in Barley (Hussain *et al*., 2019). Polysilicate ($SiO_2.nH_2O$) impregnates plant tissues like sclerenchyma, epidermis, vascular bundle to provide strength and rigidity against external stress (Mandlik *et al*., 2020). It maintained turgor pressure, nutrient accumulation in Canola against the drought stress (Bukhari *et al*., 2020). Si balanced the water status of plants by apoplastic role (Thorne *et al*., 2020), improved chlorophyll pigments and antioxidants (SOD, CAT and POD) activity in maize seedlings (Sattar *et al*., 2020).

Our study explored the possibilities of the use of soluble silica foliar sprays (a plant-available form of silicon) along with routinely used fertilizers (BDF) to reduce the adverse effect of drought on Garlic's plant growth, 120-days leaves chlorophyll (Chl-*a* and Chl-*b*), MDA, proline content and bulb quality.

MATERIALS AND METHODS

Experimental field and plant material

A field experiments on the garlic (*Allium sativum L.*) crop of variety-Amleta were carried out during *Rabi* season (28 October 2019 to 21 March 2020) at the agricultural research field, Lohar pipliya village, Dewas (MP), India (22° 54′ 42″N longitude and 75° 59′31″E latitude). Growth and Biochemical parameters of 120-days Garlic leaves and harvested matured bulbs were recorded at the Department of Biochemistry, Govt. Holkar Science College, Indore (M.P).

The soil characteristics before treatments were: pH 7. 98, E.C 0.92 d Sm^{-1}, Organic carbon 0.48%, N, P, K, are 196, 11.2 and 480 kg ha^{-1} respectively. There was no rainfall and field temperature was varied from 22°C to 34°C during the complete growth period.

Experimental design

The experimental setup was designed as randomized complete blocks consisted of six treatments, each having a 2×1.8 m^2 block area (Fig 3a). Garlic bulbs were carefully separated into individual cloves and sown in the field so that the distal end was upward and covered with soil.

Tt. no.	After 15-days of sowing, Garlic plants were treated with six treatments as follows:
T_1	Control (well-watered).
T_2	Drought stress (water supply reduced by about 50% as compared to control).
T_3	Drought stress + a basal dose of N, P, K fertilizers in soil (BDF).
T_4	Drought stress + BDF + foliar spray of 7.5 ml L^{-1} soluble silica fertilizer.
T_5	Drought stress + BDF + foliar spray of 10 ml L^{-1} soluble silica fertilizer.
T_6	Drought stress + BDF + foliar spray of 12.5 ml L^{-1}soluble silica fertilizer.

Here, soluble silica fertilizer (Agribooster™) was used as a plant-available form (PAF) of silicon (Si). It consisted of 13.1 % SiO_2. Silica was sprayed seven-time in a regular interval of 15-days from sowing up-to-the Garlic bulb maturity. Weeds were removed manually. After 120-days of sowing (DAS), Garlic leaves from each treatment were sampled for biochemical assay and at final harvest matured Garlic bulbs were collected for quality assay (Fig 3c and 3d).

Plant growth (height and number of leaves plant^{-1})

120-days (DAS) Garlic plant height (cm) and the number of leaves were recorded in triplicates (Fig 3b) (Wu *et al*., 2015).

Bulb quality (weight and diameter)

After harvest, Garlic bulbs and pseudo-stem diameter (cm), were measured through a vernier calliper. Its fresh and dry weight (gm) was measured using an electronic balance in triplicates (Mann, 1952).

Chlorophyll content

Chl-*a and* Chl-*b* content of 120-days Garlic leaves (200 mg) were extracted in 80% alcohol and estimated using Lichtenthaler and Welburn (1983) equation:

Chl-*a* (µg mL^{-1}) = 12.21 (A_{663}) - 2.81 (A_{646}) and Chl-*b* (µg mL^{-1}) = 20.13 (A_{646}) - 5.03 (A_{663}).

Malondialdehyde (MDA) estimation

MDA level of 120-Days Garlic leaves (100 mg) were estimated using: $A = \varepsilon cl$,

where

A = Absorbance at 532 nm.

ε = Extinction coefficient (155 $mM^{-1}cm^{-1}$).

l = length of cell (1cm).

C = Concentration (Heath and Packer, 1968).

Proline estimation

Proline content of 120-Days Garlic leaves (500 mg) were determined using a standard curve and estimated on a fresh weight basis of sample: µmoles of Proline/g tissue = µg proline/ ml × toluene (ml) × 5/ g sample 115.5 (Bates *et al*., 1973).

RESULTS AND DISCUSSION

Chlorophyll content in garlic leaves

As shown in Table 1 and Fig 1, Chl-*a* and Chl-*b* content in Garlic leaves were reduced under drought stress (T_2) compared to the well-watered control (T_1). Here, reduced fresh weight, increased MDA and proline content in Garlic leaves (T_2) (Table 1) indicates that water scarcity has induced oxidative stress in plants. Abid *et al*.,(2018) revealed that stomatal closure in drought stressed-wheat leaves, reduces carbon assimilation, cause an imbalance between excited electrons and their use in light reaction to trigger overgeneration of reactive oxygen species (ROS). Chlorophyll content in Garlic leaves might have reduced due to oxidative damage of chloroplast thylakoid membrane and inhibition of chlorophyll biosynthesis enzymes by ROS. Our

suggestions were in favor of other findings that drought reduced chlorophyll content in maize hybrid varieties Xida-319 and Xida-889 (Hussain *et al*., 2019) and Wheat (Pozo *et al*., 2020). Routinely used fertilizers (BDF) (T_3) insignificantly improved Chl-*a* and Chl-*b* content in Garlic leaves as compared with drought Garlic leaves (T_2). Supplementation of silica sprays to fertilizers (BDF) significantly increased leaves Chl-*a* and Chl-*b* content (T_4, T_5, T_6) in order 7.5 ml L^{-1} <12.5 ml L^{-1} <10.0 ml L^{-1} over the Garlic grown under drought without any treatments (T_2). Previous studies of Ma, (2012), Sapre and Vakharia, (2016), Greger *et al*., (2018), Alamri *et al*., (2020) suggested that silicon deposits at the leaf bundle sheath and form the silica cuticle layer (epidermis) to reduce the transpirational water loss in plants. In our study, reduced MDA level and highly significantly increased proline (osmoprotectant) content in garlic treated with BDF+silica sprays (T_4, T_5, T_6) as compared to drought garlic (T_2) shows that silica has balanced water content in plants and might have prevented Chloroplast thylakoid membrane from oxidative damage. Our study is in favour with Dehghanipoodeh *et al., (*2018) that Potassium silicate (K_2SiO_3) (10 mmol L^{-1}) maintained the water content of the Strawberry plants. Sun *et al*., (2021) also showed that 15 g L^{-1} of water-soluble silicon (Si-50G, Si-60G) has improved proline, sugar and protein (osmolytes) content to prevent membrane damage and increased chlorophyll content in maize seedlings.

Growth attributes of garlic plants

In our study, the Garlic plant's growth was assessed based on height and the number of leaves on the plants. As shown in Table 2 and Fig 2, drought (T_2) reduced garlic plant height significantly and the number of leaves $plant^{-1}$ insignificantly over the well-watered plant (T_1). It is evident that plants absorb growth nutrients from soil in a water-soluble form. Here, garlic plant's height were reduced might be due to insufficient availability of water-soluble nutrients from soil. Secondly, reduced light-capturing pigments (Chl) possibly affected plants photosynthetic activity and diminished garlic plant height in drought stress. The basal dose of NPK fertilizers (T_3) has slightly improved plant growth against drought stress (T_2). However, BDF+silica sprays ($T_{4,5,6}$) have

Table 1: Showing the effect of soluble silica on chlorophyll (Chl-*a*, Chl-*b* and Chl-*a*/*b*), MDA and proline content of garlic leaves against drought stress.

Type	Conc. of Silica (ml L^{-1})	Chl *a* (mg/g)	Chl *b* (mg/g)	Chl *a*/*b* (mg/g)	MDA (mM/g)	Proline (µmoles/g)
Control	0	13.182±0.15 a, b**, c*	6.364±0.20 a, b*, c*	2.073±0.09 a, b*, c*	0.00299±0.0001 a, b*, c*	14.66±0.57 a, b*, c*
Drought	0	11.728±0.42 a**, b, c^{ns}	5.976±0.07 a*, b, c^{ns}	1.926±0.01 a*, b, c^{ns}	0.00347±0.00003 a**, b, c^{ns}	16.33±0.58 a*, b, c^{ns}
Drought + BDF	0	11.839±0.22 a**, b^{ns}, c	6.146±0.09 a^{ns}, b^{ns}, c	1.922±0.04 a^{ns}, b^{ns}, c	0.00324±0.0001 a*, b^{ns}, c	17.33±1.15 a*, b^{ns}, c
Drought + BDF + silica	7.5 ml L^{-1}	12.512±0.42 a*, b*, c^{ns}	6.134±0.06 a^{ns}, b*, c^{ns}	2.040±0.002 a^{ns}, b*, c^{ns}	0.00317±0.0001 a^{ns}, b*, c*	20.33±1.15 a**, b**, c*
	10.0 ml L^{-1}	12.544±0.42 a*, b*, c*	6.154±0.06 a^{ns}, b*, c*	2.049±0.01 a^{ns}, b*, c*	0.00299±0.0002 a^{ns}, b*, c**	20.66±0.57 a***, b***, c*
	12.5 ml L^{-1}	12.648±0.42 a*, b*, c*	6.171±0.03a ^{ns}, b*, c*	2.048±0.01 a^{ns}, b*, c*	0.00311±0.0001 a^{ns}, b*, c*	19.66±0.57 a***, b**, c*

^{ns} indicates not significant, * indicates significant, ** indicates highly significant *** indicates extremely significant. a-shows the p-value in contrast to control, b- shows the p-value, in contrast to, drought stress, c-shows the p-value in contrast to fertilzer.

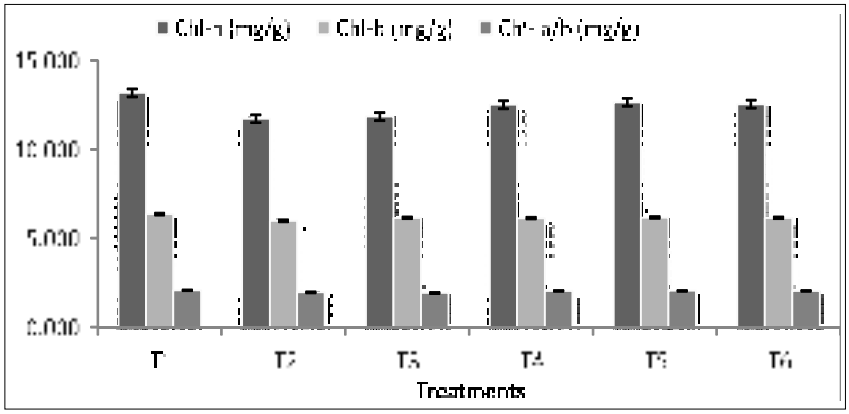


Fig 1: Effect of soluble silica on Chl-*a*, Chl- *b*, Chl- *a*/*b* content in garlic leaves against drought stress.

Table 2: Showing the effect of Soluble silica on growth and bulb quality of garlic against drought stress.

Type	Conc. of silica (ml L^{-1})	Height of garlic plant (cm)	No. of leaves $plant^{-1}$	Pseudo-stem diameter (cm)	Garlic bulb diameter (cm)	Fresh weight of Garlic bulb (gm)	Dry weight of Garlic bulb (gm)
Control	0	75.333±3.785	7.000±1.000	0.567±0.1528	3.867±0.2887	38.42 ±1.3	20.113±1.3805
		a, b**, c*	a, b^{ns}, c^{ns}	a, b^{ns}, c^{ns}	a, b^{*}, c^{ns}	a, b**, c	a, b^{*}, c^{ns}
Drought	0	52.833±5.107	6.333±0.577	0.500±0.100	2.900±0.500	28.22±1.4	15.40±0.624
		a^{**}, b, c^{ns}	a^{ns}, b, c^{ns}	a^{ns}, b^{***} c^{ns}	a^{*}, b, c^{ns}	a^{**}, b, c^{ns}	a^{*}, b, c^{*}
Drought + BDF	0	58.000±5.408	6.667±0.577	0.567±0.115	3.600±0.300	31.23±1.7	17.423±4.245
		a^{*}, b^{ns}, c	a^{ns}, b^{ns}, c	a^{ns}, b^{ns} ,c	a^{ns}, b^{ns}, c	a^{*}, b^{ns}, c	a^{ns}, b^{*}, c
Drought + BDF + Silica	7.5 ml L^{-1}	65.67±4537	7.333±1.155	0.567±0.058	4.100±0.100	33.55±1.5	22.707±1.308
		a^{ns}, b^{**}, c^{*}	a^{ns}, b^{*}, c^{*}	a^{*}, b^{**}, c^{**}	a^{**}, b^{**},c^{**}	a^{*}, b^{ns}, c^{*}	a^{**}, b^{**}, c^{**}
	10.0 ml L^{-1}	74.333±4.509	8.0±1.00	0.607±0.058	4.500±0.100	40.727±0.595	32.043±1.257
		a^{ns}, b^{**}, c^{*}	a^{ns}, b^{*}, c^{**}	a^{*}, b^{**},c^{**}	a^{**}, b^{**},c^{**}	a^{*}, b^{***}, c^{**}	a^{***}, b^{**}, c^{**}
	12.5 ml L^{-1}	73.00±1.328	8.0±1.00	0.633±0.208	4.467±0.153	36.977±2.9	27.09 ±1.257
		a^{ns}, b^{**}, c^{**}	a^{ns}, b^{*}, c^{**}	a^{*}, b^{**}, c^{**}	a^{**}, b^{**},c^{**}	a^{ns}, b^{*}, c^{*}	a^{***}, b^{**}, c^{**}

^{ns} indicates not significant, * indicates significant, ** indicates highly significant. a-shows the p-value in contrast to control, b-shows the p-value, in contrast to, drought stress, c-shows the p-value in contrast to fertilizer.

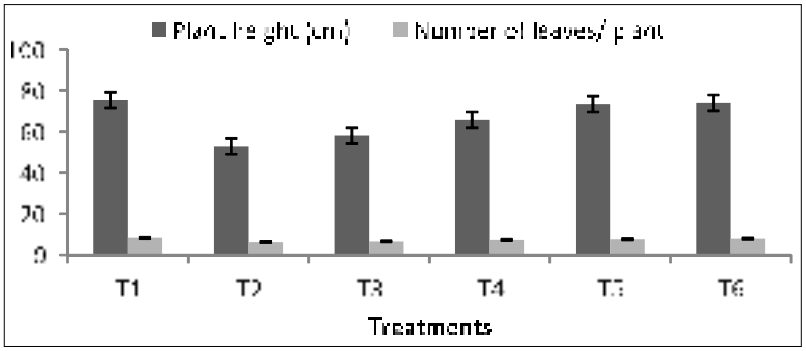


Fig 2: Effect of soluble silica on the height of the Garlic plants under drought stress.

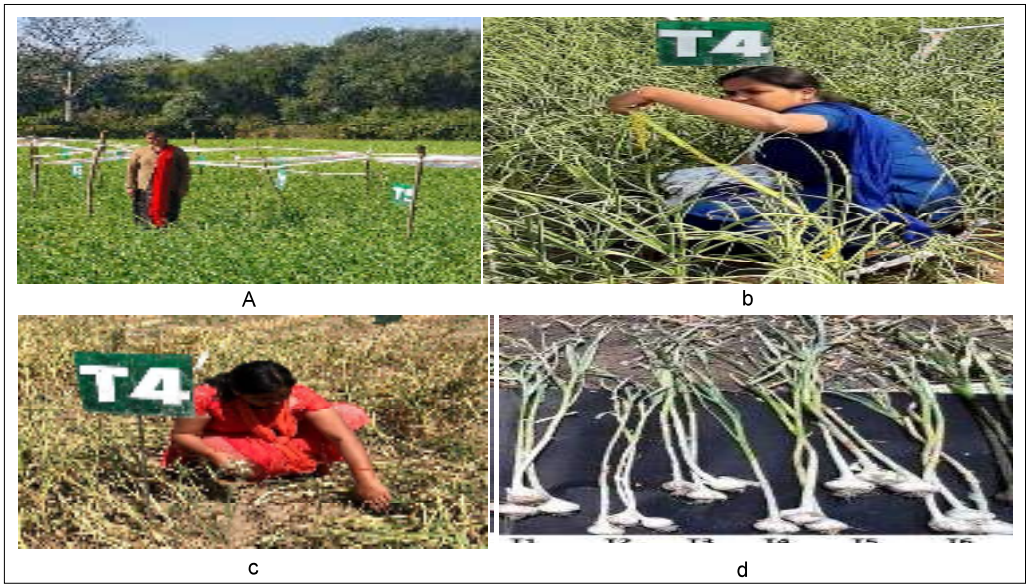


Fig 3 a): Showing randomised blocks for garlic; b) Showing garlic plant height measurement; c) Garlic bulb collection from research field; d) Comparison between Garlic grown in different treatments.

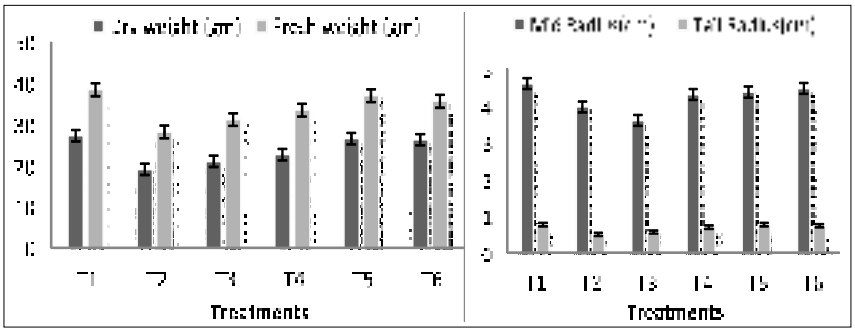


Fig 4: Effect of soluble silica on the fresh-dry weight and diameter of the Garlic bulbs against drought stress.

significantly increased plant height over the drought plants(T_2) in order, 7.5 ml L^{-1} <12.5 ml L^{-1} <10 ml L^{-1}. Our study is in agreement with Kowalska *et al*., (2020) that foliar sprays of orthosilicic acid (Si) (24%) increased plant height and number and weight of ear in spring wheat. Si increased plant growth by balancing water and nutrient content (Rizwan *et al*., 2015). Similarly, 1000 kg ha^{-1} treatment of potassium silicate (K_2SiO_3) increased the pH of the soil and P, Ca, Zn, S, Mo, Mn and Cu nutrients available to the plants (Greger *et al*., 2018). 250 kg ha^{-1} dose of Si (Diatomaceous earth, Calcium silicates, Bagasse ash) with a basal supply of fertilizer increased plant growth by enhancing nitrogen and potassium intake (Gade *et al.,* 2019), (Minden *et al*., 2020). Various Osmolytes such as proline, antioxidants and secondary metabolites helps plants to combate drought stress (Kusvuran and Dasgan, 2017). Silicon enhanced proline and antioxidants in wheat to reduce oxidative stress in term of H_2O_2 level (Sapre and Vakharia, 2016). Similarly in our study, silica prevented plants lodging, increased proline content, reduced MDA level that might have increased photosynthetic food synthesis and uptake of essential nutrients from the soil for plants vegetative growth.

Garlic bulb quality

Garlic bulb quality is the main criteria for the farmers to earn a profitable income. A perusal of our data presented in Table 2 and Fig 4, revealed that drought (T_2) considerably reduced the fresh-dry weight and diameter of the Garlic bulb over the control (T_1). As per Omar and Wabel (2010), the Garlic bulb is mainly constituted by water (65%), sugar, protein and fiber. Water deficiency and reduced leaves chlorophyll content might have declined photosynthetic food storage and affected bulb weight and diameter negatively. However, foliage applied silica sprays (7.5, 10, 12.5 ml L^{-1}) + NPK fertilizers (T_4, T_5, T_6) in the soil improved bulb diameter, fresh-dry weight in contrast to the bulbs grown under limited water supply (T_2). This is in favor with Bhangare and Shinde (2020) that foliarly applied silicon has improved onion bulb diameter. Dorairaj *et al*.,(2020) showed that silicon increased uprightness in rice plants and thus due to more photosynthetic activity weight of the panicle and 100 rice grains was increased. Foliage applied Si protected Soybean from lodging by lignin deposition and increased photosynthetic rate in soybean leaves. Magd *et al*., (2013) reported that bulb weight depends on the quantity of organic food such as sugar and protein transferred from leaves to the bulb. Hussaina *et al*., (2021) showed that foliage applied Si protected Soybean from lodging by lignin deposition and enhanced photosynthetic rate in Soybean leaves. Our studies show that silica mitigated water stress and increased chlorophyll content in Garlic plants (T_4, T_5, T_6) as compared to drought plants. Sufficient water availability and increased chlorophyll content in silica treated leaves might have increased photosynthetic food synthesis and translocation and accumulation of synthesised food to bulb increased bulb weight and diameter compared with the drought bulbs.

CONCLUSION

Drought (water scarcity) induced oxidative stress and reduced chlorophyll (light-harvesting pigments) in Garlic leaves. These might have declined photosynthetic food storage and negatively affected Garlic plant height, bulb fresh-dry weight and diameter. Routinely used fertilizers insignificantly improved bulb quality. Supplementation of fertilizers (BDF) with silica foliar sprays significantly relieved Garlic plants from oxidative stress by retaining water content and increasing proline (osmoprotectant) concentration. Probably silica also increased uptake of essential growth nutrients of soil and NPK fertilizers (BDF). Thus, the interactive effect of soluble silica foliar sprays and NPK fertilizer (BDF) in soil made it possible to obtain good quality Garlic bulbs in terms of weight and diameter despite the drought. Our studies suggested that soluble silica can be integrated with routine agriculture practices to protect plants from drought stress.

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Conflict of interest: None.

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7D

Activity Title:

Research Activities were carried out: 1) Role of soluble silica in alleviating oxidative stress in soybean crops; 2). The Role of Soluble Silica in Counteracting Lead Toxicity in Wheat (Triticum aestivum L.)

Government Holkar Science College, Indore (MP)

Department of Biochemistry

Certificate of Collaboration

This is to certify that the **Department of Biochemistry, Govt. Holkar Science College, Indore, and Noble Alchem Pvt. Ltd. (Agribooster), Sanwer Road, Indore, M.P.** with the mutual collaborative work have successfully published a Research Paper entitled **"Role of soluble silica in alleviating oxidative stress in soybean crop"** in the session 2018-19.



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Role of soluble silica in alleviating oxidative stress in soybean crop

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ABSTRACT

Sudden changes in environment causes abiotic and biotic stress due to which farmers are facing problem of decreased yield. The present study was designed to improve yield by alleviating oxidative stress in crops. Silicon is gaining importance in promoting growth and yield of plants. Soluble silica in the form of Agribooster™ was sprayed on test field of soybean during cultivation. Proline content was found to be decreased significantly in soybean sprayed with soluble silica. Significantly decreased malondialdehyde content was observed in soybean which indicates beneficial role of silica in preventing lipid peroxidation. Soluble silica increased peroxidase activity by increasing water availability and total phenol content was also found to be increased significantly in soybean. So from the present study it can be concluded that silica when applied on crops in soluble form prevent oxidative stress caused due to various environmental factors which may help in better quality product and yield.

Key words: Agribooster TM, Malondialdehyde, Peroxidase, Phenol, Proline.

INTRODUCTION

One of the main determinants of agricultural production is climate. There is significant concern about the effects of climate change and its variability on agricultural production throughout the world (Chakraborty and Hazari, 2017). In today's scenario sudden climatic changes are causing damage to crops by increasing oxidative stress. Silicon which was not believed to be essential for plant growth is becoming a boon for the development of plants. Silica in soluble form imparts many benefits for plants including enhanced growth, improvement in combating various adverse conditions like resistance to drought, salinity; heavy metal toxicity stresses etc and yield (Epstein, 1999; Ma *et al.,* 2006). Silica have been shown to protect plant against various abiotic stress such as extremes of temperature, UV radiation etc. Water losses may be decreased through deposition of silica (Haynes, 2014). Silica imparts erectness and also improves photosynthesis in plants (Dorneles *et al.,* 2016). Exposure of plants to different environmental stress, biotic or abiotic, produces various reactive oxygen species (Chiban *et al.,* 2011). As shown in Fig. 1, superoxide radical (O_2-), hydrogen peroxide (H_2O_2), hydroxyl radical (OH) and singlet oxygen are all reactive oxygen species which trigger synthesis of each other (Marschner, 1995). Silica shows positive effect on growth of many plants and provides resistance against stress (Broadley *et al.,* 2012). In plants subjected to multiple stresses, silica is actively involved in various metabolic and physiological activities (Sacala, 2009). Mechanism involved in ameliorative effect of silica to different stresses is activation of antioxidative defence (Liang *et al.,* 2003).

These ROS cause damage to cell membrane, proteins, nucleic acid and lipids (Foyer *et al.,* 1994). However, the most susceptible target is polyunsaturated fatty acids. Removal of hydrogen atoms from polyunsaturated fatty acid initiates the pathway for lipid peroxidation and causes accumulation of malondialdehyde as shown in Fig. 2

Within the plant cell, enzymatic as well as non-enzymatic antioxidant system is present which helps to maintain ROS balance (Yan *et al.,* 1996). Peroxidase is one of the components of enzymatic antioxidative system whih convert H_2O_2 to water and oxygen causing detoxification of ROS.

$$AH_2 + H_2O_2 \xrightarrow{\text{Peroxidase}} A + 2H_2O$$

$$AH_2 + ROOH \xrightarrow{\text{Peroxidase}} A + ROH + H_2O$$

Proline is believed to act as osmoprotectant by accumulating in high concentration in plant cells. It also helps in detoxification of ROS, thus maintain of membrane integrity in plants (Demiralay *et al.,* 2013). Proline is mainly involved in osmotic adjustment of cell, stabilization of membrane and detoxification of harmful ions in plants exposed to salt stress (Ashraf and Foolad, 2007).

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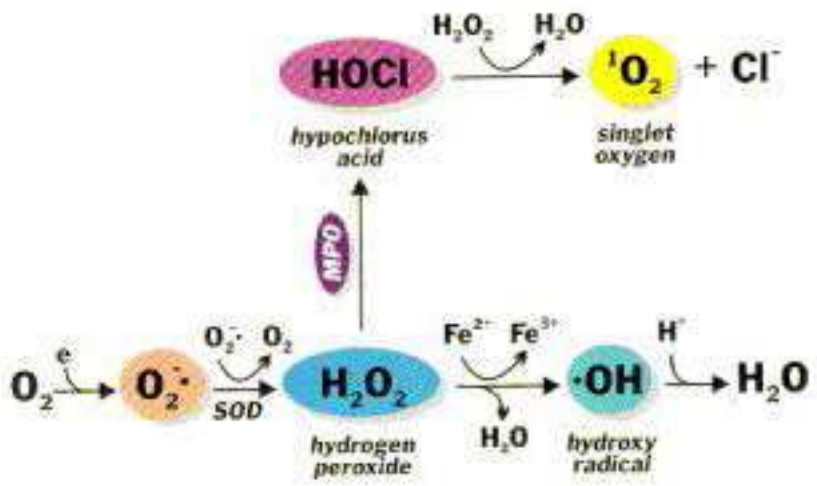


Figure 1: Generation of reactive oxygen species, where MPO is myeloperoxidase and SOD is superoxide dismutase. Grisham, (1992) and Mosker (1194)

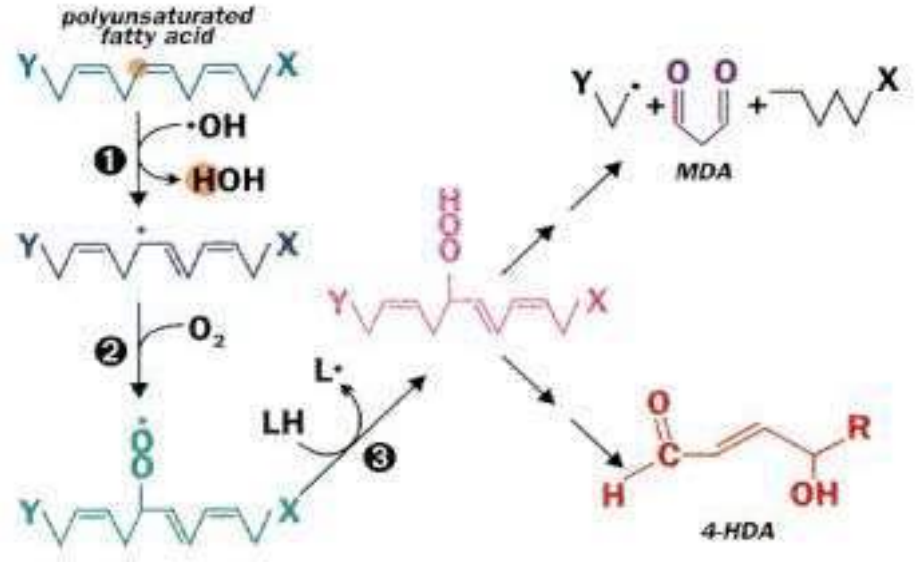


Figure 2: Peroxidation of polyunsaturated fatty acid Foyer *et al.*,(1994)

Phenolic compounds as a part of non-enzymatic system is believed to show antioxidant action. Phenolic compounds accumulation is induced in various stress condition like presence of heavy metals which suggest their role in combating such stress. Phenol has ability to form chelates with metal ions which shows its antioxidant property. These metal ions are involved in catalysing oxygenation reactions. Phenolic compounds inhibit lipid peroxidation by trapping the lipid alkoxyl radical and thereby preventing damage caused by ROS. This activity depends on the structure of the phenolic compounds and the number and position of the hydroxyl group in the molecules (Millic *et al.,* 1998). Phenolic compounds also inhibit activity of oxidizing enzymes. (Elavarthi and Martin, 2010)

In the present study, oxidative stress parameters were assessed in soybean obtained after cultivation in absence and presence of soluble silica to know the beneficial role of silica in alleviating stress. Foliar spray of soluble silica was done. Foliar spray helps in rapid and direct utilization of nutrients (Geetha and Velayutham, 2016).

MATERIALS AND METHODS

Soybean (*Glycine max* L.) was sown on 23rd June 2016 at five fields located in District Dewas, Madhya Pradesh, India. Geographical location of fields selected as per Latitude Longitude read by GPS 76 Garmin was N- 22 58'32.2" – 34.4" E- 076 10' 32.9"– 32.2"

First flowering was observed on 28th July 2016. Agribooster™ containing soluble silica was diluted to 1%

and sprayed on soybean crop twice (22nd July and 25th August 2016) approximately at the interval of one month after sowing seeds. Unsprayed crop served as control. The soybean crop was harvested on 13th September 2016 and seeds were collected to evaluate different oxidative stress parameters.

Proline content: Proline was estimated according to the method of Bates *et al.,* (1973). Proline was selectively extracted from soybean using aqueous sulphosalycilic acid. The extracted proline was made to react with 2 ml glacial acetic acid and ninhydrin which is prepared by using glacial acetic acid and phosphoric acid. (pH 1.0) to form chromophore (red color) which was read at 520nm. Except proline other amino acid reacts with ninhydrin prepared in ethanol.

MDA content: Malondialdehyde (MDA), a decomposition product of polyunsaturated fatty acid component of membrane lipid was extracted using 5% TCA and estimated using thiobarbituric acid (TBA) as reactive material (Heath and Packer, 1968).

Peroxidase activity: It was determined according to method of Summer and Gjessing, (1943). The enzyme activity was assayed using ortho-dianisidine as hydrogen donor and H_2O_2 as electron acceptor. The rate of formation of yellow orange colored dianisidine dehydrogenation product was measure of peroxidase activity and was assayed spectrophotometrically at 430 nm.

Total phenol content: It was estimated using Folin-Ciocalteu reagent which contains oxidizing agent phosphomolybdate. Under alkaline condition phenol reacts to form blue color complex, the molybdenum blue which is measured at 650 nm colorimetrically. Catechol was used as standard. (Bray and Thorpe, 1954)

RESULTS AND DISCUSSION

Values are expressed as mean ± SD. p- value was calculated to assess significant difference as compared to control (Table 1).

Proline content was found to be decreased significantly (p value < 0.05) in soybean of test fields T1 and T3. In T2 and T4 fields of soybean, decrease in proline content was highly significant (p value < 0.01) as compared to control (Fig. 3). Decrease in proline content in soybean of test field T1, T2 T3, T4 was found to be 58.8%, 71.5%, 56.6% and 68.7% respectively.

Extremely significant decrease (p value < 0.000) in malondialdehyde was observed content in soybean of test

Table 1: Oxidative stress parameters in soybean after foliar spray of Agribooster^{TM}

Parameters	Control plant	Treated plant (T1)	Treated plant (T2)	Treated plant (T3)	Treated plant (T4)
Proline content (µmoles/ gm)	5.03 ± 1.26 (0.72)	2.07 ± 0.73* (0.42)	1.43 ± 0.25** (0.14)	2.18 ± 0.39* (0.22)	1.57 ± 0.36** (0.20)
Malondialdehyde content (nmoles/ gm)	2.65± 0.27 (0.15)	0.73 ± 0.16*** (0.09)	0.45± 0.05*** (0.02)	0.49±0.006*** (0.003)	0.69± 0.19*** (0.11)
Peroxidase Activity (units/min/gm)	0.61 ± 0.32 (0.18)	18.01 ± 3.44*** (1.99)	5.2± 2.05** (1.18)	2.68 ±1.21* (0.69)	2.23±0.57* (0.32)
Total Phenol content (mg/gm)	64.33 ±8.14 (4.71)	80 ± 3* (1.73)	80 ± 6.08* (3.51)	85.33 ± 5.85* (3.38)	77.33 ± 2.51* (1.45)

* indicates p value < 0.05 and is significant as compared to control
** indicates p value < 0.01 and is highly significant as compared to control
*** indicates p value < 0.001 and is extremely significant as compared to control
Parenthesis indicates standard error

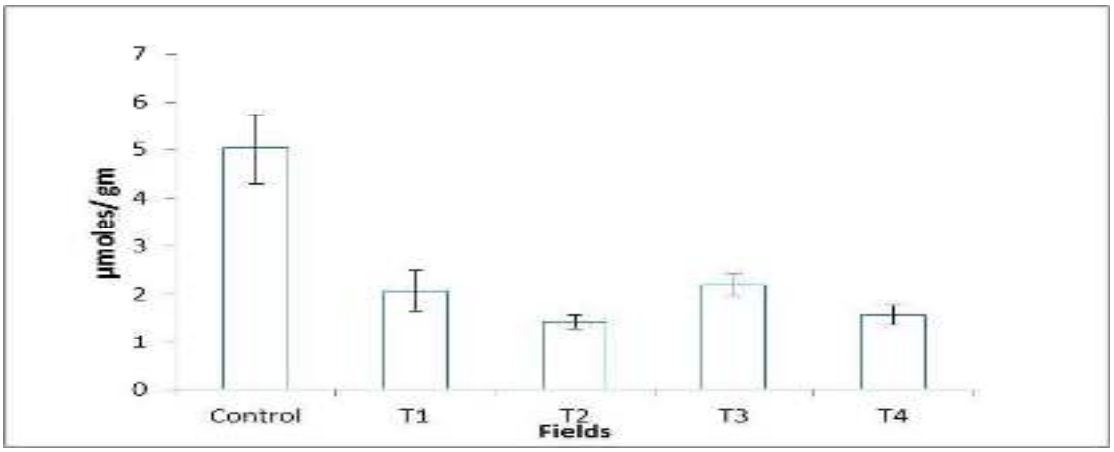


Figure 3: Effect of soluble silica on proline content of soybean

fields as compared to control (Fig. 4). 72.4%, 83.01%, 81.50% and 73.96% decrease was observed in malondialdehyde content in soybean of test field T1, T2, T3 and T4 respectively.

Activity of peroxidase enzyme was observed to be increased significantly (p value <0.05) in the seeds of test fields T3 (3.93%) and T4 (2.65%) as compared to control (Fig. 5). In soybean of T1 (28.52%) field increase in peroxidase activity was extremely significant (p value < 0.000) and in soybean of field T2 (7.52%) increase was highly significant (p value < 0.01) as compared to control.

Total phenol content in soybean was significantly increased in all the test fields as compared to control. Increase in total phenol content was found to be 24.35%, 24.35%, 32.64% and 20.2% in soybean of T1, T2, T3 and T4 fields respectively (Fig. 6).

Proline is an amino acid involved in osmoregulation. It provides high turgor potential for maintaining growth (Ashraf and Harris, 2004). Proline is also considered as a potent antioxidant and potential inhibitor of programmed cell death in plants (Pireivatloum *et al.,* 2010). Accumulation of proline is indicator of immediate response to stress (Kundar *et al,* 2016). Decrease in proline content was observed in *P. multiflorum* when sprayed with silica (Rubinowska *et al.,* 2014). Similar results were obtained by Kaya *et al.,* (2006) and Tuna *et al.,* (2008) while cultivating corn and wheat respectively under different stress conditions. Silica have been shown to enhance the water

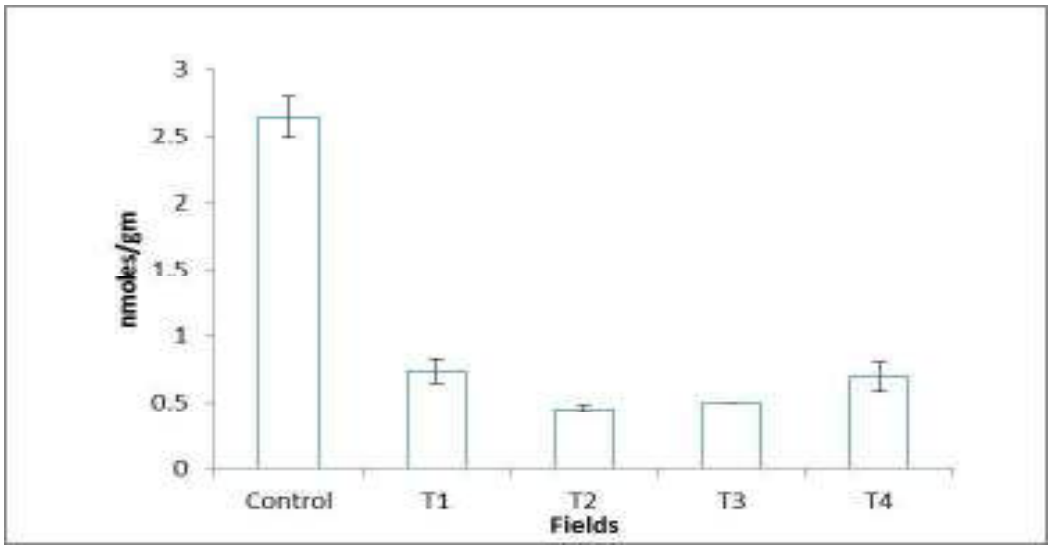


Figure 4: Effect of soluble silica on malondialdehyde (MDA) content of soybean.

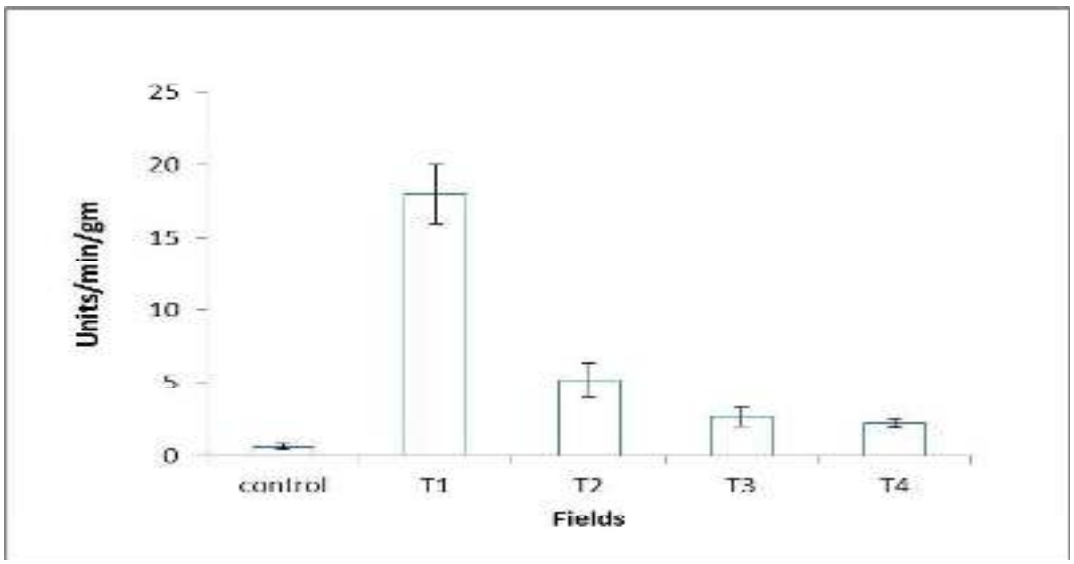


Figure 5: Effect of soluble silica on peroxidase activity of soybean

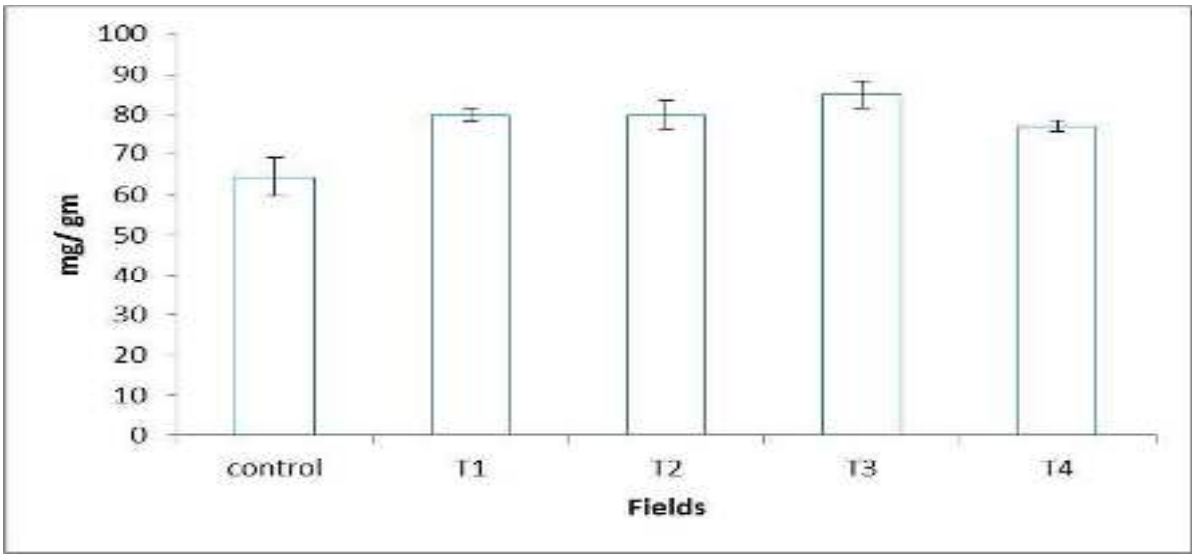


Figure 6: Effect of soluble silica on total phenol content of soybean.

status; relieving the oxidative stress and improving osmotic adjustment in plants which may favour decrease in proline content in silica treated plants.

As shown in Fig. 2, hydroxyl radical mainly cause peroxidation of lipid. Application of silica in soluble form increases availability of water which releases more protons to neutralise harmful hydroxyl ion preventing peroxidation of lipid present in the membrane. Thus malondialdehyde which is major product of membrane lipid peroxidation had decreased in presence of silica. Liang *et al.,* (2003) found that in silica-treated plants membrane lipid peroxidation had decreased, which indicates greater membrane stability under stress. Silica prevented membrane damage caused due to drought and UV B radiation (Shen *et al.,* 2010). Kazemi *et al.,* (2012) observed decrease in malondialdehyde content under influence of silica solution on Lisanthus.

Various studies have suggested that silicon protect plant from oxidative damage by promoting conversion of superoxide to H_2O and O_2 and also by increasing activities of H_2O_2 scavenging enzymes peroxidase (Dong *et al.,* 2014). Silica activates antioxidant defence system in plants in condition of salt stress (Mahmoud *et al.,* 2017). Peroxidase is believed to have scavenging role against stress condition. Increased availability of water in presence of silica helps in activation of peroxidase enzyme which has protective role in combating stress condition. Thus silica helps to relieve stress condition so that plants can utilize major part of their energy in synthesis of macromolecules which results in improved quality of plant product. Present results are supported by the work of Ahmad and Haddad (2011) who also found significant increase in activity of peroxidase in wheat under water deficit stress in presence of silica. Sayed and Gadallah (2014) suggested that silica induce increase in oxidative defence abilities in drought stressed maize. In the case of saline soils, silica increased the activity of antioxidant enzymes in wheat (Saqib *et al.,* 2008). Silica provides protection from harmful effect of UV B light by enhancing activity of peroxidase enzyme (Shen *et al.,* 2010).

Secondary metabolites such as phenol are synthesized under drought stress and act as antioxidant to protect plants (Nascimento and Fett-Neto, 2010). Phenolic compounds protect cells against the negative effects of ROS such as lipid peroxidation, protein denaturation and DNA damage (Allakhverdiev *et al.,* 2008). Phenolic compounds can scavenge ROS (Amar-owicz and Weidner 2009). It has been shown that plants which are supplemented with silica can have better defence system by elevating production of phenolics (Ma and Yamaji, 2006). (Kidd *et al.,* 2001) reported release of phenolic compounds against aluminium tolerance.

CONCLUSION

Silica when used in soluble form can enhance antioxidant capacity of crops so that they can survive and grow under adverse environmental conditions. Silica can become a boon for the farmers to increase their yield.

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Department of Biochemistry

Certificate of Collaboration

This is to certify that the **Department of Biochemistry, Govt. Holkar Science College, Indore, and Noble Alchem Pvt. Ltd. (Agribooster), Sanwer Road, Indore, M.P.** with the mutual collaborative work have successfully published a Research Paper entitled **"Role of Soluble Silica in Counteracting Lead Toxicity in Wheat *(Triticum aestivum L.)*"** in the session 2018-19.



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Role of Soluble Silica in Counteracting Lead Toxicity in Wheat (*Triticum aestivum* L.)

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The pollution of agricultural lands due to various heavy metals causes serious problems to the environment and produces a number of unfavourable physiological modifications in crop. Lead (Pb) is one of the major and common concerns among heavy metals because of its high level in the environment; it causes significant adverse effects on plant processes. Different remediation approaches have been used to overcome the toxic effect of heavy metals on crop plants. In Indian scenario, use of soluble silica is a modern and economical technique to minimize the negative effect of heavy metal stress. The objective of present study was to observe the effect of foliar spray of soluble silica in the form of Agribooster™ on lead treated and untreated wheat (*Triticum aestivum l.*) crop. Shoot length, total chlorophyll and stress parameters malondialdehyde (MDA), proline content and activity of peroxidase enzyme were assayed in six week old wheat crop. Significant increase was observed in shoot length and total chlorophyll in soluble silica treated wheat crop as compared to lead treated crop. Significant decrease in level of MDA and proline content were observed after soluble silica application in lead treated crop as well as control. Insignificant increase in peroxidase activity was observed after soluble silica application in lead treated wheat crop compared to only lead treated crop. From the present study it can be concluded that treatment of Agribooster™ *was* found significantly effective in counteracting the stress created by lead on wheat crop.

Key words: Agribooster™, lead stress, malondialdehyde, peroxidase , proline

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Plants are continuously exposed to unfavourable conditions and stresses including heavy metal toxicity. Heavy metal toxicity produces a number of unfavourable modifications in plant physiological processes such as inactivation of enzymes, replacement of certain metal ions of bio-molecules, conformational changes and disruption of the membrane integrity (1). Among the heavy metals, lead has longer persistence in soil.It affects both the production of crop and human health. It has become a major environmental contaminant of soil and air originating mainly from mining and smelting processes, industrial wastes, pesticides and urban activities(2). Lead has high tendency to accumulate in the environment because of its strong absorption in soil and sedimentation. At the morphological level, metal stress reduced plant growth because of adverse effect on cell elongation and cell wall elasticity (3). At the molecular level heavy metal toxicity may stimulate the formation of free radicals and reactive oxygen species leading to oxidative stress (4).

Plants possess defence system against oxidative destruction. This system consists of low molecular weight antioxidants like ascorbic acid, reduced glutathione, tocopherols and antioxidative enzymes such as peroxidase, superoxide dismutase, catalase. Peroxidase, an iron containing antioxidative enzyme which catalyses breakdown of harmful hydrogen peroxide and playing important role in detoxification of ROS. Level of MDA is as an indicator of oxidative damage. Lipid peroxidation involves the oxidative degradation of unsaturated fatty acids present in membrane and leads to formation of MDA. Proline acts as a vital osmoticum present in cellular system and gets accumulated in intracellular environment under numerous biotic and abiotic stresses to maintain intracellular redox potential. Silicon is the second most common element found in soil after oxygen. Silicon content in soil ranges from < 1 to 45% bydry weight while the silica (Si to SiO_2 - 2.1; Si to SiO_3 - 2.6) constitute 50-70% of the soil mass varying from less than 20% to almost 100%. One of the main functions of Si is in improving the plants growth

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and yield especially under stress condition. Si supply improves the structural integrity of crops and also improves plant tolerance to diseases, drought and metal toxicities (5). Silica shows positive effect on growth of many plants and provides resistance against stress (6). Application of silicon alleviates Mn toxicity in cucumber (7). Therefore, the aim of present work was to observe the role of soluble silica in relieving stress in wheat crop grown in soil treated with lead nitrate.

Materials and Methods

Stress was given in the form of lead nitrate in the soil. Soluble silica (Agribooster™) was sprayed after lead treatment. Six weeks old wheat leaves were used to study various parameters.

Experimental design: Field experiments were conducted at village Loharpipliya, district Dewas (M.P.). Geographical location of fields selected as per Latitude Longitude read by GPS 76 Garmin was N- 22 54'37.7" – 38.4" E- 075 59' 33.3"– 34". Randomized block of size 3.6 m^2in the field were designed for four different treatments and assigned as block T1, T2, T3 and T4. Wheat (*Triticumaestivum L.*) was sown on 22ndOctober 2017.

Types of treatment are as mentioned in Table 1.

Table 1: Showing the treatments

T1	Control
T2	Silica (7.5 ml per litre)
T3	Lead (50 mg per kg of soil)
T4	Lead (50 mg per kg of soil)+ Silica (7.5 ml per litre)

As per agriculture norms 3.6 m^2area of block contains approximately 720 Kg of soil. To create lead stress, 50 mg lead nitrate per Kg of soil was added in T3 and T4 block (15th Nov 2017) after 27 days of sowing wheat. The crop of block T2 and T4 was irrigated with 5 litre water having soluble silica (Agribooster™) in the concentration of 7.5 ml per litre after 8 days (23rd Nov 2017) of creating lead stress.

Methods used to study the oxidative stress: To observe the toxic effect of lead and alleviating effect of soluble silica leaves were collected on 8th Dec 2017after 15 days of soluble silica application. Shoot length was recorded by using the Inches tape. Chlorophyll was extracted from wheat leaves using 80% acetone, and absorbance at 663nm and 645nm were read in a spectrophotometer (8). Proline was extracted using sulphosalysilic acid and measured using acid ninhydrin (9). Leaf tissues were homogenized in 3 % sulfosalicylic acid and the homogenate was centrifuged at 3,000×*g* for 20min. The supernatant was treated with acid ninhydrin, boiled for 1 h, and then the absorbance was determined at 520 nm. MDA is a decomposition product of polyunsaturated fatty acids was utilized as a biomarker for lipid peroxidation (10). The level of lipid peroxidation was quantified by measuring the amount of MDA, which is determined by thiobarbituric acid (TBA) reaction at 532 nm (11). Peroxidase activity was assayed spectrophotometrically at 430 nm (12). Specific activity of enzyme was expressed as units/min/mg protein considering one unit of enzyme as an increase in OD by 1.0 under standard conditions.

Results and Discussion

Table 2 shows the soil analysis data before and after treatment. Small change in pH was observed after lead and silica treatments. Increased absorption of organic carbon and nitrogen were observed after silica treatment as compared to both control and lead treated plants. Absorption of lead was increased in presence of silica. Lead can form organo- metallic complexes with organic matter and increases the solubility of lead, resulting in an increase in lead bioavailability and lead uptake by plants. Absorption of nitrogen increased in presence of silica. Lead present in soil may form lead nitrate complex with soil nitrogen and absorbed through the plant root.

Shoot length: In the present study shoot length was significantly decreased in presence of lead (T3) (Table 3). This decrease may be due to accumulation of lead

Table 2: Soil analysis before and after lead and silica treatment

S. No.	Parameters	Soil analysis before sowing	T1	T2	T3	T4
1	pH	7.2	7.37	7.45	7.31	7.48
2	Electrical conductivity (mmhos/cm)	0.3	0.41	0.39	0.46	0.33
3	Organic carbon (%)	0.76	0.43	0.40	0.37	0.34
4	Nitrogen (Kg/ha)	280	186	180	168.9	157.8
5	Phosphorus (Kg/ha)	9	11.6	12.4	9.6	13.2
6	Potassium (Kg/ha)	260	310	340	360	350
7	Lead (ppm)	0.40	0.171	0.12	0.02	ND

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in the shoot region resulting in reduction of meristematic cells (13) (Fig. 1). Lead inhibits the growth of plants by reducing the activity of enzymes involved in the growth (14). Toxic level of Heavy metal exerts adverse effect on biosynthesis and translocation of auxin (15). There may be interference in absorption of growth promoting essential nutrients from soil in presence of heavy metals (16, 17). Addition of silica in soil significantly improved shoot length in T4 as compared to lead treated plants (T3). This improved shoot length may be interference of Silica in accumulation of lead.

Chlorophyll content: In the present study, total chlorophyll was reduced significantly in presence of Pb (T3) shown in Table 3 & Fig. 2. Pb may prevents the incorporation of iron in phytoporphyrin ring of chlorophyll molecule (18, 19). Heavy metal stress generates free radicals which may cause oxidation/reduction of aldehydic group present in structure of chlorophyll molecule (20). Lead present in soil may have inhibited key enzyme delta-aminolevulinic acid dehydratase (ALAD) and reduced uptake of essential n+utrients Mg^{2+}, Fe^{2+}, Zn^{2+} (21, 16) required for chlorophyll biosynthesis. Heavy metals also distort chloroplast ultra structure by aggregating pigment protein complex in photosystems (22). According to Goyal *et. al.*, chlorophyll content was decreased when *V.radiata* grown hydrophonically in sewage water having lead (20). On addition of soluble silica total chlorophyll content was increased significantly in T4 as compared to lead treated plants T3.Foliar spray with silicon photosynthetic pigments of Faba beans was significantly increased when grown under heavy metal stress (Pb and Cd) (23), due to enhanced uptake of essential nutrients like N, P, and K. Silica might have stimulated phosphorylation pathway or activation of Mg2+ and ATPase activity and enhanced chlorophyll biosynthesis (24).

Peroxidase activity: Highest peroxidase activity was observed in control plant (T1). Generation of ROS such as superoxide radicals (O2-), hydroxyl radicals (OH^-)

Table 3: Effect of soluble silica application on shoot length and total chlorophyll content in *Triticum aestivum* L. grown under lead stress.

S.No.	Treatments	Plant height (in inches)	P value	Total chlorophyll (mg/g)	P value
1	T1	18±1		0.4±0.03	
2	T2	19±1	0.14 ^{ns} (a)	0.45±0.06	0.21 ^{ns} (a)
3	T3	14.1±141	0.009**(a)	0.30±0.001	0.004** (a)
4	T4	18.1±1.5	0.42 ^{ns} (a) 0.01*(b)	0.36±0.04	0.09 ^{ns} (a) 0.04* (b)

(a) – compared to control.; (b) - compared to lead stress.
* significant; ** highly significant; *** extremely significant
ns not significant; Parentheses () indicates the – standard error.

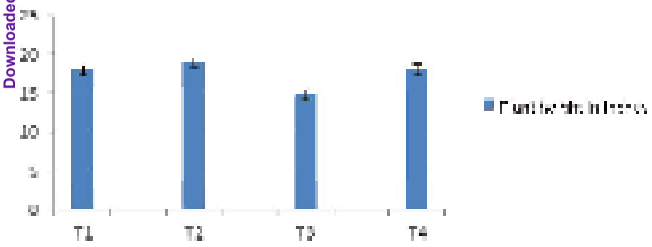


Fig. 1: Effect of soluble silica application on shoot length of *Triticum aestivum* L. grown under lead stress.

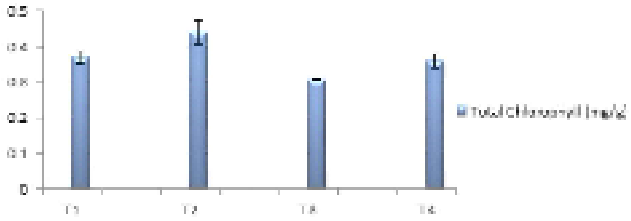


Fig. 2: Effect of soluble silica application on total chlorophyll content of *Triticum aestivum* L. grown under lead stress.

Table 4: Effect of soluble silica application on MDA, proline and peroxidase activity in *Triticum aestivum* L. grown under lead stress.

S. No.	Treatments	Malondialdehyde (mM/g)		Proline (µ moles/g)		Peroxidase activity (units/min/g)	
		Mean±SD	P value	Mean±SD	P value	Mean±SD	P value
1	T1	5.06 ±0.32 (0.18)		45.84±3.9 (2.25)		3.15±0.14 (0.08)	
2	T2	3.8±0.6 (0.34)	0.01* (a)	13.84±3.9 (2.25)	0.0002***(a)	0.95±0.6 (0.34)	0.04*(a)
3	T3	5.9±0.2 (0.11)	0.01* (a)	64.8±6.8 (3.9)	0.007**(a)	1.27±0.12 (0.06)	0.05* (a)
4	T4	3.05±0.8 (0.46)	0.01*(a) 0.002**(b)	37.19±3.9 (2.25)	0.003**(a) 0.001***(b)	1.68±0.8 (0.46)	0.09ns(a) 0.2^{ns} (b)

(a) – compared to control.; (b) - compared to lead stress.; * significant; ** highly significant; *** extremely significant; ns not significant; Parentheses () indicates the – standard error.

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and hydrogen peroxide (H2O2) is a normal metabolic product. Under environmental stress conditions, the reactive oxygen species (ROS) production in plants increases and causes an oxidative damage (25). Peroxidase acts as a ROS scavenger and play protective role against stress. Thus increased peroxidase activity was found in control plant.

After soluble silica application significant decrease in peroxidase activity was observed in T2 as compared to control. Silica perform many function under stress conditions like maintenance of water status, nutrient balance, form physical and mechanical barrier by accumulating in the cell wall, hence reduce generation of ROS, causing reduction in expression of peroxidase gene.Application of silicon enhances the water uptake ability in sorghum and improves drought tolerance (26). Silicon deposition occurred in the cell wall which is served as physical and mechanical barrier against external stress (27). Similarly soluble silica application alleviates abiotic stress like salinity stress (28) drought stress (29), radiation damage, nutrient imbalance, high temperature, freezing (30). Silicon enhances the water holding capacity by reducing transpiration rate (31), accelerate water uptake efficiency from the soil (32) and maintain Na^+ and K^+ uptake by plants (33).

In the present study Peroxidase activity was significantly decreased in lead stressed wheat plants (T3) as compared to control (T1). Lead is a redox-inactive metal exert their oxidative stress effects by chelating to sulfhydryl groups present in the active site of the enzyme (34). Our result support the findings of others (35) who reported that cadmium stress reduce the peroxidase activity in roots of wheat seedlings and thus create the oxidative stress.

In the present study, no significant difference in peroxidase activity was observed when lead treated plants were treated with soluble silica (T4). The possible reason for this insignificant difference might be that whatever amount of peroxidase is inactivated by lead is still remain inactivated even in presence of soluble silica. Moreover silica creates stress free environment for crop so, there is no need of synthesizing additional amount of peroxidase.

Lipid peroxidation: Significant increase in MDA was observed in lead stressed wheat plants (T3) as compared to control (T1) (Fig.3). Decrease in peroxidase activity may favour the elevated level of free radicals. Hydroxyl radicals are most potential toxic ROS. The unsaturated fatty acids are more susceptible to hydroxyl radical attack and peroxidation occurs in its presence. The MDA, product of the free radical mediated lipid peroxidation is an indicator of oxidative stress[35]. Similarly increased MDA level in water hyacinth was observed due to lead stress (36). Lead toxicity impairs metabolic activities of plant and enhances generation of reactive oxygen species which induces oxidative stress (37). After application of soluble silica, MDA level was decreased significantly in T2 and T4 as compared to control (T1) as well as lead stressed plant (T3). Application of soluble silica increases water availability resulting in release of more protons neutralising harmful hydroxyl ion suppressing peroxidation of lipid present in the membrane (38). The result of present study is in line with Shi *et al*. (7), they reported reduced lipid peroxidation

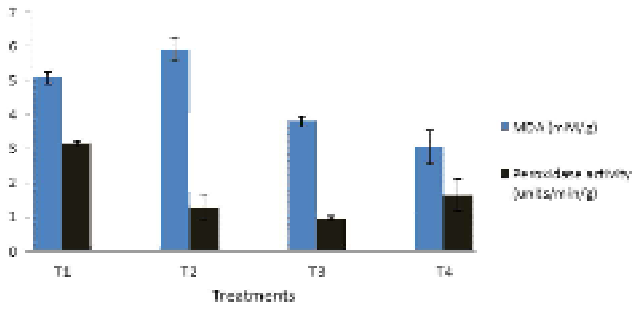


Fig. 3: Effect of soluble silica application on MDA and peroxidase activity in *Triticum aestivum* L. grown under lead stress.

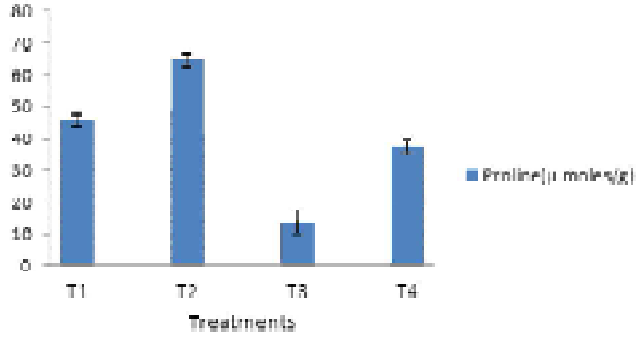


Fig. 4: Effect of soluble silica application on proline in *Triticum aestivum* L. grown under lead stress.

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and alleviation of Mn toxicity in presence of silica.

Proline: Significant increase in proline content was observed in lead stressed wheat plants (T3) as compared to control (T1) (Fig.4). Proline maintains cellular homeostasis by regulating water potential through osmotic adjustment and reduce metal uptake. Proline biosynthesis induced in presence of heavy metal because they cause imbalance in osmolyte concentration. Proline is a low molecular weight compound and plays an important role in cell protection against ROS-induced damage. Proline is involved in metal ion chelation hence maintain normal range of free radicals, stabilizes biological membrane, reduces electrolyte leakage and thus prevent cells from oxidative burst (16). Significant decrease in proline content was observed in soluble silica treated plants T2 and T4 as compared to control (T1) and lead stressed (T3) wheat plants. Soluble silica application in soil maintains osmolyte balance by regulating salt concentration and reduces the proline content. Decrease in proline content was reported in *P. multiflorum* when sprayed silica (39). Silica application reduced uptake of Na+ and increased K+ uptake and thus improved ionic balance of *V. radiata* (16).

In present study, heavy metal toxicity reduced peroxidase activity, led to increased free radical generation and resulted in increased lipid peroxidation and proline content in presence of lead. Treatment with soluble silica as Agribooster™ suppressed the generation of free radicals by enhancing availability of water and regulating salt concentration thus reduced the MDA level and proline content in stressed as well as control wheat leaves. Present study revealed that soluble silica is beneficial in counteracting stress caused by the presence of lead in wheat.

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तमसो मा ज्योतिर्गमय

8A

Activity Title:

Thematic webinar on the International Year of Basic Sciences for Sustainable Development: Inaugural Note by Prof. Y. K. Kuo, National Dong Hwa University, Hualien, Taiwan

MEMORANDUM OF UNDERSTANDING
BETWEEN
GOVERNMENT HOLKAR SCIENCE COLLEGE INDORE, INDIA
AND
NATIONAL DONG HWA UNIVERSITY, TAIWAN, R.O.C.

In the spirit of international understanding, Govt. Holkar Science College Indore, India, and National Dong Hwa University, Taiwan, R.O.C., agree to examine the possibility of establishing a framework for educational and research cooperation for our students, faculty and staff.

In preparation for establishing a formal framework for future activities, the parties hereto agree as follows:

1. Explore possibilities for faculty and staff exchanges for research, lectures, and discussions that mutually benefit both institutions;
2. Explore the feasibility of student exchanges and study programs;
3. Seek support for projects determined to be mutually beneficial to both institutions;
4. The terms of joint activities and arrangements for specific visit, exchanges, and other forms of cooperation will be agreed upon in writing prior to the initiation of any activity. Any commitment of resources, financial or otherwise, in support of these activities must be contained in subsequent specific agreements;
5. While no binding commitments have been made, we sign this Memorandum of Understanding in recognition of our common interests and agree to consult periodically concerning the status of our collaboration;
6. This understanding is done in two identical copies, both in English, by authorized representatives of each institute, and both parties will retain one copy of the memorandum.

For Govt. Holkar Science College Indore, India

10/04/19

Dr. Suresh Silawat

Principal

Date: 10 April 2019

For National Dong Hwa University, Hualien County, Taiwan, R.O.C.

Dr. Han-Chieh Chao

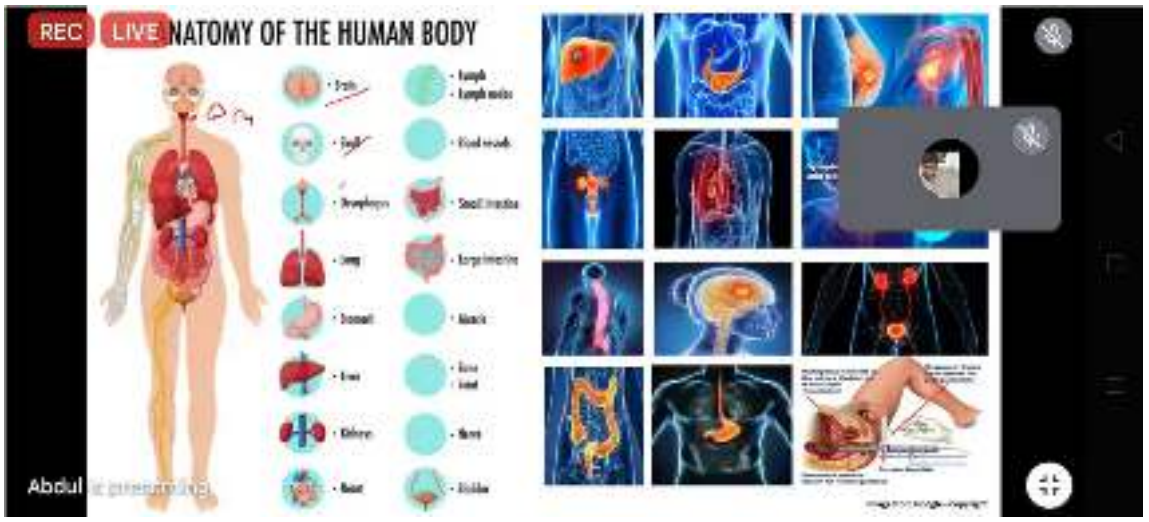
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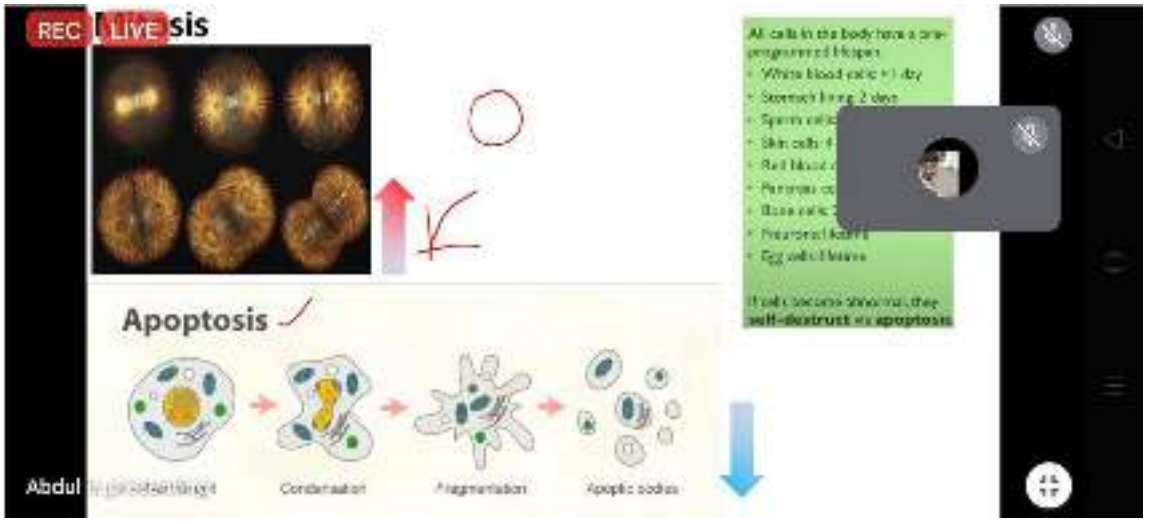
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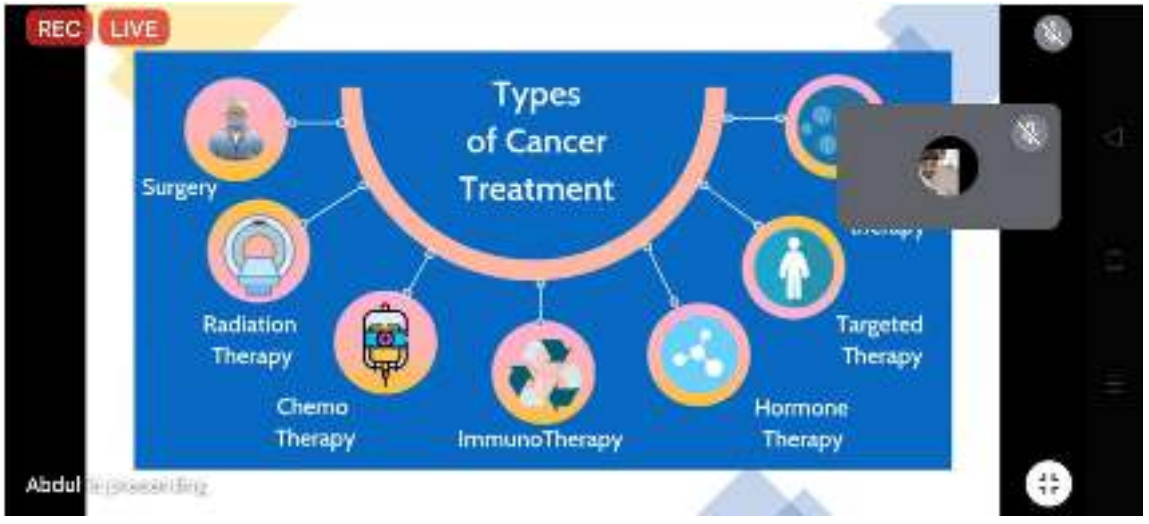
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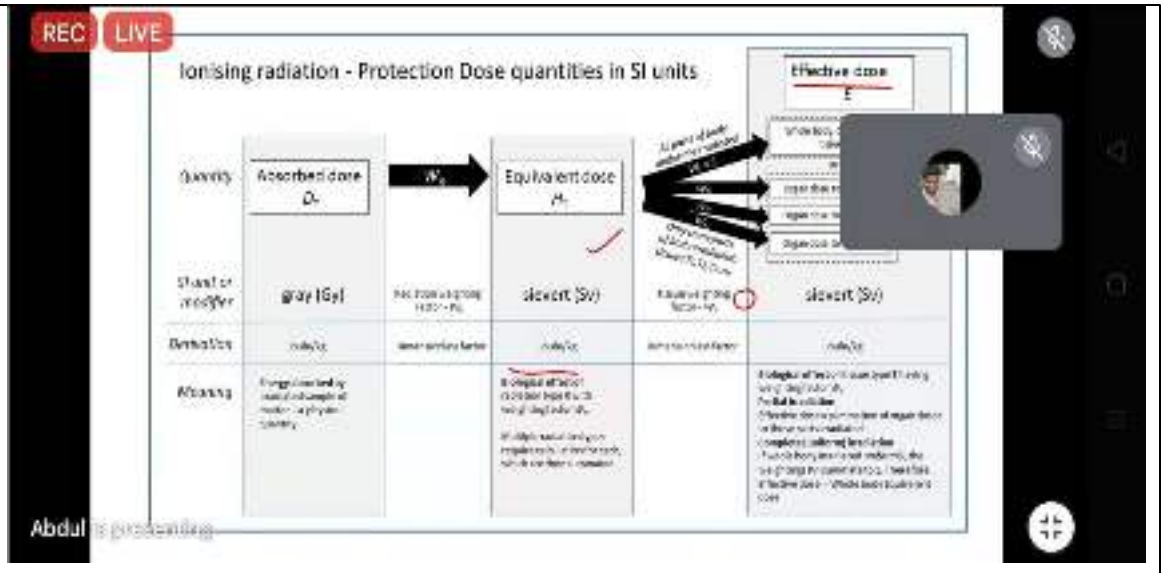
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<tr><td>1</td><td>Name of the Department / Unit / Agency:</td><td>Department of Physics</td></tr>
<tr><td>2</td><td>Name of the Activity:</td><td>Thematic Webinar on the International Year of Basic Sciences for Sustainable Development</td></tr>
<tr><td>3</td><td>Name of the Scheme:</td><td>Online Webinar</td></tr>
<tr><td>4</td><td>Date and Year of the Activity:</td><td>09/08/2022</td></tr>
<tr><td>5</td><td>Number of Students Participated in the activity:</td><td>121</td></tr>
<tr><td>6</td><td>Report of the Activity (in 100 words):</td><td>Department of Physics & IQAC, Govt. Holkar (Model, Autonomous) Science College Indore was organized an online webinar on “Thematic Webinar on the International Year of Basic Sciences for Sustainable Development”. The agenda for Sustainable Development is the ambitious agenda adopted by United Nations member states to ensure the planet's balanced, sustainable, and inclusive development. The contributions of basic, curiosity-driven sciences are undervalued. Nonetheless, they constitute the foundation of key technological developments that promote innovation and are essential for teaching future workforce and strengthening the capacity of communities to participate in future-determining decisions. Therefore, the focus of this webinar is to bring links between basic sciences and the Sustainable Development Goals.
The Inauguration of this webinar was given by Dr. Suresh T. Silawat, Additional Director, Indore Division and Principal, Govt. Holkar (Model, Autonomous) Science College. Following members were worked as :
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<tr><td>1.</td><td>Dr. Suresh T. Silawat</td><td>Chief Patron</td></tr>
<tr><td>2.</td><td>Dr. G.D. Gupta</td><td>Patron</td></tr>
<tr><td>3.</td><td>Dr. R.C. Dixit</td><td>A.O.</td></tr>
<tr><td>4.</td><td>Dr. Bijendra Rai</td><td>NAAC Coordinator</td></tr>
<tr><td>5.</td><td>Dr.Nagesh Dagaonkar</td><td>IQAC Coordinator</td></tr>
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<tr><td>7.</td><td>Dr. Pramila Kori</td><td>NAAC Facilitator</td></tr>
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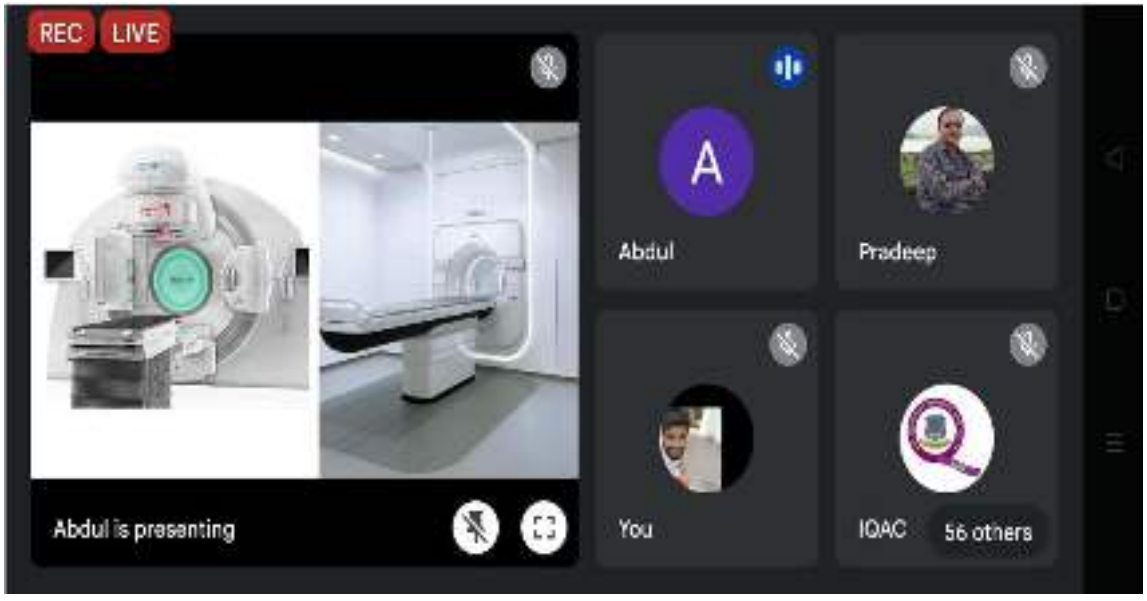
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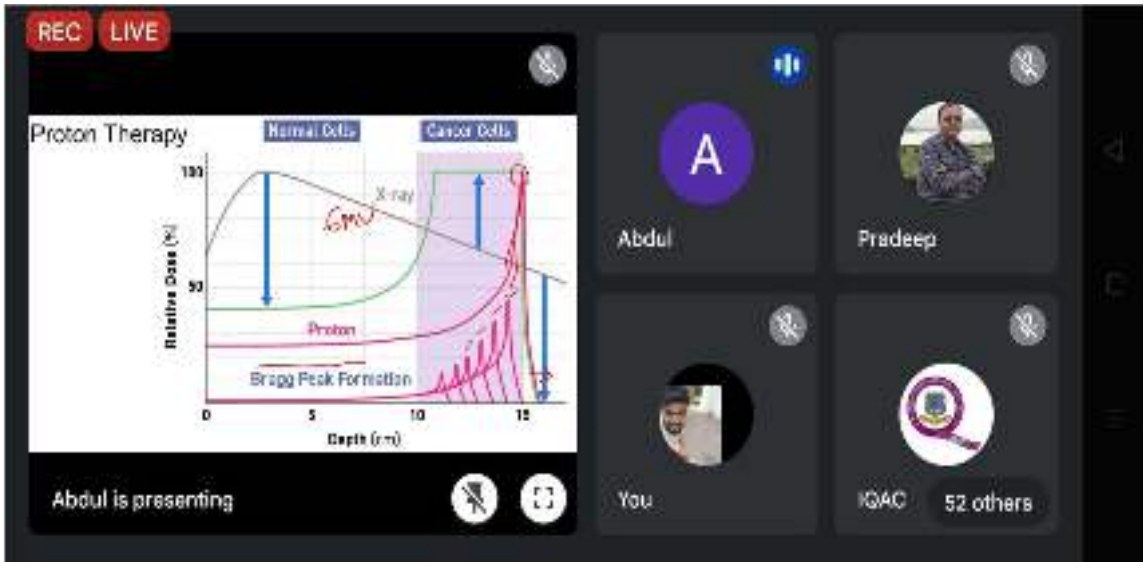












8.	Poster of Activity

आमंत्रण

THEMATIC WEBINAR ON THE INTERNATIONAL YEAR OF BASIC SCIENCES FOR SUSTAINABLE DEVELOPMENT

मुख्य अतिथि



डॉ सुरेश टी. सिलावट
अतिरिक्त संचालक, उच्च शिक्षा विभाग, इंदौर संभाग
एवं
प्राचार्य, शासकीय होलकर (आदर्श, स्वशासी) विज्ञान महाविद्यालय इंदौर (म.प्र.)

09 अगस्त, 2022

समय प्रातः 09.15 बजे से 10.30 बजे तक

आयोजक: भौतिकी विभाग, आईक्यूएसी

Invitation

THEMATIC WEBINAR ON THE INTERNATIONAL YEAR OF BASIC SCIENCES FOR SUSTAINABLE DEVELOPMENT

Inaugural Note



Prof. Yung-Kang Kuo
Professor & Provost
National Dong Hwa University,
Hualien, Taiwan

09 August, 2022

Time: 09.15 AM to 10.30 AM

Organizers: Department of Physics & IQAC

Invitation

THEMATIC WEBINAR ON THE INTERNATIONAL YEAR OF BASIC SCIENCES FOR SUSTAINABLE DEVELOPMENT



Lecture

DR. ABDUL K. PARCHUR
Medical Physics Resident
Radiation Oncology, Medical College of Wisconsin, USA

09 August, 2022

Time: 09.15 AM to 10.30 AM

Organizers: Department of Physics & IQAC



Timestamp	Event Details	Speaker
9.20 AM	Joining of participant at online platform Google Meet	Join online at **Google Meet joining info** https://meet.google.com/jge-uyfn-uhj **Live Stream** https://stream.meet.google.com/stream/5178a806-ef29-4c63-8ebf-0062f54ec505 https://youtu.be/PSlOYp6lGk0
9.30AM to 9.32AM	Starting of event, Introduction of event, Inviting Principal Sir for his inaugural address	Dr. Nagesh Dagaonkar
9.32AM to 9.35AM	Inaugural Address	Dr. Suresh T. Silawat
9.35AM to 9.36AM	Inviting Vice Principal Sir for his Inaugural Address	Dr. Nagesh Dagaonkar
9.36AM to 9.38AM	Inaugural Address	Dr. G. D. Gupta
9.38AM to 9.39AM	Inviting Dr. Bhawana Chourasia to Introduce Prof. Y. K. Kuo, Professor and Dean, Department of Physics, National Dong Hwa University, Hualien, Taiwan	Dr. Nagesh Dagaonkar
9.39 AM to 9.42 AM	Introduction of Prof. Kuo	Dr. Bhawana Chourasia
9.42 AM to 9.46 AM	Inaugural Note By Prof. Kuo	Prof. Y. K. Kuo,
9.46 AM to 9.47 AM	Inviting Dr. V.V.S. Murthy to Introduce DR. ABDUL K. PARCHUR, Medical Physics Resident, Radiation Oncology, Medical College of Wisconsin, USA	Dr. Nagesh Dagaonkar
9.47 AM to 9.50 AM	Introduction of Dr. PARCHUR	Dr. V.V.S. Murthy
9.50 AM to 10.30 AM	Lecture: Introduction to medical physics and nanomedicine for cancer treatment.	DR. ABDUL K. PARCHUR
10.30 AM to 10.35 AM	Q & A Session	Moderated by Dr. R. C. Dixit/ Dr. Nagesh Dagaonkar
10.35 AM to 10.36 AM	Inviting Dr. Netram Kaurav for Vote of Thanks to the Guests, speaker and audience	Dr. Nagesh Dagaonkar
10.36 AM to 10.40 AM	Vote of Thanks and Concluding Remarks	Dr. Netram Kaurav





Department of Physics, Govt. Holkar (Model, Autonomous) Science College, Indore (MP)

THEMATIC WEBINAR ON THE INTERNATIONAL YEAR OF BASIC SCIENCES FOR SUSTAINABLE DEVELOPMENT





The focus of this webinar is to bring links between basic sciences and the Sustainable Development Goals.

AUGUST 9, 9.30 AM TO 10.30 AM ONLINE MODE



Chief Patron:

Dr. Suresh T. Silawat,
Additional Director, Indore Division
Principal, Govt. Holkar [Model, Autonomous] Science College, Indore (MP)-INDIA



Prof. Y-K Kuo
Professor & Dean,
Department of Physics,
National Dong Hwa University,
Hualien, Taiwan





Webinar Homepage for Details and Registration:
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Yung-Kang Kuo



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Yung-Kang Kuo's received his Ph. D. degree in 1995. He joined the Department of Physics, National Dong Hwa University, Taiwan, in 1998. He has been the Dean of the College of Science and Engineering from 2016 to 2022, and he is now the provost. His expertise is in experimental condensed matter physics. His experimental techniques include designing and operating high precision calorimetric measurements on extremely small crystals, thermal expansion measurements using a capacitance dilatometer, Seebeck coefficient and thermal conductivity measurements by direct-pulse technique, and high precision electrical transport measurements. His main research interest is studying phase transitions in strongly correlated electron systems, such as charge-density-wave transition, order-disorder transition, superconducting transition, magnetic transition, etc. Besides, he is also interested in functional materials, such as thermoelectric materials, metal silicides, Heusler compounds, and shape memory alloys. He has published about 190 SCI papers.

Abdul K. Parchur, PhD

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Radiation Oncology, Medical College of Wisconsin, Milwaukee, WI 53226
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SUMMARY

- Developing Machine Learning-based tools to improve therapeutic outcomes in magnetic resonance image-guided adaptive radiation therapy and integrate them into the clinical workflow.
- Participate in testing radiation beam characteristics, image quality, radiation safety, dose delivery/calculation accuracy, and clinical/QA workflow procedures.
- Perform patient specific quality assurance using ArcCHECK (Sun Nuclear) to evaluate intensity modulated radiation therapy (IMRT) plans in the clinic.
- Practice Radiation Therapy, *in vivo* animal real time dynamic imaging (MR, CEST, X-ray - CT, NIR, SWIR fluorescence imaging) followed remote-triggered therapies (Ultrasound, X-ray, RF, NIR light triggering), Interpret, analyze results and administer statistical methods.
- Dynamic contrast enhancement Magnetic Resonance Imaging guided cancer therapy, perfusion model analysis and radiation induced lung damage using CT imaging.
- Expertise in designing and developing novel colloidal nanomaterials, liposomes, optical, magnetic, and plasmonic properties, and surface functional modification, chemical synthesis to develop new nanomedicine applications with a strict GLP protocol.
- To collaborate with a team of experts, medical physicists, MD's, dosimetrist, radiation therapists to define new approaches to clinical problems, willing to learn clinical workflows, leadership, and effective communicator.

SKILLS

Radiation Therapy, Dosimetry, Treatment Planning, T1/T2-Weighted MR imaging, DCE MR Imaging, CT imaging, CEST Imaging, Photothermal Therapy, Cancer therapy - Breast Tumors, Liver Tumors, Gd(III) Electron paramagnetic resonance, NMR, Electron Microscopy, Nanomaterials, X-ray Structural Analysis, etc.

THERAPEUTIC INSTRUMENTS

Machines: Siemens Artiste, Elekta Infinity, Accuray Radixact
QA Equipment: Sun Nuclear ArcCheck, ScandiDos Delta4 Phantom+ with Hexamotion, CIRS 1D, Motion Platform and 4D Motion Phantom, Exradin A1SL Ion Chamber, Farmers Ion Chamber, Multichannel Electrometer, IC Profiler, Gafchromic and EDR2 Film, Sun Nuclear Daily QA3
TPS: Accuray Precision, Elekta Monaco, MIM
Record and Verify: Elekta Mosaiq

Training

Radiation Safety, MR Level II Safety, General Laboratory Safety and Protocols

Computational Resources

MATLAB, Python, MIM, Amira 6.2, VivoQuant, OriginPro, Material Studio, Rietveld, ImageJ, MS Office

CLINICAL EXPERIENCE

Medical Physics Certificate Program | Froedtert & the Medical College of Wisconsin

Patient QA – Froedtert Hospital, Milwaukee WI **May 2021 – June 2022**

- IMRT (Siemens Artiste, Elekta Infinity) and Tomotherapy (Accuray Radixact) QA using ArcCheck
- Synchrony QA (Accuray Radixact with Synchrony) for fiducial targets and fiducial-free targets using ArcCheck and Delta4 Phantom+

Monthly QA– Froedtert Hospital, Milwaukee WI **November 2020 – June 2021**

- QA duties include mechanical, dosimetry, electron and photon beam characteristics, kV and MV imaging, safety on Elekta Infinity™ linear accelerator

Annual QA– Froedtert Hospital, Milwaukee WI **January 2021 – June 2021**

- Participated in annual performance of TG-142 and TG-51 on Elekta Infinity and Siemens Artiste
- Post-service QA including after MLC, Jaw replacement, imaging panel replacement

WORK EXPERIENCE

Medical College of Wisconsin, Radiation Oncology, Milwaukee, WI
Clinical Medical Physics Resident
07/2022- Expected in June 2025

Medical College of Wisconsin, Radiation Oncology, Milwaukee, WI
CAMPEP Medical Physics Researcher
07/2020-06/2022

- Development of novel machine learning techniques fully account for interfractional anatomical changes in MR-Linac image-guided adaptive radiotherapy for the effective tumor targeting during radiation therapy delivery.
- Quick assessment of MR-guided online adaptive radiation therapy workflow on MR-Linac: Adapt to Position-ATP or Adapt to Shape-ATS

Medical College of Wisconsin, Radiology, Milwaukee, WI
Research Scientist
04/2015-06/2020

- Perform 3D image rendering and analysis of different organs in lamb, mice, and rats using micro-computed tomography (micro-CT) imaging and Magnetic Resonance (MR) Imaging after contrast perfusion (microfil, Iodine, and Gadolinium(III) based contrast)
- Design and develop novel nanomaterials and characterize through various analytical methods and establish procedures using Good Laboratory Practice (GLP)
- Conduct effective *In vivo* animal research on Computed Tomography imaging, Dynamic Near-Infrared (NIR) imaging, Short-wave infrared (SWIR) imaging, Magnetic Resonance (MR) Imaging, CEST Imaging, and Cancer Therapy

Utah State University, Biomedical Engineering, Logan, UT
Postdoctoral Researcher
09/2013-03/2015

- Engineering multifunctional magnetic nanostructures for the selective targeting of HER2-expressing breast cancer cells and SERS-fluorescence bimodal nanoprobes for *in vitro* imaging of fatty acid responsive receptor GPR120 and single cell Raman imaging
- Exploring biomechanical properties of human lung adenocarcinoma epithelial cells pre- and post uptake of designed nanocontrast materials
- Standardization Atomic force microscopy and enhanced Raman spectroscopy for nanoscale molecular imaging and developing analytical methods for the detection of heavy metal ions in water in Utah State

Bhabha Atomic Research Centre, BARC, Mumbai | Banaras Hindu University, India
Young Scientist
08/2010-08/2013

- Developed a new method using wet chemistry to make temperature sensing nanomaterials and it's characterization.
- X-ray diffraction crystal refinement of nanostructures using different regression models and spectroscopy techniques.
- Communicating with team and other groups to develop and implement safety standards while performing test procedures as well as recommending realistic quality goals and objectives

Dr. H S Gour Central University, India
Research Scholar - PhD
2006 - 2010

- Dissertation: "Performance analysis of modern processors used in computers"
- SPEC Benchmark workload performance analysis on advanced intel and AMD processors
- Finite element method analysis of Cu metal attached to a Si substrate above a height of 1.2 μm using different low-k values and voltages

SELECTED PUBLICATIONS | Citations 2060, H-index 24, i10-index 33

1. Ahunbay E, **Parchur A. K.**, Paulson E, Chen X, Omari E, Li XA. Development and implementation of an automatic air delineation technique for MRI-guided adaptive radiation therapy. *Phys Med Biol.* **2022**;67(14).
2. Ansari, A. A.; **Parchur, A. K.**; Chen, G., Surface modified lanthanide upconversion nanoparticles for drug delivery, cellular uptake mechanism, and current challenges in NIR-driven therapies. *Coordination Chemistry Reviews* **2022**, *457*, 214423.
3. Ansari, A. A.; **Parchur, A. K**.; Labis, J. P.; Shar, M. A., Physiochemical characterization of highly biocompatible, and colloidal LaF3:Yb/Er upconversion nanoparticles. Photochem Photobiol Sci **2021**, *20(9)*, 1195.

4. Sharma, M.; Rana, U.; Joshi, C.; Michalkiewicz, T.; Afolayan, A.; **Parchur, A. K.**; Joshi, A.; Teng, R. J.; Konduri, G. G., Decreased Cyclic GMP-protein Kinase G signaling impairs Angiogenesis in a Lamb Model of Persistent Pulmonary Hypertension of Newborn. Am J Respir Cell Mol Biol **2021**, *65(5)*,555.
5. Thorat, N.; Pricl, S.; **Parchur, A. K.**; Somvanshi, S. B.; Li, Q.; Umrao, S.; Townley, H., Safeguarding COVID-19 and cancer management: drug design and therapeutic approach; DOI: 10.12688/openreseurope.13841.1.
6. Ansari, A. A.; **Parchur, A. K.**; Nazeeruddin, M. K.; Tavakoli, M. M., Luminescent lanthanide nanocomposites in thermometry: Chemistry of dopant ions and host matrices. *Coordination Chemistry Reviews* **2021,** *444*, 214040.
7. Ansari, A. A.; **Parchur, A. K.**; Thorat, N. D.; Chen, G., New advances in pre-clinical diagnostic imaging perspectives of functionalized upconversion nanoparticle-based nanomedicine. *Coordination Chemistry Reviews* **2021,** *440*, 213971.
8. Ansari, A. A.; **Parchur, A. K.**; Labis, J. P.; Shar, M. A.; Khan, A., Highly hydrophilic CaF2:Yb/Er upconversion nanoparticles: Structural, morphological, and optical properties. *Journal of Fluorine Chemistry* **2021,** *247*, 109820.
9. **Parchur, A. K.**; Fang, Z.; Jagtap, J. M.; Sharma, G.; Hansen, C.; Shafiee, S.; Hu, W.; Miao, Q. R.; Joshi, A., NIR-II window tracking of hyperglycemia induced intracerebral hemorrhage in cerebral cavernous malformation deficient mice. *Biomaterials Science* **2020**, 8 (18), 5133-5144.
10. **Parchur, A. K.**; Sharma, G.; Jagtap, J. M.; Gogineni, V. R.; LaViolette, P. S.; Flister, M. J.; White, S. B.; Joshi, A. Vascular Interventional Radiology-Guided Photothermal Therapy of Colorectal Cancer Liver Metastasis with Theranostic Gold Nanorods. *ACS Nano* **2018,** *12* (7), 6597.
11. Gogineni, V. R.; Maddirela, D.; Ram, W.; Jagtap, J. M.; Sharma, G.; **Parchur, A. K.**; Joshi, A.; Kim D. H.; Larson, A. C.; White, S. B. Localized and triggered release of oxaliplatin for the treatment of colorectal liver metastasis. *Journal of Vascular and Interventional Radiology* **2020,** 11(23), 6982.
12. Sharma, G.; **Parchur, A. K.‡**; Jagtap, J. M.**‡**; Gogineni, V. R.; Bergom, C.; White, S. B.; Flister, M. J.; Joshi, A. Heritable Modifiers of Tumor Micro-environment Heterogeneity Influence Nanoparticle Uptake, Distribution and Response to Photo-thermal Therapy". *Theranostics* **2020,** 10(12):5368-5383.

‡Authors contributed equally

13. Jagtap, J. M.; Fish, B.; Hancen, C.; Gao, F.; Sharma, G.; **Parchur, A. K.**; Narayan, C.; Audi, S.; Joshi, A. A rapid dynamic *in vivo* near-infrared fluorescence imaging assay to track lung vascular permeability after acute radiation injury. *Am J Physiol Lung Cell Mol Physiol* **2021,** *320(3)*, L436-L450.
14. Zimmerman, K. C.; Sharma, G.; **Parchur, A. K.**; Joshi, A.; Schmidt, T. G. Experimental investigation of neural network estimator and transfer learning techniques for K-edge spectral CT imaging. *Medical Physics* **2020**, 47 (2), 541.
15. Rana, U.; Callan, E.; Entringer, B.; Michalkiewicz, T.; Joshi, A.; **Parchur, A. K.**; Teng, R.-J.; Konduri, G. G. AMP-Kinase Dysfunction Alters Notch Ligands to Impair Angiogenesis in Neonatal Pulmonary Hypertension. *American Journal of Respiratory Cell and Molecular Biology* **2020,** PubMed: 32048878.
16. Ansari, A. A.; Khan, S.; Aldalbahi, A.; **Parchur, A. K**.; Kumar, B.; Kumar, A.; Raish, M.; Rai, S. B. In-vitro cytotoxicity evaluation of surface design luminescent lanthanide core/shell nanocrystals. *Arab. J Chem.,* **2020,** *13* (1), 1259.
17. Thorat, N. D.; Townely, H.; Brennan, G.; **Parchur, A. K.**; Silien, C.; Bauer, J.; Tofail, S. A. M. Progress in Remotely Triggered Hybrid Nanostructures for Next-Generation Brain Cancer Theranostics. *ACS Biomaterials Science & Engineering* **2019,** *5* (6), 2669.
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19. Xiao, L.; **Parchur, A. K.**; Gilbertson, T. A.; Zhou, A. SERS-fluorescence bimodal nanoprobes for in vitro imaging of the fatty acid responsive receptor GPR120. *Analytical Methods* **2018,** *10*, 22.
20. Jaidip, J.; Gayatri, S.; **Parchur, A. K.**; Venkateswara, G.; Carmen, B. S. W.; Flister, M. J.; and Amit, J. Methods for detecting host genetic modifiers of tumor vascular function using dynamic near-infrared fluorescence imaging. *Biomedical Optics Express* **2018,** *9* (2), 543.
21. Jagtap, J.; Patil, N.; **Parchur, A. K.**; Pantola, C.; Agarwal, A.; Pandey, K.; Pradhan, A. Effective screening and classification of cervical precancer biopsy imagery. *IEEE transactions on Nanobioscience* **2017,** *16* (8), 687.
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23. Belkhir, N. H.; Toncelli, A.; **Parchur, A. K.‡**; Alves, E.; Maalej, R. Efficient temperature sensing using photoluminescence of Er/Yb implanted GaN thin films. *Sensors and Actuators B: Chemical* **2017,** *248*, 769.

‡Corresponding Author

24. **Parchur, A. K.**; Li, Q.; Zhou, A. Near-infrared photothermal therapy of Prussian-blue-functionalized lanthanide-iondoped inorganic/plasmonic multifunctional nanostructures for the selective targeting of HER2-expressing breast cancer cells. *Biomaterials Science* **2016,** *4*, 1781.
25. Li, Q.**‡**; **Parchur, A. K.‡**; Zhou, A. In-vitro biomechanical properties, fluorescence imaging, surface-enhanced Raman spectroscopy, and photothermal therapy evaluation of luminescent functionalized CaMoO4:Eu@Au hybrid nanorods on human lung adenocarcinoma epithelial cells. *Science and Technology of Advanced Materials* **2016,** *17* (1), 346.

‡Both authors contributed equally

26. Ansari, A. A.; **Parchur, A. K.**; Kumar, B.; Rai, S. B. Highly aqueous soluble CaF2:Ce/Tb nanocrystals: effect of surface functionalization on structural, optical band gap, and photoluminescence properties. *J Mater Sci Mater Med* **2016,** *27* (12), 178.
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30. Singh, B. P.; **Parchur, A. K.‡**; Ningthoujam, R. S.; Ansari, A. A.; Singh, P.; Rai, S. B. Enhanced photoluminescence in CaMoO4:Eu3+ by Gd3+ co-doping. *Dalton Transactions* **2014,** *43* (12), 4779.

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31. Singh, B. P.; **Parchur, A. K.‡**; Ningthoujam, R. S.; Ansari, A. A.; Singh, P.; Rai, S. B. Influence of Gd3+ co-doping on structural property of CaMoO4:Eu nanoparticles. *Dalton Transactions* **2014,** *43* (12), 4770.

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35. Ansari, A. A.; **Parchur, A. K.**; Alam, M.; Azzeer, A. Structural and photoluminescence properties of Tb-doped CaMoO4 nanoparticles with sequential surface coatings. *Materials Chemistry and Physics* **2014,** *147* (3), 715.
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38. Prasad, A. I.; **Parchur, A. K.**; Juluri, R. R.; Jadhav, N.; Pandey, B. N.; Ningthoujam, R. S.; Vatsa, R. K. Bi-functional properties of Fe3O4@YPO4:Eu hybrid nanoparticles: hyperthermia application. *Dalton Trans* **2013,** *42* (14), 4885.
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43. **Parchur, A. K.**; Ningthoujam, R. S. Behaviour of electric and magnetic dipole transitions of Eu3+, 5D0→7F0 and Eu-O charge transfer band in Li+ co-doped YPO4: Eu3+. *RSC Advances* **2012,** *2* (29), 10859.
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46. **Parchur, A. K.**; Ningthoujam, R. S. Preparation and structure refinement of Eu3+ doped CaMoO4 nanoparticles. *Dalton Transactions* **2011,** *40* (29), 7590.

PUBLICATIONS UNDER PREPARATION

1. **Parchur, A. K.**; Lim, S.; Nasief, H.; Omari, E.; Zhang, Y.; X. Allen Li, Auto-detection of structural similarity index map from daily MRI as an indicator for MR-guided online adaptation replanning, *Medical Physics, 2021* (***under preparation***).
2. Omari, E.; Nasief, H.; Zhang, Y.; **Parchur, A. K.;** Paulson, E.; Chen, X.; Ahunbay, E.; Hall, W.; Erickson,B.; X. Allen Li, Should Daily Online Adaptive Replanning be Utilized for Every Treatment in MRI-guided Radiotherapy for

Pancreatic Cancer? Annual Meeting Scientific Program Committee of the American Society for Radiation Oncology (ASTRO). (***under preparation***).

3. Nasief, H.; Omari, E.; Zhang, Y.; **Parchur, A. K.;** Paulson, E.; Hall, W.; Erickson,B.; X. Allen Li, Automatically determining necessity of online adaptive replanning based on MRI wavelet multiscale texture features for MRI-guided adaptive radiation therapy. Annual Meeting Scientific Program Committee of the American Society for Radiation Oncology (ASTRO) (***under preparation***).

PROCEEDINGS PUBLICATIONS

1. Gogineni, V. R.; Park, W. R.; Jagtap, J.; **Parchur, A. K.**.; Sharma, G.; Joshi, A.; Kim, D.-H.; Larson, A. C.; White, S. B. Localized and triggered release of oxaliplatin for the treatment of colorectal liver metastasis. In *Cancer Res*; Proceedings of the AACR Annual Meeting 2018, **2018**; Vol. 78.
2. Singh, B. P.; **Parchur, A. K.**; Rai, S. B.; Singh, P. Luminescence and electrical behavior of lead molybdate nanoparticles. *AIP Conf. Proc.* **2013,** *1512* (1), 248.
3. **Parchur, A. K.**; Kaurav, N.; Ansari, A. A.; Prasad, A. I.; Ningthoujam, R. S.; Rai, S. B. CaMoO4:Tb@Fe3O4 hybrid nanoparticles for luminescence and hyperthermia applications. *AIP Conf. Proc.* **2013,** *1512* (1), 184.
4. **Parchur A. K.**, G. S. O., R. A. Singh, R. Tewari, L. Pradhan, R. K. Vatsa, and R. S. Ningthoujam. Effect Of EDTA On Luminescence Property Of Eu3+ Doped YPO4 Nanoparticles. *AIP Conf. Proc.* **2010,** *1313*, 391.
5. Singh, B. P.; **Parchur, A. K**.; Rai, S. B.; Singh, P.;Luminescence and electrical behavior of lead molybdate nanoparticles, *AIP Conf. Proc.* **2013,** *1512*, 248.
6. Sharma, G.; **Parchur, A. K.**; Jagtap, J.; Fish, B.; Carmen, B.; Medhora, M.; Flister, M.; Joshi, A. Image-guided radiotherapy with novel trimodal optical/MR/x-ray contrast nanoconstructs enhance the radiation response of head and neck tumor xenografts, *Abstracts of Papers of the ACS*, **2017**, *254*, Abstract 88.
7. Lodhi, P. D.; Kaurav, N.; **Parchur, A. K**.; Choudhary, K. K.; Interpretation of thermal conductivity in LaFeAsO at low temperatures. *AIP Conf. Proc.* **2015,** *1665*, 900025 .

BOOK CHAPTERS

1. Jagtap, J. M.; **Parchur, A. K.**; Sharma, G., Smart Nanomaterials for Hyperthermia Therapy Tumor Targeted Nanomaterials", In *Intelligent Nanomaterials for Drug Delivery Applications*, Elsevier Inc., **2020**, *Ch* 3, 43-59.
2. Jagtap, J. M.; Sharma, G.; **Parchur, A. K.**,Functional Nanostructures for drug resistance breast cancer theranostics", In *Micro and Nano Technologies, 1st Edition*, Elsevier Inc., **2020**, *Ch* 7, 131-152.
3. **Parchur, A. K.**; Jagtap, J. M.; Sharma, G.; Hansen, C. P. Radiation and ultrasound stimulated breast cancer nanomedicine, In *External Field and Radiation Stimulated Breast Cancer Nanotheranostics*; IOP Publishing Ltd, **2019**, *Ch* 6, 1-6.
4. **Parchur, A. K.**; Jagtap, J. M.; Sharma, G.; Gogineni, V.; White, S. B.; Joshi, A. Remotely Triggered Nanotheranostics. In *Nanotheranostics for Cancer Applications*; Springer Inc., **2019**, *Ch 17*, 429-460.
5. **Parchur, A. K.**; Jagtap, J. M.; Sharma, G.; Gogineni, V.; Hansen, C. P.; White, S. B.; Joshi, A. Nanostructures for Externally Triggered Chemo/Thermal Therapies, In *Hybrid Nanostructures for Cancer Theranostics*; Elsevier Inc., **2019**, *Ch* 6, 105-124.
6. Sharma, G.; **Parchur, A. K.**; Jagtap, J. M.; Hansen, C. P.; Joshi, A. Hybrid Nanostructures in Targeted Drug Delivery. In *Hybrid Nanostructures for Cancer Theranostics*; Elsevier, **2019**, Ch 8, 139-158.
7. Sharma, G.; Jagtap, J. M.; **Parchur, A. K.**; Hansen, C. P. Ionizing radiation stimulated breast cancer nanomedicine. In *External Field and Radiation Stimulated Breast Cancer Nanotheranostics*; IOP Publishing Ltd, **2019,** Ch 8, 1-21.

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2. Nasief H., Omari E., **Parchur A. K.**, Zhang Y., Chen X., Paulson E., Hall W, et. al., MRI Wavelet-Based Machine Learning Classifier to Automatically Determine OLAR Necessity During MRgART, *Medical Physics* 49 (6), E612-E612.
3. Nasief H., **Parchur A. K.**, Omari E., Zhang Y., Chen X., Paulson E., Li X, Hall W,Implementation of Primary and Secondary Methods for Automatically Determining Necessity of Online Adaptive Replanning During MRI-Guided Adaptive Radiation Therapy, *Medical Physics* 49 (6), E245-E245
4. Amjad A., Moreau M., **Parchur A. K.**, Ahunbay E., Cooper D., LiX, A Fast 3D Contour Editing Tool with 3D paintbrush and Edge Detection for MRI-Guided Adaptive Radiation Therapy *Medical Physics* 49 (6), E761-E761
5. Ahunbay E., Xu J., **Parchur A. K.**, Thill D., Paulson E., Chen X., Omari E., Li X, A Two-Step Deep Learning Method for Accurate Synthetic CT From Abdominal MRI, Medical Physics 49 (6), E755-E755
6. **Parchur, A. K.**; Lim, S.; Nasief, H.; Omari, E.; Zhang, Y.; X. Allen Li, Auto-detection of structural similarity index map from daily MRI as an indicator for MR-guided online adaptation replanning, *AAPM 63rd Annual Meeting & Exhibition, 2021*. **ORAL**

7. Omari, E.; Nasief, H.; Zhang, Y.; **Parchur, A. K.;** Paulson, E.; Chen, X.; Ahunbay, E.; Hall, W.; Erickson,B.; X. Allen Li, Should Daily Online Adaptive Replanning be Utilized for Every Treatment in MRI-guided Radiotherapy for Pancreatic Cancer? *ASTRO* Annual Meeting, Oct 24-27th 2021, Chicago. **POSTER**
8. Nasief, H.; Omari, E.; Zhang, Y.; **Parchur, A. K.;** Paulson, E.; Hall, W.; Erickson,B.; X. Allen Li, Automatically determining necessity of online adaptive replanning based on MRI wavelet multiscale texture features for MRI-guided adaptive radiation therapy. *ASTRO* Annual Meeting, Oct 24-27th 2021, Chicago. **ORAL**
9. Sharma G.; **Parchur, A. K.**; Jagtap, J. P.; Fish B.; Carmen, B.; Flister, M.; Medhora,M. M.; and Joshi, A.; Magnetic Resonance Image guided radiation therapy with nanoparticles improves radiation response of Oral Tumor Xenograft, ISMRM & SMRT, 2020, (Poster).
10. C. Hansen, J. M. Jagtap, G. Sharma, **Parchur, A. K.**, K. Allen, R. K. Woods, V. Hraska, A. Joshi; Near Infrared Fluorescence Image Guidance System for Thoracic Duct Visualization During Pediatric Cardiac Surgery, Biomedical Engineering Society Annual Meeting, Oct 17-20, 2018, Atlanta, GA. (Poster)
11. J. M. Jagtap, G. Sharma, **Parchur, A. K.**, B. Fish, M. Medhora, A. Joshi; Near-infrared dynamic fluorescence imaging to characterize radiation-induced cardiovascular changes in Invivo in rats, 64th Annual Meeting of the Radiation Research Society, Sep 23-26, 2018, Chicago, IL (Poster)
12. Stephen Mazurchuk, J. M. Jagtap, G. Sharma, **Parchur, A. K**., B. Fish, M. Medhora, A. Joshi; Machine Learning Framework for Dynamic NIR Fluorescence Based Classification of Congenic Mapping in Rats; 2018 WMIC, Sep 12–15th, 2018, Seattle, WA. (Poster)
13. J. M. Jagtap, G. Sharma, **Parchur, A. K.**, B. Fish, M. Medhora, A. Joshi; Assessing radiation induced acute vascular injury in rats with near-infrared dynamic fluorescence imaging; 2018 WMIC, Sep 12–15th, 2018, Seattle, WA. (Poster)
14. **Parchur, A. K**., J. M. Jagtap, G. Sharma, S. M. Holzhauer, W. Jing, B. D. Johnson, M. Riese, A. Joshi; Tracking T-Cell Based Therapies with Short-Wave-Infrared Emitting Quantum Dots; 2018 WMIC, Sep 12–15th, 2018, Seattle, WA. (Oral)
15. J. M. Jagtap, G. Sharma, **Parchur, A. K.**, V. Gogineni, S. B. White, M. Flister, A. Joshi; Imaging the Effect of Germline Tumor Microenvironment Variation on Triple Negative Breast Cancer, 2017 BMES Annual Meeting, Oct 11–14th, 2017, Phoenix, AZ. (Poster)
16. J. M. Jagtap, G. Sharma, **Parchur, A. K.**;, V. Gogineni, S. B. White, C. Bergom, M. Flister, A. Joshi; Imaging lymphatic function in a rat model of hypertension and the impact on breast cancer metastasis, 2017BMES Annual Meeting, Oct 11–14th, 2017, Phoenix, AZ. (Poster)
17. **Parchur, A. K.**, J. M. Jagtap, V. Gogineni, G. Sharma, S. B. White, M. Flister, A. Joshi; Efficient Hepatic Site-Selective Delivery of Novel Trimodal Optical/MR/X-ray Contrast Nanoconstructs for Colorectal Cancer Liver Metastasis Therapy, 2017 BMES Annual Meeting, Oct 11–14th, 2017, Phoenix, AZ. (Oral)
18. G. Sharma, **Parchur, A. K.**, J. M. Jagtap, B. Fish, B. Carmen, M. M. Medhora, M. Flister, A. Joshi; Enhanced Radiation Response of Head and Neck Tumor Xenografts Using Novel Trimodal Optical/MR/Xray Contrast Nanoconstructs, 2017 BMES Annual Meeting, Oct 11–14th, 2017, Phoenix, AZ. (Oral)
19. **Parchur, A. K**., J. M. Jagtap, V. Gogineni, G. Sharma, S. B. White, M. Flister, A. Joshi; Image Guided Site-Selective Delivery of Novel Trimodal Optical/MR/X-ray Contrast Nanoconstructs for Colorectal Cancer Liver Metastasis Therapy, 2017 WMIC, Sep 13–16th, 2017, Philadelphia, PA. (Oral)
20. J. M. Jagtap, G. Sharma, **Parchur, A. K**., V. Gogineni, C. Bergom, S. B. White, M. Flister, A. Joshi; Genetic variation in vascular morphology affects plasmonic nanoparticle uptake, temperature distribution, and efficacy of photothermal ablation of breast cancer, 2017 WCIO; Jun 8–11th 2017, Boston, MA. (Poster)
21. **Parchur, A. K**;, J. M. Jagtap, G. Sharma, V. Gogineni, M. Flister, S. B. White, A. Joshi; Site-Selective Delivery of Novel Trimodal Optical/MR/X-ray Contrast Bearing Photothermal Nanoconstructs Increases Uptake in Colorectal Liver Metastasis Tumors, 2017 WCIO; June 8–11th 2017, Boston, MA. (Oral)
22. **Parchur, A. K.**, J. M. Jagtap, V. Gogineni, G. Sharma, S. B. White, M. Flister, A. Joshi; Theranostic Nanoparticles with Native Short Wave IR and MR Contrast for Plasmonic Photothermal Therapy of Breast Cancer in a Rat Model, 2016 WMIC, Sep 7–10th, 2016, New York, NY. (Poster)
23. J. M. Jagtap, **Parchur, A. K.**, V. Gogineni, G. Sharma, A. L. Kaczmarowski, P. S. LaViolette, C. Bergom, S.B. White, M. Flister, A. Joshi; Imaging the Impact of Germline Tumor Micro-environment Variation on Triple Negative Breast Cancer, 2016 WMIC, Sep 7–10th, 2016, New York, NY. (Oral)
24. V. Gogineni, **Parchur, A. K.**, J. M. Jagtap, G. Sharma, M. Flister, S. B. White, M. Flister, A. Joshi; DynaCT and Short wave-IR Optical Image Guided Interventional Photothermal therapy of Colorectal Liver Metastasis, 2016 WMIC, Sep 7–10th, 2016, New York, NY. (Poster)
25. **Parchur, A. K.**, J. M. Jagtap, G. Sharma, V. Gogineni, M. Flister, S. B. White, A. Joshi; A Novel Tri-Modal Gold Nanocomplex for Image-Guided Thermal Ablation of Liver Tumors, 2016 WCIO; June 9–12th 2016, Boston, MA. (Oral)
26. J. M. Jagtap, **Parchur, A. K.**, G. Sharma, V. Gogineni, M. Flister, S. B. White, A. Joshi; Impact of Germline Tumor Microenvironment Variation on Plasmonic Photothermal Ablation of Breast Cancer, 2016 WCIO; June 9–12th 2016, Boston, MA. (Oral)

27. J. M. Jagtap, **Parchur, A. K.**, V. Gogineni, G. Sharma, A. Kaczmarowski, M. Flister, S. B. White, A. Joshi; A Novel Tri-Modal Gold Nanocomplex for Image-Guided Thermal Ablation of Liver Tumors, 2016 Midwest Preclinical Imaging Consortium, May 15–17th, 2016, Madison, WI. (Poster)
28. **Parchur, A. K.**, J. M. Jagtap, G. Sharma, V. Gogineni, M. Flister, S. B. White, A. Joshi; A Novel Tri-Modal Gold Nanocomplex for Image-Guided Thermal Ablation of Liver Tumors, 2016 Midwest Preclinical Imaging Consortium, May 15–17th, 2016, Madison, WI. (Poster)
29. **Parchur, A. K.**, J. M. Jagtap, G. Sharma, V. Gogineni, M. Flister, S. B. White, A. Joshi; Theranostic Nanoparticles for the Noninvasive Diagnosis and Photothermal Therapy of Breast Cancer, 2016 Cancer Center Scientific Retreat, the Medical College of Wisconsin Cancer Center, April 29, 2016, Milwaukee, WI. (Poster)

HONORS AND AWARDS

- Guest Editor, Nanomaterials (ISSN 2079-4991), July 2022.
- AAPM Oral presentation at 2021 AAPM Virtual 63rd Annual Meeting
- ASTRO Oral presentation (co-author) at 2021 ASTRO's 63rd Annual Meeting
- Guest Editor, IEEE Transactions on NanoBioscience, Dec 2017.
- Best Scientific Abstract: Site-Selective Delivery of Novel Trimodal Optical/MR/X-Ray Contrast Bearing Photothermal Nanoconstructs Increases Uptake in Colorectal Liver Metastasis Tumors, World Conference on Interventional Oncology, Boston, 2017.
- Best Scientific Abstract: Impact of Germline Tumor Micro-environment Variation on Plasmonic Photothermal Ablation of Breast Cancer, World Conference on Interventional Oncology, Boston, 2016.
- Travel Grants: Talk Title: Tracking T-Cell Based Therapies with Short-Wave-Infrared Emitting Quantum Dots,World Molecular Imaging Society, 2018
- Travel Grants: Talk Title: Image Guided Site-Selective Delivery of Novel Trimodal Optical/MR/X-ray Contrast Nanoconstructs for Colorectal Cancer Liver Metastasis Therapy, World Molecular Imaging Society, 2017
- Travel Grants: Talk Title: Imaging the Impact of Germline Tumor Micro-environment Variation on Triple Negative Breast Cancer, World Molecular Imaging Society, 2015

PEER REVIEWS | Verified reviews at Publons >250 (https://publons.com/a/1324077)

Reviewed manuscripts for: Applied Physics Reviews, Journal of Applied Physics, Applied Physics A, Applied Physics Letters, AIP Advances, Advanced Materials, Physical Chemistry Chemical Physics, Acta Biomaterialia, IEEE Transactions on NanoBioscience, Langmuir, Crystal Growth & Design, Nanoscale, Analyst, Nanomedicine: Nanotechnology, Biology, and Medicine, Dalton Transactions, Journal of Material Chemistry C, RSC Advances, ACS Biomaterials Science & Engineering, etc.

PROFESSIONAL MEMBERSHIP

Junior member of American Association of Physicists in Medicine - AAPM	**July 2020 – Present**
Radiological Society of North America - RSNA	**August 2016 – Present**
World Molecular Imaging Society - WMIS	**2016 – 2018**

EDUCATION

Clinical Medical Physics Resident
Froedtert Hospital & Medical College of Wisconsin, Milwaukee WI
2022 - Expected June 2025

CAMPEP Medical Physics Certificate
Medical College of Wisconsin, Milwaukee WI
2020 - 2022

Ph.D. in Physics
Dr. H. S. Gour Central University, India
2006 - 2010

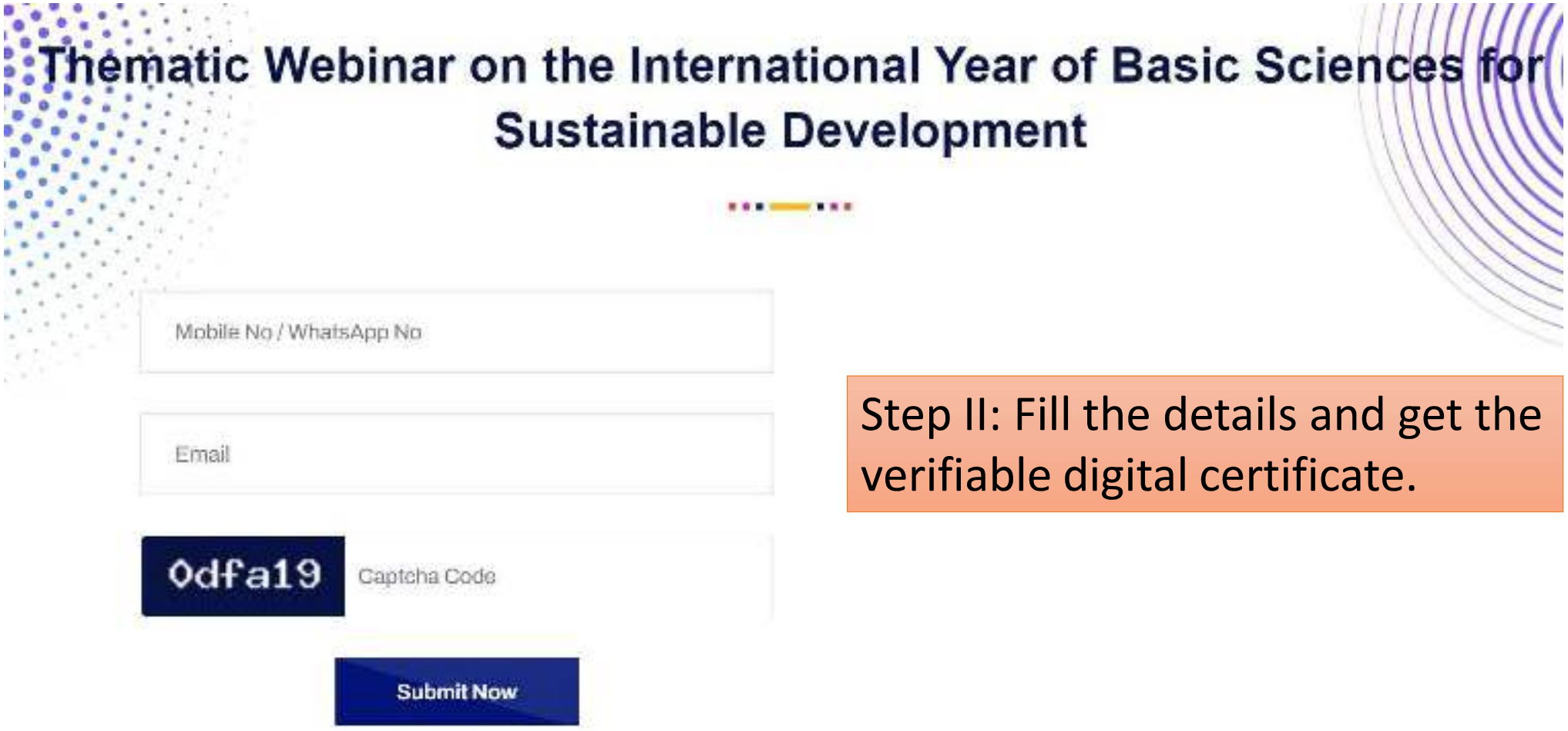
M.Sc. in Physics | Laser Spectroscopy Percentage: 70%
Dr. H. S. Gour Central University, India
2003 - 2005

B.Sc. in Physics Percentage: 80%
Acharya Nagarjuna University, India
2000 - 2003

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Step II: Fill the details and get the verifiable digital certificate.

8B

Activity Title:

National Conference on Physics and Chemistry of Materials: Keynote Speaker: Prof. Y-R Ma, National Dong Hwa University, Hualien, Taiwan

MEMORANDUM OF UNDERSTANDING
BETWEEN
GOVERNMENT HOLKAR SCIENCE COLLEGE INDORE, INDIA
AND
NATIONAL DONG HWA UNIVERSITY, TAIWAN, R.O.C.

In the spirit of international understanding, Govt. Holkar Science College Indore, India, and National Dong Hwa University, Taiwan, R.O.C., agree to examine the possibility of establishing a framework for educational and research cooperation for our students, faculty and staff.

In preparation for establishing a formal framework for future activities, the parties hereto agree as follows:

1. Explore possibilities for faculty and staff exchanges for research, lectures, and discussions that mutually benefit both institutions;
2. Explore the feasibility of student exchanges and study programs;
3. Seek support for projects determined to be mutually beneficial to both institutions;
4. The terms of joint activities and arrangements for specific visit, exchanges, and other forms of cooperation will be agreed upon in writing prior to the initiation of any activity. Any commitment of resources, financial or otherwise, in support of these activities must be contained in subsequent specific agreements;
5. While no binding commitments have been made, we sign this Memorandum of Understanding in recognition of our common interests and agree to consult periodically concerning the status of our collaboration;
6. This understanding is done in two identical copies, both in English, by authorized representatives of each institute, and both parties will retain one copy of the memorandum.

For Govt. Holkar Science College Indore, India

10/04/19

Dr. Suresh Silawat

Principal

Date: 10 April 2019

For National Dong Hwa University, Hualien County, Taiwan, R.O.C.

Dr. Han-Chich Chao

President

Date: 10 April 2019

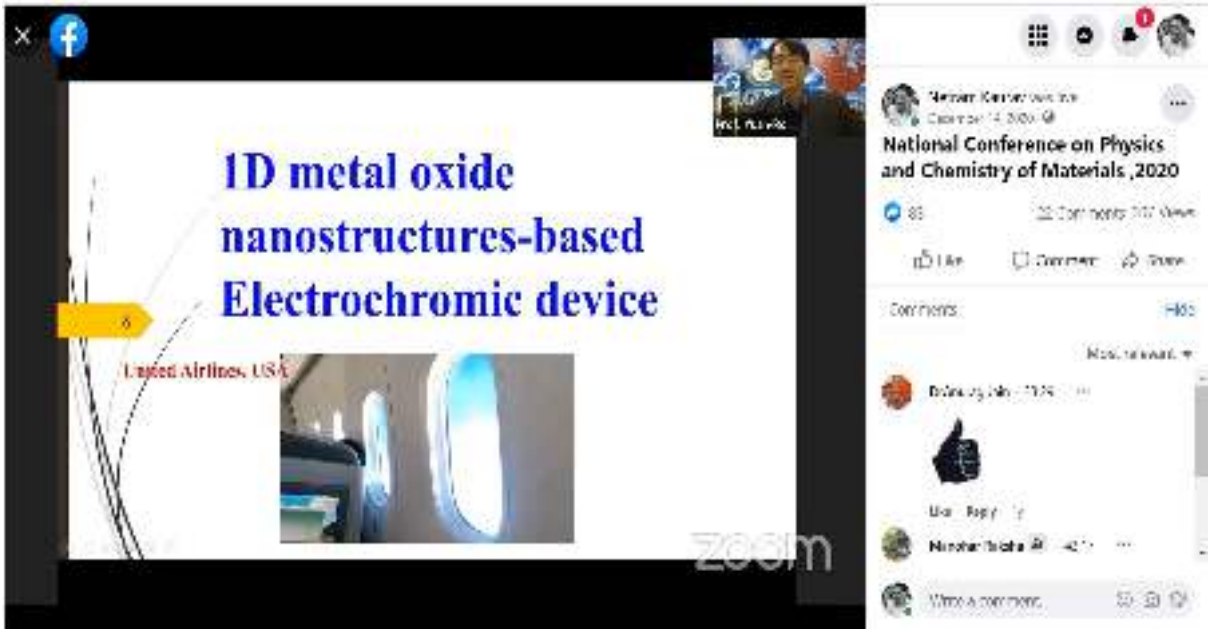
RESEARCH METHODOLOGY/ SKILL DEVELOPMENT PROGRAM
2020-21

S. No	Component/Activities	Details
1	Name of the Department / Unit / Agency:	Department of Physics
2	Name of the Activity:	National Conference on Physics and Chemistry of Materials
3	Name of the Scheme:	Under the MOU with National Dong Hwa University, Hualien, Taiwan
4	Date and Year of the Activity:	14/12/2020 to 16/12/2020
5	Number of Students Participated in the activity:	219
6	Report of the Activity (in 100 words):	The Government Holkar (Model, Autonomous) Science College in Indore's department of physics hosted a three-day national conference on the physics and chemistry of materials. This conference was run entirely online. This conference has given us the perfect forum and chance to discuss research ideas with distinguished academics, businesspeople, scientists, and policymakers working in the various branches of science and technology. The conference's focus has included advances in both basic and applied science and technology. This conference included a wide range of topics in the physics and chemistry of materials, including computational physics, thin-film technology, solar energy, nanomaterials, condensed matter physics, and materials chemistry, among others. Dr. Suresh T. Silawat, Additional Director and Principal of Govt. Holkar Science College in Indore, opened the conference. Prof. Yuan-Ron Ma of National Dong Hwa University in Hualien, Taiwan, led the first session. The Conference's chairman, conveners, and organising secretaries were Dr. G.D. Gupta (HOD, Department of Physics), Dr. RC Dixit, Dr. Netram Kaurav (HOD, Department of Electronics), and Dr. Kmal Kumar Choudhary, IMA Dehardun.

7	Photo of Activity:

https://www.facebook.com/1095451055/videos/10219732949969658/



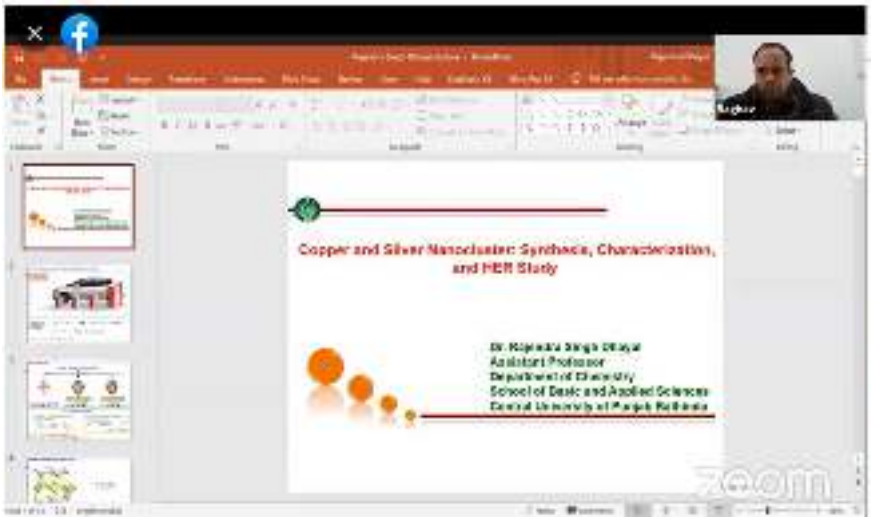




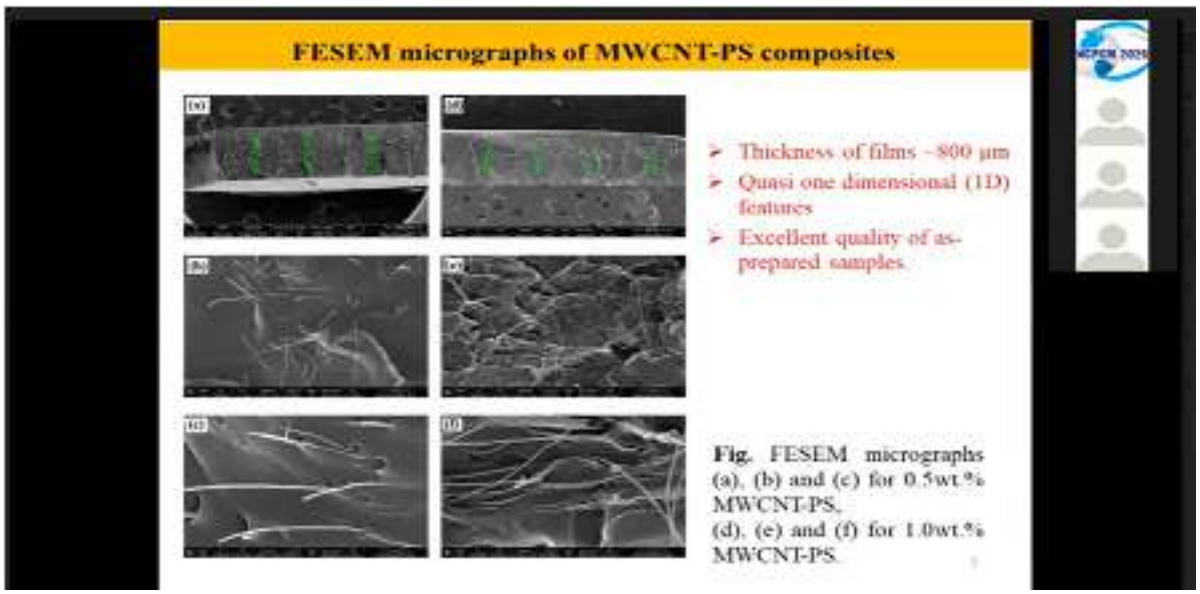
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8	Poster of Activity



ONLINE MODE!





Chief Patron
Dr. Suresh T. Silawat,
Additional Director, Indore Division
Principal, Govt. Holkar [Model, Autonomous]
Science College, Indore (MP)-INDIA

AIP
American Institute of Physics

National Conference on Physics and Chemistry of Materials

14th - 16th December, 2020, Indore - India

Department of Physics, Govt. Holkar Science College, Indore

Important Dates

Registration Deadline
15st Nov., 2020

Paper Submission Deadline
20th Oct., 2020

CONFERENCE WILL COVER FOLLOWING TRACKS :-

- Track#1: Nano Materials and Thin Film Technology
- Track#2: Phase Transition and Mechanical Properties of Materials
- Track#3: Semiconductor & Dielectric Material
- Track#4: Plasma Physics, Photonic materials & Plasmonics
- Track#5: Physics and Chemistry of Noval Materials
- Track#6: Organic, Inorganic & Biomaterials and their Chemistry
- Track#7: Electronic Structure & Phonons
- Track#8: Superconductivity, Magnetism & Spintronics
- Track#9: Computational methods in Physics and Chemistry
- Track#10: Glasses & Ceramics, Composites Materials



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Session	Time Slot	Presenter Guest/ Chair/ Speaker/ Oral	Zoom Meeting
14th Dec. 2020 Monday			
Inaugural	10:30 am to 11:00 am	**Chief Guest:** Chief Patron: **Dr. Suresh T. Silawat**, Additional Director Higher Education, Indore Division Principal, Govt. Holkar Science College, Indore Conf. Chairman: **Dr. G. D. Gupta**, Govt. Holkar Science College, Indore Conf. Convener: **Dr. R. C. Dixit**, Govt. Holkar Science College, Indore Organizing Secretaries: **Dr. Netram Kaurav**, Govt. Holkar Science College, Indore **Dr. Kmal Kumar Choudhary**, IMA Dehardun Technical Co-ordinator: **Prof. Sagar Sen**, Maharaja Bhoj Government PG College, Dhar	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 895 5269 0090 Passcode: 043266
Invited Talk	11:00 am to 11:40 am 11:40 am to 12:20 pm	Session Chair: **Dr. Rupesh Devan**, Indian Institute of Technology, Indore. Co-chair: **Dr. Pradeep Sharma**, Govt. Holkar Sci. College, Indore Keynote Speaker: **Prof. Yuan-Ron Ma**, National Dong Hwa University, Hualien, Taiwan Invited Speaker: **Dr. Sanjay Singh**, School of Mat. Sci. & Tech., IIT (BHU) Technical Co-ordinators: (1) **Dr. Bhawna Chourasia**, Govt. Holkar Sci. College, Indore (2) **Prof. Vinod Rathore**, Govt. Holkar Sci. College, Indore	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 895 5269 0090 Passcode: 043266
Parallel Session I	01:00 pm to 03:00 pm	Session Chair: **Dr. V. V. S. Muthy**, Science College, Dewas Judge I: **Dr. Vandana Rathore**, School of Engineering & Technology, Jagran Lakecity University Bhopal Judge II: **Dr. Ravindra Kinge**, Smt G G Khadse College Muktainagar Dist Jalgaon Maharashtra. Technical Co-ordinators: (1) **Prof. Sagar Sen**, Maharaja Bhoj Government PG College, Dhar (2) **Dr. Prasad Deshpande**, Govt. Holkar Sci. College, Indore Track#1: Nano Materials and Thin Film Technology List of Oral Presentations: NCPCM-1011, 1018, 1027, 1034, 1041, 1044, 1045, 1051, 1061, 1064, 1068, 1073, 1078	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 895 5269 0090 Passcode: 043266
Parallel Session II	01:00 pm to 03:00 pm	Session Chair: **Dr. Jitendra Tripathi**, IPS Academy, Indore Judge I: **Dr. Swati Goyal**, Girls PG College, Indore Judge II: **Dr. Ravi Vanspal**, SVVV, Indore Technical Co-ordinators: (1) **Dr. Jaiveer Singh**, IPS Academy, Indore (2) **Dr. Vinay Dashore**, Govt. Holkar Sci. College, Indore Track#2: Phase Transition and Mechanical Properties of Materials List of Oral Presentations: NCPCM-1025, 1037, 1055, 1059, 1186, 1222, 1226, 1233, 1261 Track#3: Semiconductor & Dielectric Material List of Oral Presentations: NCPCM-1012, 1040, 1049, 1050	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 865 1170 9510 Passcode: 600093
Parallel Session III	01:00 pm to 03:00 pm	Session Chair: **Dr. Venkat Raman**, PMB Gujrati Science College, Indore Judge I: **Dr. Srimathy B**, Indian Institute of Handloom Technology, Salem Judge II: **Dr. Supragan Thakur**, SVVV, Indore Technical Co-ordinators: (1) **Prof. Aadish Jain**, Swami Vivekanand Government College, Susner (2) **Dr. Saleem Malla**, Govt. Holkar Sci. College, Indore Track#5: Physics and Chemistry of Noval Materials List of Oral Presentations: 1007, 1014, 1020, 1023, 1024, 1031, 1047, 1065, 1075, 1083, 1098, 1107	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 856 5017 4365 Passcode: 028125
Parallel Session IV	03:30 pm to 05:30 pm	Session Chair: **Dr. Uttam Sharma**, SVVV, Indore Judge I: **Dr. Rajesh Thakur**, Jawahar lal Nehru College, Bhopal Judge II: **Dr. Rajesh Kumar**, Indira Gandhi National Tribal University, Amarkantak Technical Co-ordinators: (1) **Prof. Ravi Rathore**, Govt JNS PG College Shujalpur (2) **Mrs. Poornima Karil**, Govt. Holkar Sci. College, Indore Track#1: Nano Materials and Thin Film Technology List of Oral Presentations: NCPCM-1081, 1086, 1090, 1092, 1097, 1099, 1106, 1108, 1114, 1115, 1116, 1119, 1165	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 895 5269 0090 Passcode: 043266
Parallel Session V	03:30 pm to 05:30 pm	Session Chair: **Dr. Nishchhal Yadav**, Vikram University, Ujjain Judge I: **Dr. Shweta Mishra**, SVVV, Indore Judge II: **Dr. Prasant Thapliyal**, IMA Deharadun Technical Co-ordinators: (1) **Dr. Paras Dubey**, SAGE University, Indore (2) **Prof. Suraj Parwani**, Govt. Holkar Sci. College, Indore Track#3: Semiconductor & Dielectric Material List of Oral Presentations: NCPCM-1079, 1084, 1101, 1103, 1123, 1128, 1149, 1206, 1209, 1214, 1215, 1269	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 865 1170 9510 Passcode: 600093
Parallel Session VI	03:30 pm to 05:30 pm	Session Chair: **Dr. P. Murlidhar Reddy**, Osmania University, Hedrabad Judge I: **Dr. Sheetal Shrimal**, Govt. PG College, Mandsaur Judge II: **Dr. Pooja Singh**, College of Technology and Engineering, Udaipur Technical Co-ordinators: (1) **Dr. Jitendera Solanki**, Government College, Manawar (2) **Prof. Vishal Tandan**, Govt. Holkar Sci. College, Indore Track#6: Organic, Inorganic & Biomaterials and their Chemistry List of Oral Presentations: NCPCM-1015, 1052, 1057, 1062, 1076, 1089, 1110, 1126, 1127, 1133, 1141, 1145, 1249	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 856 5017 4365 Passcode: 028125
Note: All the papers will be presented orally for 7 minutes and 3 minutes for discussions. Increasing order of manuscript will be followed for presentation. Join the Zoom meeting before 15 minutes. Please follow all the instructions of online presentation etiquette.			

15th Dec. 2020 Tuesday			
Invited Talk	11:00 am to 11:40 am 11:40 am to 12:20 pm	Session Chair: **Dr. Susheel Kalia**, IMA Dehradun Co-chair: **Dr. Nagesh Dagaonkar**, Govt. Holkar Science College, Indore Invited Speaker: **Dr. Pradip Paik**, School of Biomedical Engineering IIT BHU Invited Speaker: **Dr. Rajendra Singh Dhayal**, Central University of Punjab, Bathinda Technical Co-ordinators: (1) **Dr. Shubhangi Soni**, Govt. Holkar Sci. College, Indore (2) **Dr. Saligram Verma**, Govt. Holkar Sci. College, Indore+D15	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 841 5487 2078 Passcode: 604403
Parallel Session I	01:00 pm to 3:00 pm	Session Chair: **Dr. Manoj Rathore,** MPCST, Bhopal Judge I: **Dr. Neetu Parsai**, Govt. College, Badwah Judge II: **Dr. Tanmoy Chakrabarty,** National Institute of Chemical Physics and Biophysics (NICPB), Tallinn Technical Co-ordinators: (1) **Prof. Pyush Joshi**, Govt. Holkar Sci. College, Indore (2) **Dr. Prasad Deshpande**, Govt. Holkar Sci. College, Indore Track#1: Nano Materials and Thin Film Technology List of Oral Presentations: NCPCM-1121, 1124, 1125, 1139, 1140, 1142, 1146, 1151, 1153, 1164, 1166, 1167, 1291	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 841 5487 2078 Passcode: 604403
Parallel Session II	01:00 pm to 03:00 pm	Session Chair: **Dr. Prerana Sharma**, UEC, Ujjain Judge I: **Dr. Apramita Chand**, National Institute of Science Education and Research, Bhubaneswar Judge II: **Dr. Aparna Agrawal**, Govt Shri Nilkantheshwar PG College, Khandwa Technical Co-ordinators: (1) **Dr. Jitendra Solanki**, Government College, Manawar (2) **Dr. Vinay Dashore**, Govt. Holkar Science College, Indore Track#3: Semiconductor & Dielectric Material List of Oral Presentations: 1272, 1280 Track#8: Superconductivity, Magnetism & Spintronics List of Oral Presentations: NCPCM-1063, 1087, 1104, 1111, 1131, 1161, 1173, 1179, 1228, 1239, 1277, 1289	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 875 0138 1674 Passcode: 080061
Parallel Session III	01:00 pm to 03:00 pm	Session Chair: **Dr. B. D. Shrivastava**, Maharaja Bhoj Government PG College, Dhar Judge I: **Dr. Nisha Pandey**, St. Aloysius College (autonomous) , Jabalpur Judge II: **Dr. Gireesh Soni**, SGSITS, Indore Technical Co-ordinators: (1) **Prof. Ravi Rathore**, Govt JNS PG College Shujalpur (2) **Dr. Saleem Malla**, Govt. Holkar Science College, Indore Track#5: Physics and Chemistry of Noval Materials List of Oral Presentations: 1113, 1130, 1157, 1174, 1176, 1183, 1212, 1216, 1240, 1244, 1268, 1275, 1284	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 891 1763 3110 Passcode: 645297
Parallel Session IV	03:30 pm to 05:30 pm	Session Chair: **Dr. Griraj Sharma,** Govt. PG College, Neemach Judge I: **Dr. Sachin Kumar Mahajan**, Samrat Ashok Technological Institute, Vidisha Judge II: **Dr. Irfan Mansuri**, Indore institute of science and technology, Indore Technical Co-ordinators: (1) **Ms. Disha Harinkhere**, Govt. Holkar Science College, Indore (2) **Dr. Kapil Kumar Kushwaha**, Govt. Holkar Science College, Indore Track#1: Nano Materials and Thin Film Technology List of Oral Presentations: NCPCM-1109, 1168, 1169, 1171, 1172, 1177, 1178, 1184, 1200, 1210, 1213, 1217, 1225, 1227	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 841 5487 2078 Passcode: 604403
Parallel Session V	3:30 pm to 5:30 pm	Session Chair: **Dr. Rakesh Sharma**, NDA Pune Judge I: **Dr. Atul Gour**, Government Kusum PG college Seoni malwa Hoshangabad, Hoshangabad Judge II: **Dr. Dinesh Choudhary**, Govt. PG College, Khargone. Technical Co-ordinators: (1) **Dr. Mona Gupta**, Maharaja Bhoj Government PG College, Dhar (2) **Dr. Ashish Mamgain**, Govt. Holkar Science College, Indore Track#4: Plasma Physics, Photonic materials & Plasmonics List of Oral Presentations: NCPCM-1004, 1046, 1054, 1132, 1160, 1223, 1257 Track#6: Organic, Inorganic & Biomaterials and their Chemistry List of Oral Presentations: NCPCM- 1148, 1163, 1189, 1193, 1245, 1252, 1259, 1265, 1287	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 875 0138 1674 Passcode: 080061
Parallel Session VI	03:30 pm to 05:30 pm	Session Chair: **Dr. Meenu Varshney**, DAVV, Indore Judge I: **Dr. Deepi Jain**, IPS Academy, Indore Judge II: **Dr ANIL VITHALRAO RAUT**, Department of physics, Vivekanand Art's and Sardar Dalipsing Commerce and Science College, Aurangabad, Maharashtra INDIA Technical Co-ordinators: (1) **Ms. Nikita Karma**, Govt. Holkar Sci. College, Indore (2) **Prof. Jaiprakash Yadav**, Govt. Holkar Sci. College, Indore Track#9: Computational methods in Physics and Chemistry List of Oral Presentations: NCPCM-1019, 1030, 1060, 1067, 1070, 1093, 1095, 1102, 1122, 1154, 1175, 1181	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 891 1763 3110 Passcode: 645297
Note: All the papers will be presented orally for 7 minutes and 3 minutes for discussions. Increasing order of manuscript will be followed for presentation. Join the Zoom meeting before 15 minutes. Please follow all the instructions of online presentation etiquette.			

Session	Time Slot	Presenter Guest/ Chair/ Speaker/ Oral	Zoom Meeting
16th Dec. 2020 Wednesday			
Invited Talk	11:00 am to 11:40 am 11:40 am to 12:30 pm	Session Chair: **Dr. J. T. Andrews**, SGSITS, Indore Co-chair: **Dr. H. S. Dagar**, Govt. Holkar Science College, Indore Invited Speaker: **Dr. Arvind Yogi,** UGC-DAE CSR, Indore Invited Speaker: **Prof. S. I. Patil**, University of Pune, Pune Technical Co-ordinators: (1) **Prof. Sheetal Malviya**, Govt. Holkar Sci. College, Indore (2) **Dr. Nidhi Parmar**, Govt. Holkar Sci. College, Indore	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 863 6112 0283 Passcode: 008095
Parallel Session I	01:00 pm to 03:30 pm	Session Chair: **Dr. Ashwani Kumar**, NDA Pune Judge I: **Dr. Visakha Vibute**, Sahid Chandra Shekhar Azad Govt PG College Jhabua Judge II: **Dr. Sachin Kaothekar**, Mahakal Institute of Technology & Management , Ujjain Technical Co-ordinators: (1) **Prof. Sagar Sen**, Maharaja Bhoj Government PG College, Dhar (2) **Prof. Trun Garg**, Govt. Holkar Sci. College, Indore (3) **Prof. Dermendra Mewada**, Govt. Holkar Sci. College, Indore Track#1: Nano Materials and Thin Film Technology List of Oral Presentations: NCPCM-1234, 1235, 1242, 1247, 1253, 1254, 1258, 1260, 1263, 1264, 1266, 1276, 1278, 1281, 1286	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 863 6112 0283 Passcode: 008095
Parallel Session II	01:00 pm to 03:30 pm	Session Chair: **Dr. Swati Dubey,** Vikram University, Ujjain Judge I: **Dr. Kirti Sahu**, SN PG College, Khandwa Judge II: **Dr. Vashim Shekh,** Govt. Swami Vivekanand College, Sarangpur, Rajgarh (M.P.) Technical Co-ordinators: (1) **Prof. Taruna Verma**, Govt. Holkar Science College, Indore (2) **Prof. Kritika Shukla**, Govt. Holkar Science College, Indore (3) **Dr. Muni Prasad Mishra**, Govt. Holkar Science College, Indore Track#6: Organic, Inorganic & Biomaterials and their Chemistry List of Oral Presentations: NCPCM-1270, 1270, 1285 Track#10: Glasses & Ceramics, Composites Materials List of Oral Presentations: NCPCM-1017, 1048, 1077, 1082, 1105, 1117, 1118, 1137, 1150, 1152, 1170, 1202, 1204, 1248, 1262	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 854 2679 7470 Passcode: 860157
Parallel Session III	01:00 pm to 03:30 pm	Session Chair: **Dr. N. P. Rajpoot**, Govt. College, Rau Judge I: **Dr. Arvind Jain**, St. Paul Institute of Professional Studies, Indore Judge II: **Dr. Manoj Nagar**, BLP Govt PG College, Mahow Technical Co-ordinators: (1) **Prof. Ashish Mamgain**, Govt. Holkar Sci. College, Indore (2) **Dr. Pavitra Lodhi**, Govt. Holkar Sci. College, Indore Track#7: Electronic Structure & Phonons List of Oral Presentations: 1088, 1156, 1159, 1185, 1194, 1219, 1224, 1232, 1243 Track#9: Computational methods in Physics and Chemistry List of Oral Presentations: NCPCM-1191, 1203, 1208, 1220, 1221, 1250	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 834 7844 9185 Passcode: 936309
Valedictory	04:00 pm to 04:30 pm	Chief Guest: Chief Patron: **Dr. Suresh T. Silawat,** Additional Director Higher Education, Indore Division Principal, Govt. Holkar Science College, Indore Conf. Chairman: **Dr. G. D. Gupta**, Govt. Holkar Science College, Indore Conf. Convener: **Dr. R. C. Dixit**, Govt. Holkar Science College, Indore Organizing Secretaries: **Dr. Netram Kaurav**, Govt. Holkar Science College, Indore **Dr. Kamal Kumar Choudhary**, IMA Dehardun	Join Zoom Meeting https://us02web.zoom.us Meeting ID: 863 6112 0283 Passcode: 008095
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List of Speakers

Keynote Speaker		
Name & Designation		**Area of Interest**
	**Prof. Yuan-Ron Ma** Professor & Head Department of Physics National Dong Hwa University Associate Dean Office of International Affairs National Dong Hwa University	Surface Science, Nanotechnique
Invited Speakers		
	**Dr. Sanjay Singh,** Assistant Professor, School of Mat. Sci. & Tech., IIT (BHU)	Heusler Compounds, Spintronics, Topological and Quantum Materials, X-ray and neutron diffraction, Magnetism, Multiferroic Device, Shape Memory Alloys, Solid State Cooling, Phase Transition.
	**Dr. Rajendra Singh Dhayal** Assistant Professor Center for Chemical Science, School of Basic and Applied Sciences, Central University of Punjab, Bathinda.	Properties of Boranes and Metallaboranes Chemistry, higher nuclearity copper polyhydride nanoclusters, super atom of silver nanoclusters and their applications in H 2 evolution.
	**Dr. Pradip Paik** Associate Professor School of Biomedical Engineering IIT BHU paik.bme@iitbhu.ac.in 8500109932 8500109932	Materials for Health Care and Therapeutic Applications: New designing and synthesis of Polymers, Ceramic, Composites, other Nanoscale Materials of Health care and Nanomedicine, in-plantable materials, Drug Delivery, Cancer Therapy, Nano vaccination, in-vitro and in-vivo studies
	Dr. Arvind Yogi, Scientist D, UGC-DAE CSR, Indore (MP).	Strongly correlated electron systems, Superconductivity, Crystal Growth.

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प्रेस नोट

दिनांक :– 10.04.2019

ताईवान के विश्वविद्यालय से होलकर कॉलेज का शैक्षणिक गतिविधियों के लिए हुआ अनुबंध (एम.ओ.यू.)

दिनांक 10 अप्रैल 2019 को शासकीय स्वशासी होलकर विज्ञान महाविद्यालय, इन्दौर का ताईवान के नेशनल डोंग हवा विश्वविद्यालय, हावालियन से साईंस एवं टेक्नोलॉजी के क्षेत्र में शोधकार्य, अध्ययन, अध्यापन एवं विद्यार्थियों के एक्सचेंज प्रोग्राम जैसी शैक्षणिक गतिविधियों के लिए अनुबंध (एम.ओ.यू.) हस्ताक्षर किया गया जिससे महाविद्यालय के शिक्षकों, विद्यार्थियों तथा शोधार्थियों को रिसर्च के क्षेत्र में नए–नए शोध कार्य के लिए प्रोत्साहन मिल सके। एम.ओ.यू. पर ताईवान विश्वविद्यालय के इंटरनेशनल अफेयर्स के डीन – प्रो. यान रोन मा तथा कॉलेज के प्राचार्य डॉ. सुरेश टी. सिलवाट द्वारा हस्ताक्षर किए। साथ ही इंटरनेशनल अफेयर्स के डीन – प्रो. यान रोन मा ने महाविद्यालय के गौरवशाली इतिहास की सराहना करते हुए महाविद्यालय के विद्यार्थियों को शोधकार्य हेतु स्टूडेंट प्रोग्राम के तहत विशेष स्कॉलरशिप देने का प्रस्ताव रखा। एम.ओ.यू. के हस्ताक्षर कार्यक्रम का संचालन डॉ. नेतराम कौरव ने किया तथा अध्यक्षता प्रशासनिक अधिकारी डॉ. आर. सी. दीक्षित ने की। कार्यक्रम में अन्य वरिष्ट प्राध्यापक विशेष रूप से उपस्थित रहे। प्रो. यान रोन मा ने महाविद्यालय को स्मृति चिन्ह प्रदान किया।

प्रति,

संपादक महोदय,

.....

.....

कृपया उक्त समाचार अपने लोकप्रिय समाचार में निशुल्क प्रकाशित करने का कष्ट करें।

प्राचार्य

10/4/19

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Manganese Ore (India) Limited, Balaghat

तमसो मा ज्योतिर्गमय

9A

Activity Title:

Internship of students with Manganese Ore (India) Limited (MOIL), Balaghat.

DEPARTMENT OF GEOLOGY
GOVT. HOLKAR [Model, Autonomous] SCIENCE COLLEGE,
INDORE – 452001 [M.P.]

No. 1350 / Geology/UG Internship

Indore: October 19, 2022

To,
Mines Manager,
Balaghat Manganese Mines,
Manganese Ore India Ltd (MOIL)
Balaghat (Madhya Pradesh)

Sub : Internship of UG students (B.Sc. Part - III) of Geology Department.

Ref. : Commissioner Higher Education, Govt. of M.P. Order No. Bhopal dated 16\7\2010

Sir,

We always appreciate your cooperation and help for considering our request and providing Internship training to UG students of Geology department of our institution. In this regard this is to state that as per the curriculum, the UG students of B.Sc. Part – III 2022-23 are required to complete Internship of one week during first week of November 2022 with concerned department/organization. In this connection, you are requested to accommodate and guide 10 students of B.Sc. Part - III Geology in your Department/Office/Field, so they will be able to carry out the work to fulfill the requirement of Internship. In this regard, you are also requested to assess their performance after completion of Internship as per norms given. Kindly provide a certificate regarding Internship to those students who are present during full course of Internship at your organization. List of participating students is enclosed herewith.

Thanking you for extending help.

Yours sincerely

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Head
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List of students is annexed with letter

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Head, Department of Geology,
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Shri Vinay Kumar Rahengdale
Chief Manager (Geology)
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DEPARTMENT OF GEOLOGY
GOVT. HOLKAR [Model, Autonomous] SCIENCE COLLEGE,
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No. 1351 /Geology/UG Internship

Indore: October 19, 2022

To,
Mines Manager,
Balaghat Manganese Mines,
Manganese Ore India Ltd (MOIL)
Balaghat (Madhya Pradesh)

Sub : Internship of UG students (B.Sc. Part - III) of Geology Department.

Ref. : Commissioner Higher Education, Govt. of M.P. Order No. Bhopal dated 16\7\2010

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GOVT. HOLKAR SCIENCE COLLEGE,

INDORE (MP)

INTERNSHIP REPORT ON

MANGANESE ORE INDIA LIMITED

MANGANESE MINES OF BHARVELI,

BALAGHAT, MADHYA PRADESH

From - 18th March to 24th March 2021

SUBMITTED BY:

SHIVANI THAKUR

M.Sc. IV Sem

(EN.NO.- DS19OO505)

SUBMITTED TO:

DR. VISHNU GADGIL SIR

HEAD OF THE DEPARTMENT:

GEOLOGY

MANGANESE ORE INDIA LIMITED



BHARVELI, BALAGHAT, MADHYA PRADESH

VISITED BY: Students of M.Sc. IV Sem

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Acknowledgement

First and foremost, we are grateful to Mr. Vinay kumar Rahangdale Sir, chief geologist for providing an opportunity to kindly attend seven days mine training.

We express our deep sense of gratitude to MOIL (Manganese Ore India Limited) Bharweli, Balaghat, and Madhya Pradesh for approving our letter, dated on 18th of march 2021.

We are also thankful to Mr. Keshavrao Patle sir (Diamond drill supervisor), Mr. Prashant Thaware (trannie geologist) and Mr. Rajesh Daharwar sir, Moil Bharveli, Balaghat,(Madhya Pradesh) for knowledgeable lecture session and also for guiding us and helping us through out the training.

Our sincere thanks are also to mine operators, labors, villagers for their corporation, and valuable guidance within field days. Our heartfelt thanks are for our parents for giving us financial support to carry out the field training and motivation.

Finally, we would like to express our gratitude to all colleagues who directly and indirectly helped us to make this short training success and joyful.

Date:18 to 24 march 2021

College – Govt. Holkar Science College, Indore (Madhya Pradesh)

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- Spot 5: Preparing Of Borehole Section And Ore Reserve Estimation.
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GENERAL GEOLOGY OF THE AREA AND STRATIGRAPHY

The rocks in this area belong to Sausar group of rocks. Sausar group is a part of Sausar Mobile Belt (SMB) along with Tirodi biotite gneiss and Meta pelites and Mafic granulites. Sausar group of rocks comprises of multiply deformed and polymetamorphosed sequence of calc silicate gneiss, marble, politic to psammopelitic schist, quartzites and Mn oxide silicate. This group is economically rich because the Mn ore deposits are associated with Sausar group of metasediments. Metamorphic grade of Sausar group of rocks increases from south to north and also towards west. Low grade green schist to green schist-amphibolites facies transition zone metamorphism have been recognized all along the southern periphery of Sausar Group starting from Ukwa in the east to Mansar-Kandri-Satak-Lohdongri areas in the southwestern corner of the basin. In the Tirodi area sillimanite has appeared through the transformation of fibrolite (formed at lower temperature than sillimanite).

Lithologically Sausar group represents an outright supracrustal cratonic assemblage of metamorphosed quartzite, pelites and carbonate (QPC assemblage of Condie 1989). The richest manganese ore deposits of India occur in the mica schist (Mansar formation) and to a lesser extent, in the carbonate (Lohangi formation) horizons of SSG. SSFB is known to extend from Ramakona (Chhindwara, M.P.) in the west to Baihar (Balaghat, M.P.) in the east for a strike length of more than 200km.

Sausar group of rocks are deformed into isoclinal folds along E-W, ENE-WSW, AND NE-SW axes. These are overturned towards north. Sausar Mn ore are identified as synsedimentary low phosphorous type deposited in shelf environment, there are many ores having high phosphorus content. The Mn ore of Balaghat are derived mainly from hydrothermal exhalative and partly from continental sources.

Earlier Narayanswami et al (1963) had given a stratigraphic succession for the Sausar Group of rocks. Recently A. Chattopadhyay, B.K. Bandopadhyay and A.S.Khan (2001) has proposed a stratigraphic succession of Sausar Group and associated gneiss-migmatites which is given as follows:

	Stratigraphic name	Rock type
SAUSAR GROUP	Sitapur formation	Hornblende-schists and amphibolites
	Intrusives Massive	potassic granite, pegmatite, aplite and quartz
	Bichua Formation	Pure and impure dolomitic marble with subordinate
	Junewani formation	muscovite-biotite schists and Granulites
	Chorbaoli formation	Garnetiferrous quartz-mica-schist with local development of magnetite and staurolite.
	Mansar Formation	Biotite (±fibrolite)-muscovite-quartz schist, Dolomitic marble and quartzite with manganese and gondite
	Lohangi Formation	Calc-silicate rocks, calc-gneiss and calcitic with or without manganese ore
	kadbikhera formation	Granulitic rocks with biotite and magnetite
	Sitasaongi formation	Gritty quartzite and associated pebbly quartz-mica schist
TBG	Tirodi-biotite gneiss migmatite,	Multi component gneiss, Biotite gneiss, Tonalite gneiss, cordierite gneiss etc

DESCRIPTION OF BALAGHAT MINE:

Balaghat Mine is located in Balaghat District, Madhya Pradesh and is 223 Km from Nagpur. It can be approached by all weathered road. The Balaghat Manganese Mine is 6 Km away from Balaghat railway station. The Mine area falls on toposheet No 64 C/1 and is situated at 21° 50' North Latitude and 80° 14' East Longitude. Mining was started in the year 1903 in this mine. Balaghat Mine is deepest and largest underground Manganese Mine in Asia. The lease hold area is located over rolling plain, near the foot

of Baihar plateau. The area comprises of ridge trending in NNE-SSW direction. This ridge forms the southern part of a spur jutting out from the scarp of main Baihar plateau. The average elevation of the plateau is about 610 m above sea level. Ore is mainly silicate in origin (Braunite).

At Balaghat, the litho formations identified are-

Recent alluvium

Quartz vein/ pegmatite

Mansar formation

Manganese Horizon

Sitasaongi formation

MINE AT A GLANCE

- Strike length : 2.8 km
- Strike direction : N25°E- S25°W.
- Dip : 15°- 80° due West
- No. of level of operations : 7th to 12th level.
- No. of level proved : 23rd level.
- Thickness of ore body : 3 -30 m
- Hanging Wall rock : Sericitic schist

  (Mansar formation)
- Foot wall rock : Felapathic Quartzite & quartz schist

  (Siatasaongi)

Details of Main Entry-

Holmes Shaft	:	6.60 m X 2.70 m Depth upto 15th level 383.50 m & proposed depth upto 16.5 level i.e. 428.50 m
Production Shaft	:	4.50 m dia. Depth 370.26 m
Edward Shaft	:	4.55 m X 1.80m Depth 62 m
Haulage Road	:	3.6 m X 2.4 m (North) 3.0 m X 2.4 m (South)
Ore Drive	:	2.4 m X 2.1 m
Cross Cut	:	3.0 m X 2.4 m (North) 2.4 m X 2.1 m (South)
Winze	:	2.4 m X 1.8 m



HOLMES SHAFT, MOIL, BALAGHAT

METHOD OF MINING:

UNDERGROUND MINE:

At Balaghat, mining commenced in the year 1901. Over a period 100 years, the activities have reached to the depth of 300 m, through underground mining The development of drives in the underground is done in the ore horizon of dimension of 2.4 m x 2.1m. For proper ventilation in the underground winzes of dimension 2.1 m x 1.8 m are developed in the ore horizon. Winzes generally connect one level to the other; it can also be used for transportation of material from one level to other.

The method of mining in the underground is horizontal cut and fill method by hydraulic sand stowing. In a stope block a slice of 3 m is mined out first, the excavated area is filled with sand (hydraulic sand stowing) for 2 m leaving behind one meter gap. Again another slice of 2 m is mined out, this process continues till we reach the crown pillar. Ore is generally extracted from drives, winzes and stopes.

- Method of Stoping : Cut and Fill Overhand with Hydraulic Sand Stoping.
- No. of Levels worked : 7^{th} to 12^{th} level
- Level Interval : 30 Mtrs.
- Size of the stope block :60 mtr X 15 mtr X 30 mtr
- Percentage Recovery of Ore from stope: 78%

SALIENT DESCRIPTION OF PRESENT MINING METHOD:

Currently Balaghat Mine is being worked by underground cut & fill mining method with pre mining supports like rock bolts and cable bolts. Voids created are filled by sand.

SEQUENCE OF MINING OPERATION:

- **DRILLING:** Drilling is done by jack hammer machine (32 mm dia). It can drill horizontal as well as inclined hole.
- **CHARGING:** The blast holes are charged with explosive, then blast out to open the drive or to get the ore.
- **BLASTING:** For blasting electric detonators are used.
- **DRESSING:** After blasting drives and stopes are dressed to remove the loose and weak portion.
- **MUCKING & TRANSPORTATION:** By SDL (side discharge loader) & hopper loader, material sent to ore pass or ore chute. Ore loaded from chute into GB car and tub. There after ore is dropped into main ore pass.

VISIT TO UNDERGROUND MINES (LEVEL 13.5):



A visit to underground mines level 13.5 which is below **420 m** from MSL was done. The traverse was done along the haulage road which was made

on the country rock. The haulage road connects the ore by a road called as ore drive.

An exposure was studied of the country rock. The country rock was having fine bands of light and dark colour in which the dark coloured minerals were flaky in nature thus we say that the country rock is micaceous schist which is by stratigraphy the hanging wall. There also patches and veins of quarts seen.

After observing the country rock we went to see the Mn ore. The rock was blackish in colour with lusture and having higher density than the country rock. Strikes and dip were taken ,

- Strike of ore body- N25E – S25W
- Dip- 65˚W

MINE SUPPORT SYSTEM:

MINE SUPPORT: a) Crown Pillar

b) Rib Pillar

c) Post Pillar



(LEVEL 13.5 VISIT)

DIAMOND DRILLING

Drilling is an important method of prospecting subsurface rocks and ore deposits. In drilling data are collected by direct penetration of sub surface rocks by drill hole. The sample of rocks are obtained in the form of cylindrical cores of rocks fragments.

It has been employed in mining and geological work. they are

1. Prospecting
2. Exploration
3. Blasting
4. During exploitation for development shaft ,sinking, rescue work etc.

TYPES OF DRILLING :

1. **Percussion**
2. **Rotary : Diamond drilling**
3. **Miscellaneous**

DIAMOND DRILLING

Diamond drilling is a form of core drilling which uses a rotary drill with a diamond drill bit attached in order to create precisely measured holes. As diamond is the hardest naturally occurring material in the world, it is ideal for crating openings in a range of materials including concrete, metal and glass.

The main part in diamond drilling methods are;

1. Drill rods
2. Core Bit
3. Barrel
4. Casing(Borehole)
5. Diamond Bit
6. Tungston core bit
7. Stone per carat
8. Impregnated Bit
9. Hosting Plug

Two types of core bit are;

- NQWL
- BQWL

NQWL and BQWL core bits are used with NQWL reaming shell and BQWL reaming shell respectively, where NQ and BQ are series and WL means Wire Line Drilling.

Reaming shell;

The outer shell in NQWL bit which has 2mm larger diameter that of bit, used for making the hole wider so as to decrease friction caused by rubbing of the tools and drill rods, against the drill hole walls.

Barrel;

A hollow cylinder attached to a specially designed bit and which is used to obtain and to preserve a continuous section or core of the rocks penetrated in drilling.

1. Outer Barrel
2. Inner Barrel

CORE BARREL;

It is a tube inside a drill pipe and supported by a bit to receive the core in core drilling, it is a tube usually of iron on which a foundry loam core is formed. All bits are fitted in the core barrel.

There are two types of core barrel;

1. Single Tube
2. Double Tube

CASING;

It is a large diameter pipe that assembled and inverted into a recently drilled section of boreholes.

1. HW Casing
2. NW Casing

DIAMOND BIT;

Diamond bits are tools for drilling rock that works by scrapping industrial grade diamonds against bottom of hole. The diamonds are embedded into the metal surface during manufacturing of bit.

There are various sizes of diamond bit they are;

1. HW Bit
2. NW Bit
3. NQ Bit



CORE LOGGING

Core logging is the systematic recording and measuring of as much information as possible required to determine the lithology, mineralogy, potential, geological history, structure and alteration zone through a tiny piece of cylindrical rock drilled and removed from a potential mineral deposit.

Vocabulary of Core Logging;

- Core Length
- Core Recovery
- Recovery Percentage
- RQD(Rock Quality Designation)
- RQD Percentage

1. **Core length:**
   Length of core is core length a core has a core length 3m.
2. **Core Recovery:**
   In full 3m length which we get is called total core length and reduce is called Recovery.
3. **Core Recovery Percentage:**
   The ratio of the length of the recovered to the length drilling ranges from 0% to 100%.

Core Recovery % = Total length of core recovery.100 /core run length

4. **RQD:**
   RQD is modified core recovery percentage in which the length of all round rocks core pieces over 100mm in length are summed and divided by the length of the core run, pieces of core length are not hard and round should not be included in the RQD evaluation even if they are at least 100mm or 10cm in length.

Range	Length	Recovery	Recovery%	RQD	RQD%	Formation
o-3	3m	3m	100%	2.80m	93.33%	Mica ceresite schist+quartzite
0-3	3m	3m	100%	2.87m	96%	Mica ceresite schist+ quartzite



(Our team with our mentors at diamond drill)

VISIT TO FERRO MANGANESE PLANT

INTRODUCTION:

As a part of diversification, the company has set up a 5 MVA capacity Ferro Managanese Plant with installed capacity 10000 TPA. The plant was commissioned on 1.10.1998. The submerged arc furnace of 5 MVA capacity is able to produce about 10000 TPA of Ferro Managanese or 6800 TPA of Silico Manganese or any combination of these two products depending on the market scenario. The capital costof the plant is about Rs. 5.00 crores.

High Carbon Ferro Manganese is through smelting of charge burden consisting of manganese ore, coke, steam coal, dolomite, iron ore, etc., in the furnace. The High Carbon Ferro Manganese produced in the plant is of the best quality in India having 78% Mn, 0.35% Phosphorous and 6 to 8 % Carbon.

A)



B)



A). Heat Furnace B). Molten ferro manganese aloy flow

The plant has been awarded with ISO 9001-2000 Quality Certificate during the year 2004-05. As production of Ferro alloy is power intensive, the company is considering to set up a captive power plant of 50 MW capacity to meet its power requirements. The company is also planning to expanding the capacity of ferro manganese plant and setting up a new 16.5 MVA Silico Manganese Plant to meet the ever increasing demand of the ferro alloys globally.

WORKING OF THE PLANT IN BRIEF:

Firstly the raw materials i.e. Mn ore (2.5 to 2.6 MT), pearl coke (0.55 to 0.600 MT), dolomite(0.360 MT), Fe ore (0.070 MT), Carbon paste (0.016 MT) and silica gel (0.200 MT) are taken seperately into 6 bunkers which are then mixed together in a single bunker. The mixture is then taken to the furnace by a carrier. The furnace is an submerged arc furnace which has three electrodes which are formed of carbon paste and forms a delta structure. The electodes have contact rings which ae used to supply current to it coming from the transformer situated above the furnace. There is also pressure ring around the furnace which is used as a support to the furnace.

The current generates heat in the furnace which melts the raw material. The temperature in the furnace is around 1200˚C. In the furnace, electric arc is produced underneath the charge to generate necessary heat for reactions for smelting of the Ferro Manganese. During the process oxides of manganese and iron are reduced by carbon content in coke and goes to metal and gang material su--ch as alumina and silica react with the calcium oxide and magnesium oxide available in the dolomite to form complex silicates in the form of slag. The tapping is done four times a day in which the smelted material is taken out of the furnace and then cooled. First the slag comes out of the furnace followed by the metal as it is less denser than the metal.

USES OF HIGH CARBON FERRO MANGANESE:

High Carbon Ferro Mn is a vital constituent for the production of steel. It is used as deoxidiser in steel making and also finds strategic importance in as alloying element when additional or specific properties are required in the special steel such as stainless steel, alloy steel, etc.



VISIT TO INTEGRATED MANGANESE BENEFICIATION PLANT (IMB PLANT)

Date :21/03/2021

Latitude : 21.850^0 N

Longitude : 80.2280E

As a part of mechanization of ore handling and beneficiation of manganese ore, the Company has set up an integrated Manganese Ore Beneficiation Plant comprising of crushing, handling, wet screening, drying and magnetic separation operations in one complex at a capital cost of Rs.4 crores, in 2001.

The plant is utilized for bulk handling of ROM and to improve the productivity of the mine and also the grade of ores. This will help in sustaining production and market requirements in future. The plant is first of its kind in the country to be set up for manganese ore beneficiation.

The following operations are carried out during operation of plant:

1. **Crushing:** In this process manganese rock particles got crushed in fine particles through the crushers having fastly moving cutting plates in it. It does Crushing of +75 mm material to -75 mm by means of jaw crusher.





2. **Screening**: There are 3 sizes of screens (seives) being used for separation by mechanical vibrations.

Screen sizes	Product grade
75mm- 25mm	Lumphy
25mm- 6mm	Coarse
<=6mm	Fine

3. **Washing:** After screening ROM separated into 3 size and washing is done with water to remove soil from the manganese ore**.**
4. **Hand picking** : The workers pick out the waste material through hand by weighing their specific gravity (as manganese ore mineral, braunite have high specific gravity 4.7-4.8).

5. **Jigging:** Jigging is a method of gravitational preparation of natural resoures based on separation of mineral mixture on density in vertically oscillating water stream of variable direction. The formed layer different density are separately removed as a concentrate, waste and intermediate product. It is done manually as well as mechanically.



(IMB PLANT MAP AND SAMPLES)

CONCLUSION

It was a really nice experience for us to work here under the great guidance of our guide. we learn from the very beginning of how the ore is extracted to how it is processed in various plants like Ferro Manganese Plant and Integrated Manganese Beneficiation Plant. we also learn how to prepare the borehole sections to estimate the ore reserve and also how the borehole is drilled i.e. its methodology. The underground mine visit was really a thrilling experience as it was our first time that too in Asia's biggest and deepest underground mines. we practically learnt all the methodologies and principles applied here. Overall it was a very good learning experience.

The most important reason that we extract any ore is because of its wide applications in our lives so the applications of Mn are as follows:

1. Oxidizing agent in steel industry
2. Dry Battery as Depolarizer
3. Used in the manufacture of
   - Ferro Manganese (70-74% Mn.)
   - Silico Manganese (60-65% Mn.)
   - Chrome Manganese (20- 25% Mn.)
4. Preparation of Organic and Inorganic Chemicals.
5. In Paints, Pigments, Ceramics and Ferrites.
6. As Micro-nutrients in Fertilizer and animal.
7. Electronics - High purity manganese oxides are designed specifically for component manufacture
8. Fuel Additives - Manganese containing octane improvers provide refiners a highly efficient alternative to MTBE. They reduce pollution

LOCATION AND ACCESSIBILITY:-

Balaghat Mine is located in village Bharveli, Tawejhari, Aowlajhari Hirapur & Manjhara of Balaghat District, Madhya Pradesh, It is about 223 km from Nagpur . It falls under 21° 50' North Latitude and 80° 14' East Longitude and comes under Topo-sheet no. 64 C/1. It is well connected by road, State Highway No. 26 passes through it and connects Baihar. The nearest railway station is in Balaghat which is connected to Gondia & Jabalpur.

LOCAL GEOLOGY:

The manganese ore belt in Sausar extends from North-East of Balaghat, Madhya Pradesh to south-west of Nagpur, Maharashtra. It is for about 215km covering Balaghat, Bhandara & Nagpur districts. In Balaghat Mine the surface outcrop of manganese ore is for about 2.8km along the strike. It has a trend NE-SW direction and is dipping towards W direction. The general strike length is N25°E and the dip amount varies from 15° to 85° at various sections.

Genetically, the Manganese deposit in Balaghat mine is Sedimentary in nature, where pure and impure sediments were deposited in the form of higher oxides. These sediments were converted to lower oxide during metamorphism. Since the deposit was admixture of both pure and impure sediments, the zoning of grade is absent. By and large the central part is higher in grade; the quality depletes towards hangwall and footwall. Towards footwall the impure sedimentation is present as manganiferous Quartzite. Therefore in every stope the Manganese varies from 25 – 48 %. The Phos. Distribution within ore zone is prominent. The central portion i.e. between ch.11 & ch.60, the Phos. is less than 0.1 % whereas it is greater than 0.1 % on either *side.* Stratigraphically ore horizon of Balaghat Mine underlies the rocks of Munsar stage & overlies the Sitasaongi stage of Sausar series.

The manganese ore deposit of Balaghat mine is the richest deposit in India occurring in association with the formations of "Sausar Series" as lenticular mass and stretched over a distance of about 8000 ft (2.80 Km). The ore body striking NE-SW with a swing to N-S beyond chainage 'O' and to E-W beyod ch.100, where it thins out both along strike as well as depth.As stated earlier, the Manganese ore of the Bharveli area is the richest one in Central region's Manganese deposit. Out of the total reserve estimated, about 52% is having manganese value more than 40% and remaining 48% is having the Manganese value less than 40%. The

phosphorous value is high (0.2%) from Ch. No.0 to 5 and between Ch. . 60 & 90 on the surface. However this value gradually tapers down between Chainages 11 & 63 respectively at 8th Level underground. Thereafter it follows downwards vertically as evident from the drilling data. The ore horizon consists of manganese ore, manganiferous quartzite and jasperiod quartzite. The width of the ore body varies from 3 mtrs. (at the extremities) to 30 meters at the central part. The maximum true width of the ore body is observed between Chainage 2100 to 1500. The dip of the ore body is towards NW and varies from 20 degree to 80 degree. The steep dip is observed between Chainage 5200-7000.

STRUCTURE OF ORE BED:

The Ore bed of the Bharveli mine strikes N 25º E dipping about 50º to 85º towards N 65º W. In the Northern section dip becomes flat (25º to 30º) and in Southern Section it is very steep (70º to 80º). The variation in dip is due to low deformation of the strata.

FOLDS:

There are two generations of folds encountered here:-

(I)`The older (F-1) generation fold, in which recumbent fold is existing, is found in between Ch. 800 and Ch.4200. The plunge of this fold is 15 degree towards NW, which causes local flatness of dip in various levels.

(II)The younger generation of fold (F-2) is drag folds, which occur all along the strike, but they have very little effect on the strata. The fold system is displayed on vertical plain, as a result reversal dip is noticed in course of stoping.

FAULTS :

Presently there are no faults traceable due to exploitation activities, at opencast as well as in underground levels. They were minor dislocations and had no influence in any direction on the strata.

JOINTS:

The Ore bed of this mine is highly jointed. Different sets of joints are developed in section of mines; this may be due to local structural disturbances. In the North Section where the ore body is influenced of recumbent fold (Ch: 800 to Ch: 4200). Four sets of joints along with the random joints are present. The dip of major sets of joint is 78(towards North 130). .But the trend of the joint changes according to local dip direction. The South Section is found to be less disturbed. Here two sets of joints were seen along with the random joints. The dip of the major set of

joint is 70(towards North 298°. The Ore bed of this mine is stretching about 2.8 Kms. In length is continuous along the dip & The Balaghat manganese deposit is a stratiform type deposit; it is also good example for meta-sedimentary deposit. Low grade metamorphism of sedimentary rocks like shale, sandstone and Mn bearing silicate rocks altered to Phyllite, Quartzite & Mn ore horizon. The alternate bands of quartzite and Mn ore clearly indicate sedimentation before metamorphism.

STRATIGRAPHY:

The major rock types found in Balaghat are Phyllite, Mica schist, Mn ore and Felspathic/ Quartzite schist. The above series of the rocks are of Mansar formation in sausar group.

Bichua formation: Dolomitic Marble, Calc gneiss and Schist.

Junewani formation: Mica schist, Quartzite, Biotite gneiss

Charbaoli formation: Quartzite, Felspathic schist gneiss, autoclastic Quartz Conglomerate

Mansar formation: Mica schist gneiss, graphic schist, phyllite and Quartzite with Manganese deposit including Gondite

Lohangi formation: Pink white Calcitic and Dolomitic Marble, calc-silicate gneiss, Quartzite and Manganese deposits, Quartz-Biotite schist and gneiss.

Sitasongi formation: Quartz mica schist, Felspathic schist and gneiss, Quartzite and conglomerate

----------unconformity----------

Tirodi gneiss/older metamorphic group

Sitasaongi formation consist of white to pink jaspery quartzite, followed by a thick zone of conglomerate & grit. The quartzite beds thin out towards North. These rocks form the bottommost member of the sausar series & are in contact with underlying granitic gneiss.

Manganese bed in this area occupies a stratigrahic horizon between phyllite & sericite schist of Munsar formation.

Munsar formation- overlying the ore bed is a great thickness of sericite schist, which is thrown in to rolling folds. They are medium to fine grained soft, sometimes garnetifeous in nature. Munsar stage comprises of muscovite schist, muscovite, biotite-sillimanite schist and sericite schist in

the low-grade metamorphic zone. At places, these schist are feldspathic and grade into muscovite gneiss. Phyllitic rocks in the Eastern part of the Balaghat District represent this stage.

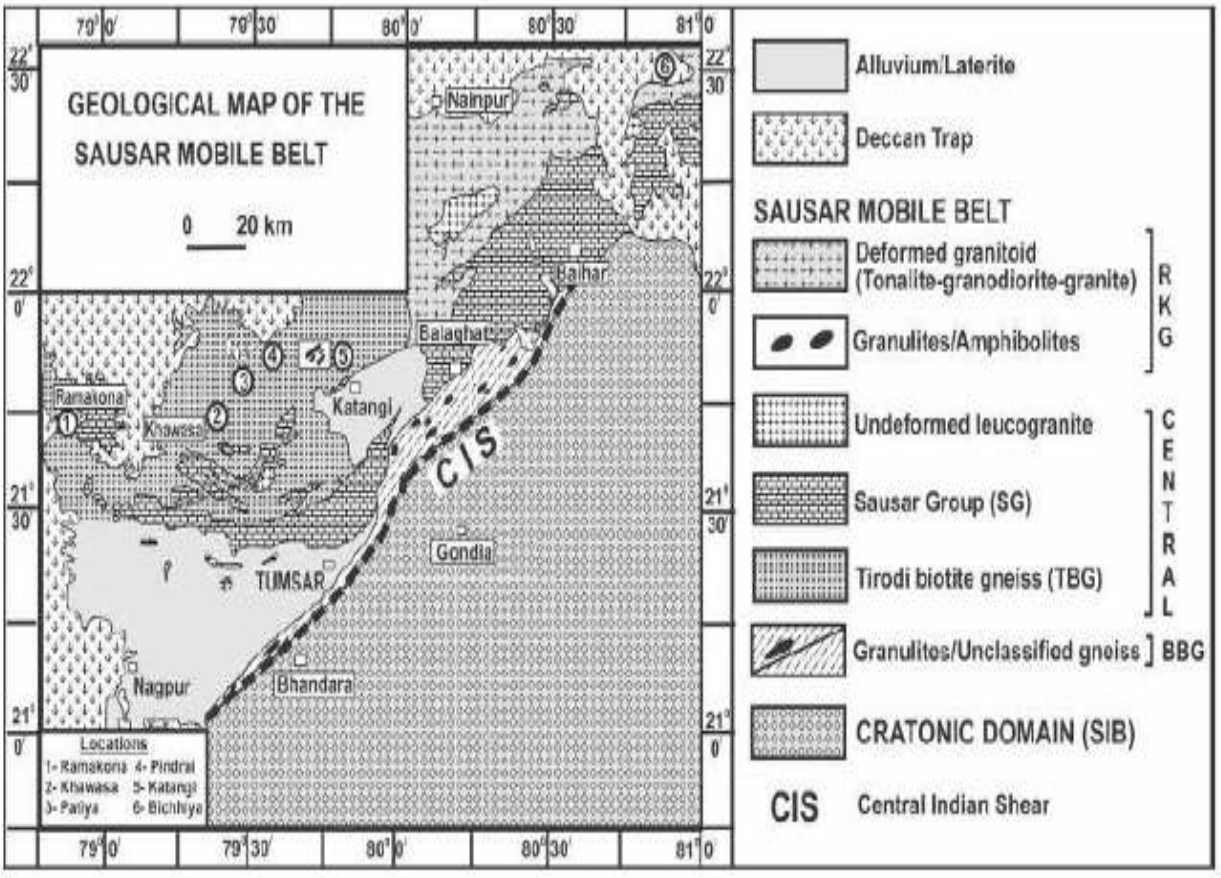


Fig. 2. Geological map of the Sausar Mobile Belt in central India, showing the different lithotectonic domains (after Bhowmik & Pal, 2000).

The contact of ore horizon with hanging wall and Footwall rocks is sharp. The sequence could be represent as below-

H/W,- SCHISTOSE ROCK - ORE HORIZON

F/ W. - FELDSPATHIC QUARTZITE

ORE MINERALS OF MANGANESE

NAME	BRAUNITE	PYROLUCITE	HAUSMANITE
Colour	Brownish black	Steelgrey ,bluish grey	Brownish black
System	Tetragonal	Tetragonal	Tetragonal
Hardness	6-6.5 (Moh's scale)	6-6.5 (Moh's scale)	5.5 (Moh's scale)
Formula	$Mn^{2+}Mn^{3+}SiO_4O_8$	MnO_2	$MnMn_2O_4$
Lustre	Sub-metallic	Sub-metallic	Sub-metallic
Streak	Black	Black	Dark brown
Diaphaneity	Opaque	Opaque	Opaque
Tenacity	Brittle	Brittle	Brittle
Cleavage	Perfect	Perfect	Perfect
Fracture	Irregular /concoidal	Concoidal to uneven	Uneven-flat
Density	4.8 g/cm^3	4.4-5.06 g/cm^3	4.8-4.83g/cm^3
Mode of formation	Braunite is formed due to metamorphism of manganese silicates and weathering products.	Occurs as Sedimentary, hydrothermal and secondary.	A primary mineral in hydrothermal veins. Also produced by metamorphism of manganiferrous rocks.

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Azim Premji University, Bengaluru, India

तमसो मा ज्योतिर्गमय

10 A

Activity Title:

Workshop on translation work in science subjects conducted by Azim Premji University, Bengaluru, India : 2022

MEMORANDUM OF UNDERSTANDING

This Memorandum of Understanding (MOU) is entered into on this **24th day of May, 2021** by and between:

Azim Premji University, a private university established under the Azim Premji University Act, 2010 (Karnataka Act No. 14 of 2010) with its principal place of operations at Survey No. 66, Burugunte Village, Bikkanahalli Main Road, Sarjapura Bengaluru- 562125; and a division of Azim Premji Foundation for Development, a section 25 company registered under the Companies act, 1956 and having its registered office at #134, Doddakannelli, Next to Wipro Corporate Office, Sarjapur Road, Bangalore- 560035, hereinafter referred to as "**University**" (which expression shall, unless repugnant to the context, include its successors in interest, administrators and assigns)of the **One Part**;

AND

Government Holkar Science College, with its principal place of operations at A.B. Road, Near Bhawarkua, Indore, Madhya Pradesh – 452 017, hereinafter referred to as "**Institute**" (which expression shall, unless repugnant to the context, include its successors in interest, administrators and assigns) of the **Other Part**.

University and Institute shall be referred to individually as "**Party**" and jointly as "**Parties**".

WHEREAS

A. University is a not-for-profit university established in Karnataka by the Azim Premji University Act, 2010 offering undergraduate and postgraduate programmes in education and development domains.

B. Institute is an autonomous institution established in Indore with NAAC 'A' grade accreditation and is a leading science college in the State of Madhya Pradesh.

C. University is interested in generating Science, Mathematics, Economics, and other subjects' education resources in Indian languages. Institute is interested in expansion of sciences, mathematics, and their education in general. Both Parties admit students to their respective undergraduate science programs many of whom are making a transition from education in their own languages to English as a medium of instruction. These interests provide a common ground for collaboration.

D. Both Parties welcome collaboration between their members including faculty and students on projects related to resource generation for science and mathematics pedagogy and are therefore executing this MOU. Parties will respectively provide the required resources to facilitate the collaborative projects from time to time.

(c) *Applicable Law.* This MOU shall be governed by the Laws in India and each of the Parties submit to the jurisdiction of the courts of Bangalore.

IN WITNESS WHEREOF the Parties hereto have duly caused these presents to the executed on the day, month and year first above written.

By:

Name: Manoj P
Registrar
Azim Premji University
Date:

By:

Name:
Principal,
Government Holkar Science College
Date:

Azim Premji University, Bengaluru, India
(Workshop on translation work of science subject)






हदा में विज्ञान शिक्षण : चुनौतियां एवं संभावनाएं
दिनांक : 7 जून 2022
समय : दोप. 2 से 4.30 बजे तक
स्थान : कॉन्फ्रेंस हॉल



हिंदी में विज्ञान शिक्षण की चुनौतियां और संभावनाएं विषय पर हुई बात

- दो विश्वविद्यालय समस्याओं को दूर करने का कर रहे हैं प्रयास
- पाठ्य सामग्री की उपलब्धता व मौलिक लेखन पर हुई चर्चा

इंदौर (नईदुनिया प्रतिनिधि)। शासकीय होलकर विज्ञान महाविद्यालय के वनस्पति शास्त्र और सूक्ष्मजैविकी विभाग द्वारा अजीम प्रेमजी विश्वविद्यालय बेंगलुरु के साथ मिलकर हिंदी में विज्ञान शिक्षण की चुनौतियां एवं संभावनाएं विषय पर कार्यशाला का आयोजन किया गया। इसमें हिंदी पृष्ठभूमि के उच्च शिक्षा प्राप्त करने वाले विद्यार्थियों को पाठ्य सामग्री की उपलब्धता, गुणवत्ता, संदर्भ सामग्री व मौलिक लेखन पर चर्चा की गई।

कार्यशाला में चर्चा की गई कि मध्य प्रदेश, उत्तर प्रदेश, राजस्थान, बिहार, हरियाणा और अन्य प्रदेशों में हिंदी मातृभाषा होने के कारण विद्यार्थियों को स्कूली शिक्षा के बाद महाविद्यालयों में कठिनाई का सामना करना पड़ता है। इन समस्याओं को दूर करने के लिए अजीम प्रेमजी विश्वविद्यालय हिंदी और अन्य क्षेत्रीय भाषाओं में उच्च गुणवत्तापूर्ण सामग्री विद्यालय और महाविद्यालयीन विद्यार्थियों के लिए उपलब्ध करवाने के प्रयास में कई वर्षों से कार्यरत है। विश्वविद्यालय द्वारा होलकर विज्ञान महाविद्यालय के साथ इसके लिए समझौता किया गया है। इसके तहत विद्यार्थियों के लिए अंग्रेजी में उपलब्ध विज्ञान साहित्य का अनुवाद हिंदी भाषा में किया जाएगा। कार्यक्रम के वक्ता डा. अरविंद गुप्ते, डा. अशोक शर्मा और डा. विजय पंवार थे। होलकर कालेज के प्राचार्य डा. सुरेश टी. सिलावट, देवी अहिल्या विश्वविद्यालय के इकोनॉमिक्स विभाग के विभागाध्यक्ष डा. कन्हैया आदमा, डा. संघमित्रा इकबाल, विनय जैन, फरहत्नी सांगी सहित अजीम प्रेमजी फाउंडेशन के प्रो. सिद्धार्थ जैन मौजूद थे। कार्यक्रम का संचालन डा. संजय व्यास ने किया।

SSR DOCUMENT

2022

CRITERION – 3

MoUs/Linkages/Collaborations

Ultra Lab Instruments, New Delhi

Document Title:

The Department of Pharmaceutical Chemistry has organized a 3-day workshop on "instrumental techniques" in association with Ultra Lab Instruments, New Delhi.

10 B

Activity Title:

Online meeting organized for Translation work of Physics books from English to Hindi in association with Azim Premji University, Bengaluru, India :2021

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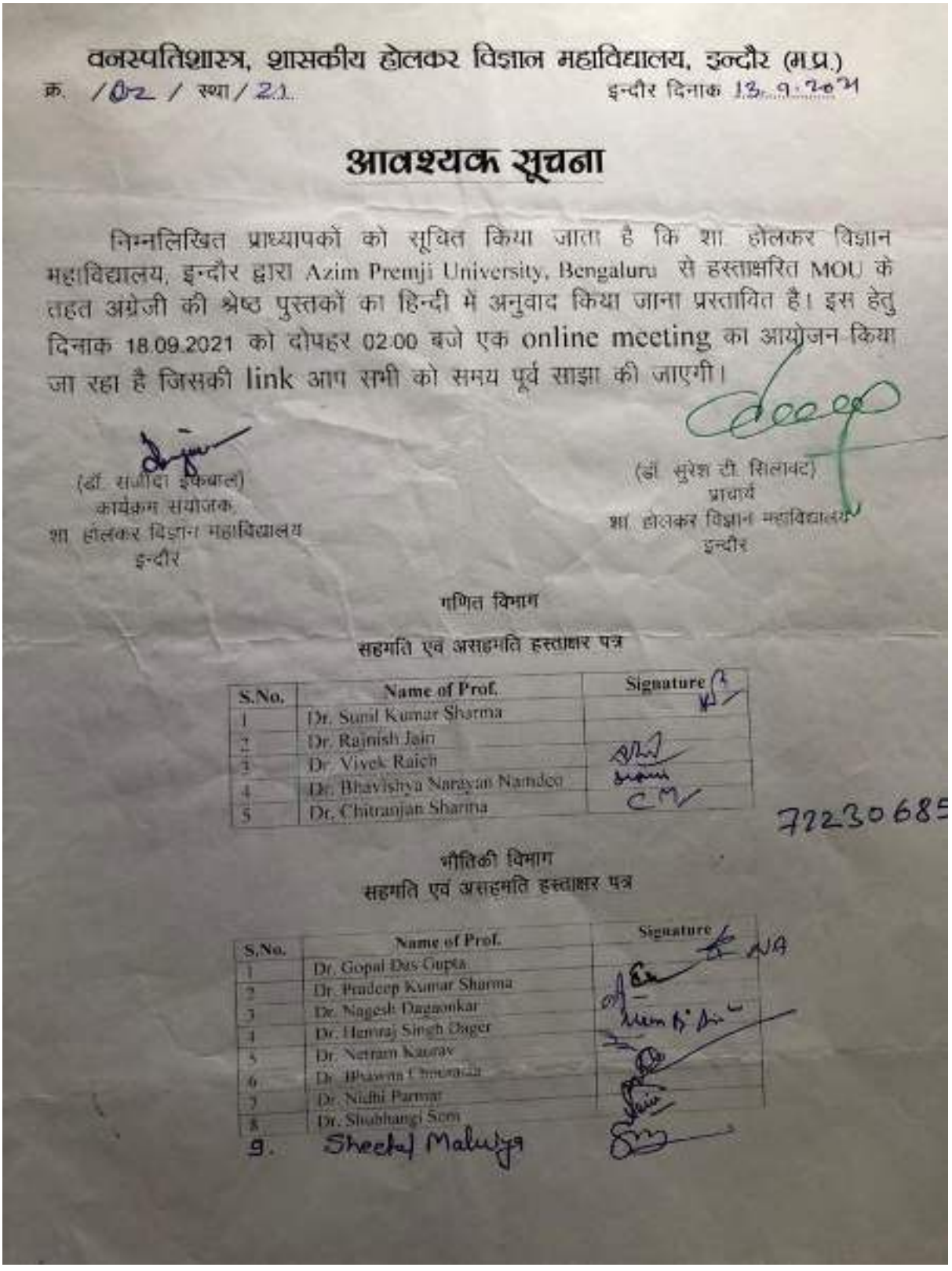
By:

Name: Manoj P
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Date:

By:

Name:
Principal,
Government Holkar Science College
Date:

Azim Premji University, Bengaluru, India (Online meeting organized for Translation work of Physics books from English to Hindi)



वनस्पतिशास्त्र, शासकीय होलकर विज्ञान महाविद्यालय, इन्दौर (म.प्र.)

क्र. /02 / स्था / 21 इन्दौर दिनांक 13.9.2021

आवश्यक सूचना

निम्नलिखित प्राध्यापकों को सूचित किया जाता है कि शा. होलकर विज्ञान महाविद्यालय, इन्दौर द्वारा Azim Premji University, Bengaluru से हस्ताक्षरित MOU के तहत अंग्रेजी की श्रेष्ठ पुस्तकों का हिन्दी में अनुवाद किया जाना प्रस्तावित है। इस हेतु दिनांक 18.09.2021 को दोपहर 02:00 बजे एक online meeting का आयोजन किया जा रहा है जिसकी link आप सभी को समय पूर्व साझा की जाएगी।

(डॉ. साजीदा इकबाल)
कार्यक्रम संयोजक
शा. होलकर विज्ञान महाविद्यालय
इन्दौर

(डॉ. सुरेश टी. सिलावट)
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शा. होलकर विज्ञान महाविद्यालय
इन्दौर

गणित विभाग

सहमति एवं असहमति हस्ताक्षर पत्र

S.No.	Name of Prof.	Signature
1	Dr. Sunil Kumar Sharma	
2	Dr. Rajnish Jain	
3	Dr. Vivek Raich	
4	Dr. Bhavishya Narayan Namdeo	
5	Dr. Chitranjan Sharma	

7223068

भौतिकी विभाग

सहमति एवं असहमति हस्ताक्षर पत्र

S.No.	Name of Prof.	Signature
1	Dr. Gopal Das Gupta	NA
2	Dr. Pradeep Kumar Sharma	
3	Dr. Nagesh Dagaonkar	
4	Dr. Hemraj Singh Dager	
5	Dr. Netram Kaurav	
6	Dr. Bhawna Chouhan	
7	Dr. Nidhi Parmar	
8	Dr. Shubhangi Soni	
9.	Sheetal Malviya	

Azim Premji University, Bengaluru, India (Meeting for translation work by Team of translation initiative)







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CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Infutech Health Care Pvt. Ltd., Indore

तमसो मा ज्योतिर्गमय

11 A

Activity Title:

Internship training is provided to microbiology students by Infutech Health Care Pvt. Ltd., Indore, under active collaboration

DRAFT

MEMORANDUM OF UNDERSTANDING
BETWEEN
DEPARTMENT OF MICROBIOLGY, GOVERNMENT HOLKAR SCIENCE COLLEGE INDORE, INDIA
AND
INFUTECH HEALTH CARE PVT. LTD. INDORE, INDIA

In the spirit of National understanding, Dept. of Microbiology, Govt. Holkar Science College, Indore, India and Infutech Health Care Pvt. Ltd., Indore agree to examine the possibility of establishing a framework for educational and research cooperation for our students, faculty and staff.

In preparation for establishing a formal framework for future activities, the parties hereto agree as follows:

1. Explore possibilities for faculty and staff exchanges for research, lectures, and discussions that mutually benefit both institutions.

2. Explore the feasibility of student exchanges and study programs.

3. Seek support for projects determined to be mutually beneficial to both institutions.

4. The nature of such activities and arrangements for specific visits, exchanges, and other forms of cooperation will be agreed upon in writing prior to the initiation of any activity. Any concurrent of resources, financial or otherwise, in support of these activities must be contained in subsequent, specific agreements.

5. While no binding commitments have been made, we sign this Memorandum of Understanding in recognition of our common interests and agree to consult periodically concerning the status of our collaboration.

6. This understanding is done in two identical copies, both in English, by authorized representatives of each institution, and both parties shall retain one copy of the understanding.

For Department of Microbiology, Govt. Holkar Science College Indore, India

Dr. (Name): SANJAY VYAS

Title: Head, Dept. of Microbiology, Govt. Holkar Science College

Date: 01/03/2021

For Infutech Health Care Pvt. Ltd., Indore, India

Dr. (Name): C. K. NAIR

Title:

Date: 01/03/2021

To,

Date: 01/02/2021

The Director
InSitech Health Care Pvt. Ltd.,
Indore (M.P.)

Sub: Regarding Internship for B.Sc. Students of Microbiology.

Respected Sir,

This is to request you for allowing eight of our B.Sc. Microbiology students for the internship in your Institute for fulfilling the norms stated in the MOU signed by our respective Institute. The list of students is attached with this letter.

Thanking You,

Dr. Sanjay Vyas
Professor & Head
Dept. of Microbiology
Govt. Holkar College, Indore (M.P.)
Indore (M.P.)

GOVT. HOLKAR SCIENCE COLLEGE, INDORE
DEPARTMENT OF MICROBIOLOGY

INTERNSHIP/PROJECT INFORMATION -2021
MICRO B.Sc. FINAL YEAR [B.S]

S.N.	NAME OF STUDENT	SURNAME	CLASS SECTION	NAME OF COLLEGE GUIDE	NAME OF PLACE	DATE OF TRAINING	INTERNSHIP SUBJECT
1	JYOTI	SHRIVAS	B.Sc. III rd Year B-S	DR. D.C.P.T. SHARMA	INTAS PHARMACEUTICALS PVT. LTD.	12.10.2020 TO 12.11.2021	QC
2	KIRAN CHOUHAN		B.Sc. III rd Year B-S	DR. D.C.P.T. SHARMA	INTAS PHARMACEUTICALS PVT. LTD.	12.10.2020 TO 12.11.2021	QC
3	PANKAJ KUMAR		B.Sc. III rd Year B-S	DR. D.C.P.T. SHARMA	INTAS PHARMACEUTICALS PVT. LTD.	12.10.2020 TO 12.11.2021	QC
4	RAJESH NAGAR		B.Sc. III rd Year B-S	DR. D.C.P.T. SHARMA	INTAS PHARMACEUTICALS PVT. LTD.	12.10.2020 TO 12.11.2021	QC
5	SHIVANI	KUSHWAHA	B.Sc. III rd Year B-S	PROF. ANJU SHARMA	INTAS PHARMACEUTICALS PVT. LTD.	12.10.2020 TO 12.11.2021	QC
6	SHUBHAM	SATAVA	B.Sc. III rd Year B-S	PROF. ANJU SHARMA	INTAS PHARMACEUTICALS PVT. LTD.	12.10.2020 TO 12.11.2021	QC
7	URJA BANGI		B.Sc. III rd Year B-S	PROF. ANJU SHARMA	INTAS PHARMACEUTICALS PVT. LTD.	12.10.2020 TO 12.11.2021	QC
8	YOGITA	THAKUR	B.Sc. III rd Year B-S	PROF. ANJU SHARMA	INTAS PHARMACEUTICALS PVT. LTD.	12.10.2020 TO 12.11.2021	QC

Kindly above students for Internship in your Institute

Professor & Head
Dept. of Microbiology
Govt. Holkar College, Indore (M.P.)

SSR DOCUMENT

2021

CRITERION – 3

MoUs/Linkages/Collaborations

Parenteral Drugs Pharmaceuticals Pvt. Ltd. Indore

Document Title:

Parenteral Drugs Pharmaceuticals Pvt. Ltd., Indore, provided an industrial internship to microbiology students as per the MoU between both institutes.

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DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Dr. Kamal Kumar Choudhary, Army Cadet College (ACC), Indian Military Academy, Dehradun, Uttrakhand

तमसो मा ज्योतिर्गमय

12 B

Activity Title:

Collaborative Research Activity and Joint Publication : 2018

Army Cadet College
Indian Military Academy
Dehradun, Uttarakhand -248007; Phone: 0135-2775769

Dr. K. K. Choudhary

Professor and Head,
Faculty of Science

No.

Date: 04 Jul 2020

RESEARCH COLLABORATION

Prof. R. C. Dixit, Dr. H. S. Dager and Dr. Netram Kaurav, Department of Physics, Govt. Holkar Science College, Indore are engaged in collaborative research with Dr. Kamal Kumar Choudhary, Professor, Army Cadet College, Indian Military Academy, Dehradun.

This research collaboration is focused on research activities in the fields of Thermuelectric properties of nanomaterials, superconducting materials, research at high pressure and related topics.

By the virtue of this collaboration, the research groups at both institutions will be able to share the expertise and research facilities at each other's institutes and will be able to guide the research scholars. However, there will be no financial implication on any of the institution due to this research collaboration.

This research collaboration will be effective for the academic session 2020-2021 and will be carried forward based on the need and agreement of both the research groups.

(Dr.K. K. Choudhary)

Dr K K Choudhary
Professor (Physics)
Army Cadet College Wing
Indian Military Academy
Dehradun-248007

RESEARCH ARTICLE | SEPTEMBER 13 2021

Analysis of size dependent electrical resistivity of Bi_2Te_3 nanoparticles

Vinod Rathore; R. C. Dixit; Ravindra R. Kinge; K. K. Choudhary

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+ Author & Article Information

AIP Conference Proceedings 2369, 020225 (2021)
https://doi.org/10.1063/5.0062273

The size-dependent electrical resistivity ρ(T) of Bi_2Te_3 nanoparticles is theoretically analyzed. Temperature-dependent resistivity of Bi_2Te_3 nanoparticles is very sensitive to particle size, it shows clearly semiconducting phase for 22nm particle size, whereas, for 150nm particle size, it shows metallic behaviour dominated by electron-phonon interaction. The resistivity in metallic phase is estimated considering electron-phonon scattering mechanism using Bloch-Gruneisen [BG] model of resistivity. Whereas, resistivity in Semiconducting phase has been estimated by small polaron conduction (SPC) mechanism. The theoretically calculated resistivity for various particle sizes in semiconducting and metallic phase of Bi_2Te_3 nanoparticles shows good agreement with experimental results in wide temperature range.

Topics
Electrical resistivity, Polarons, Nanoparticle, Elementary particle interactions, Phonon scattering, Public policy and governance

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RESEARCH ARTICLE | SEPTEMBER 13 2021

Investigation of structural and optical properties of Fe^{3+} ion substituted molybdenum oxide

Pankaj Gupta ; M. Saleem; K. K. Choudhary; Netram Kaurav; R. C. Dixit

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+ Author & Article Information

AIP Conference Proceedings 2369, 020226 (2021)
https://doi.org/10.1063/5.0061432

Transition metal oxides of the type $Mo_{1-x}Fe_xO_3$ (x = 0.01, 0.02, 0.05) are reported in this work. These metal oxides were synthesized by the solid state reaction method. The as synthesized metal oxides were studied for structural properties using X-ray diffraction characterization. The data collected in the angular range of 20° ≤ θ ≤ 60° was analyzed and it was found that all the synthesized oxides have acquired orthorhombic (Pbnm) crystal structure. It was witnessed that all sample were single phased inferred from the identical diffractogram of these oxides. To verify the results of XRD analysis further, we refined the XRD data and the various structural parameters obtained established the structure and space group of the prepared oxide materials. To obtain the crystallite size acquired as a result of high temperature firing, we approached with classical Debye-Scherer formula and Williamson-Hall approach and the calculated crystallite size in both approaches agree with each other. Further, Williamson-Hall approach helped us in the determination of the strain induced as a result of severe mechanical grinding and high temperature treatment. The optical bandgap estimated exploiting UV-Vis spectroscopic technique was found 3.34eV, 3.5eVand 3.3eV for $Mo_{0.99}Fe_{0.01}O_3$, $Mo_{0.98}Fe_{0.02}O_3$ and $Mo_{0.95}Fe_{0.05}O_3$ oxides respectively.

Topics

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RESEARCH ARTICLE | SEPTEMBER 13 2021

Preparation and optical properties of nickel nanoparticles implanted carbon membranes

Disha Harinkhere ; K. K. Choudhary; Netram Kaurav

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+ Author & Article Information

AIP Conference Proceedings 2369, 020201 (2021)

https://doi.org/10.1063/5.0061269

Through dip coating method monodisperse nickel nanoparticles assisted carbon membrane was prepared on porous alumina disc support. The coating solution was prepared by blending of thermally stable polymer polyphenylene oxide (PPO) and thermally labile polymer polyvinylpyrrolidone (PVP) followed by addition of nickel nanoparticles. Size of nanoparticles, surface porosity, average pore size, element composition and optical properties of the membrane were investigated by means of different techniques such as XRD, FE-SEM, EDS and UV-Visible spectrometer Incorporation of nano-sized nickel in polymer matrix causes increase in pore size from 0.022 μm to 0.076 μm as well as porosity and decrease in optical band gap from 5.44 eV to 5.09 eV of membrane.

Topics

Band gap, Materials synthesis and processing, Optical properties, Polymers, Porous media, Visible spectroscopy, Nanoparticle, Transition metals, Chemical elements

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RESEARCH ARTICLE | SEPTEMBER 13 2021

Synthesis, structural and optical properties of Cr-Doped nickel oxide (NiO)

Suraj Parwani; Ravindra R. Kinge; K. K. Choudhary; Netram Kaurav; R. C. Dixit

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+ Author & Article Information

AIP Conference Proceedings 2369, 020224 (2021)
https://doi.org/10.1063/5.0061301

Cr doped nickel oxide (NiO) were successfully synthesized using a one-step solid state reaction method. The X-ray diffraction patterns analysis shown that all doped NiO powder samples were exhibited polycrystalline structures. When NiO doped with the different elements such as Cr then substantial modifications and anomalies were observed in NiO such as, morphology, thickness, lattice constant, stress/strain, crystallite size, and dislocation density. The doping in NiO also altered optical properties. Moreover, the characteristic deviations in the doped NiO powder have been thoroughly discussed.

Topics

Doping, Optical properties, Polycrystalline material, X-ray diffraction, Transition metal oxides

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12 A

Activity Title:

Collaborative Research activity and Joint Publication : 2020

Army Cadet College
Indian Military Academy
Dehradun, Uttarakhand -248007, Phone: 0135-2775769

Dr. K. K. Choudhary

Professor and Head,
Faculty of Science

No.

Date: 07 Jul 2018

RESEARCH COLLABORATION

Prof. R. C. Dixit, Dr. H. S. Dager and Dr. Netram Kaurav, Department of Physics, Govt. Holkar Science College, Indore are engaged in collaborative research with Dr. Kamal Kumar Choudhary, Professor, Army Cadet College, Indian Military Academy, Dehradun.

This research collaboration is focused on research activities in the fields of Thermoelectric properties of nanomaterials, superconducting materials, research at high pressure and related topics.

By the virtue of this collaboration, the research groups at both institutions will be able to share the expertise and research facilities at each other's institutes and will be able to guide the research scholars. However, there will be no financial implication on any of the institution due to this research collaboration.

This research collaboration will be effective for the academic session 2018-2019 and will be carried forward based on the need and agreement of both the research groups.

(Dr.K. K. Choudhary)

Dr K K Choudhary
Professor (Physics)
Army Cadet College Wing
Indian Military Academy
Dehradun-248007

RESEARCH ARTICLE | APRIL 24 2019

Effect of sintering temperature on the dielectric properties of non-stoichiometric nickel oxide

Paras Dubey ; K. K. Choudhary; Kiran Singh; Netram Kaurav

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+ Author & Article Information

AIP Conference Proceedings 2100, 020171 (2019)
https://doi.org/10.1063/1.5098725

Non-stoichiometric nickel oxide was synthesized by solid state route method at different sintering temperatures upto 1100 °C. The structure of synthesized compounds were analyzed by X ray diffraction analysis (XRD) and the dielectric constant was found to different for samples of different stoichiometry. These results were interpreted as the decomposition temperature increases, which heals the defects present in the non-stoichiometric nickel oxide and loss peak shifts to the higher frequency which is due to long range hopping of charge carriers.

Topics

Dielectric properties, Sintering, X-ray diffraction, Transition metal oxides, Stoichiometry

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Abstract

This paper discusses the high pressure-dependent crystal structure phase transformation and elastic behavior of $ZnSe_xTe_{1-x}$ (x = 0.0, 0.2, 0.55, 0.81, 0.93 and 1.0) by speculating effective interionic interaction potential (EIoIP), that contains long-range type Coulomb force, short-range overlap repulsion of the Hafemeister and Flygare types and the van der Waals (vdW) interaction. The assessed values of structural phase transition pressure and the considerable volume discontinuity associated with the pressure–volume phase diagram support the structural phase transformation from zinc blende ($B3$) type to rock-salt ($B1$) type crystal structure. The equation of state curves (relationship between $V(p)/V(0)$ and pressure in the pressure–volume phase diagram) for both the zinc blende ($B3$) and rock-salt ($B1$) structures is in reasonably good agreement with that of experimental observations. Moreover, systematic variations of the second-order elastic constants (SOEC) with pressure have been found to follow systematic trends showed by the other systems with $B3$ type to $B1$ type pressure-dependent structural phase transition.

Keywords: Structural phase transition ▪ high pressure ▪ elastic constants ▪ interionic interaction potential

PACS: 62.50.−p, 64.70.Kb, 62.20.Dc, 62.20.−x, 65.40.−b

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HIGH-PRESSURE INDUCED STRUCTURAL PHASE TRANSITION AND ELASTIC PROPERTIES

Application of broadband terahertz spectroscopy in semiconductor nonlinear dynamics

OF DILUTED MAGNETIC SEMICONDUCTORS Zn1-xMnxSe
DINESH VARSHNEY et al., International Journal of Modern Physics B, 2012

First-principles calculations for transition phase, mechanical and thermodynamic properties of ZnS under extreme condition
Tao Yang et al., International Journal of Modern Physics B, 2017

INVESTIGATION OF STRUCTURAL PHASE TRANSFORMATION IN HALF METALLIC FERROMAGNETIC EuN UNDER PRESSURE
VIPUL SRIVASTAVA et al., International Journal of Modern Physics B, 2012

Pressure-induced reversible metallization and phase transition in Zinc Telluride
Yukai Zhuang et al., Modern Physics Letters B, 2018

ELECTRONIC AND ELASTIC PROPERTIES OF ZINC-BLENDE MgSe
B. I. ADETUNJI et al., International Journal of Modern Physics B, 2013

I-Chen HO et al., Frontiers of Optoelectronics, 2014

Preparation of shape-controlling VO2(M/R) nanoparticles via one-step hydrothermal synthesis
Yuchao LI et al., Frontiers of Optoelectronics, 2021

Phase equilibria and crystal structure of ternary compounds in Al-rich corner of Al-Er-Y system at 673 and 873K
Xiaoxu Liu et al., Journal of Materials Science & Technology, 2021

Existence of a Ground State Solution for the Choquard Equation with Nonperiodic Potentials
Yuanyuan Luo et al., Acta Mathematica Scientia, 2022

Understanding social innovation in local energy transitions processes: A multi-case study
Sujeetha Selvakkumaran et al., Global Transitions, 2021

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RESEARCH ARTICLE | APRIL 24 2019

Interpretation of Raman modes in FeTe and $FeTe_{0.9}S_{0.1}$ compounds

Pavitra Devi Lodhi ; K. K. Choudhary; Netram Kaurav

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+ Author & Article Information

AIP Conference Proceedings 2100, 020182 (2019)

https://doi.org/10.1063/1.5098736

In the present investigation, we have prepared FeTe and $FeTe_{0.9}S_{0.1}$ compounds via conventional solid-state reaction method. We have measured X-ray diffraction and Raman spectra of poly-crystalline FeTe and $FeTe_{0.9}S_{0.1}$ at room temperature. X-ray profile of FeTe and $FeTe_{0.9}S_{0.1}$ confirmed the primitive tetragonal unit cell. Further, Raman active mode corresponds to A_{1g} (Te) Te vibrations are at around (395 cm^{-1}) B_{1g} ((Fe)), corresponds to Fe vibrations (598 cm^{-1}) and the E_{2g} (Te, Fe)) modes were found to doubly degenerated at (473 cm^{-1}). The mode observed in the spectrum of Raman at 1301 cm^{-1} is extremely near to the energy difference between x_2-y_2 and xz/yz which attributed to electronic Raman scattering in d-orbitals of Fe.

Topics

Raman scattering, Raman spectroscopy, X-ray diffraction

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Published: 13 May 2019

Measurement and Analysis of Normal-State Transport Properties of FeSe Superconductor

Pavitra Devi Lodhi, Netram Kaurav, K. K. Choudhary & Y. K. Kuo

Journal of Low Temperature Physics **196**, 494–509 (2019)

486 Accesses | **3** Citations | Metrics

Abstract

Transport properties such as thermal conductivity (κ), Seebeck coefficient (S) and electrical resistivity (ρ) of the FeSe superconductor were measured and analyzed theoretically. The samples were synthesized through a solid-state reaction route via vacuum encapsulation and characterized by X-ray diffraction and Rietveld refinement analysis. It is found that the Seebeck coefficient, $S(T)$, exhibits an anomalous temperature dependence and shows a crossover of sign at around 190 K, which is an artifact of coexistence of electron and hole bands, wherein carrier diffusive Seebeck coefficient $S_c^{\mathrm{diff}}(T)$ and phonon drag contribution $S_{ph}^{\mathrm{drag}}(T)$ can successfully explain the experimental results. The

measured thermal conductivity $\kappa(T)$ develops a phonon peak at around 80 K, presumably due to various phonon scattering mechanisms. Our thermal conductivity analysis indicates not only phonon thermal conductivity (κ_{ph}), but also the carrier contribution to thermal conductivity (κ_c) is also important, particularly, around room temperatures. Electrical resistivity of *FeSe* shows superconducting transition (T_C) around 10 K and shows a metallic temperature dependence above T_C which is explained using the Bloch–Gruneisen function of the temperature-dependent resistivity.

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RESEARCH ARTICLE | APRIL 24 2019

Structural phase transition and elastic behavior of WN

Shubhangi Soni ; Mumtaz Azad; K. K. Choudhary; Netram Kaurav

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AIP Conference Proceedings 2100, 020085 (2019)

https://doi.org/10.1063/1.5098639

Structural and elastic properties of WN has been investigated using theoretical model calculations. The long range Coulomb, van der Waals (vdW) interaction and the short range repulsive interaction up to second-neighbor ions within the Hafemeister and Flygare approach with modified ionic charge are properly incorporated in effective interionic potential (EIOP) model. We first deduced vdW coefficients with the help of Slater-Kirkwood variational method. A structural phase transition from ambient ZnS (*B*3)-type structure to NaCl (*B*1)-type was identified in pressure volume curve in WN compound. The estimated value of transition pressure is 2GPa in WN compound. Further, the variation of second order elastic constants (C_{11}, C_{12} and C_{44}) were followed the systematic decreasing trends with pressure.

Topics

Phase transitions, **Elastic modulus**, **Variational methods**

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RESEARCH ARTICLE | APRIL 24 2019

Structural phase transition and elastic properties of molybdenum nitride

Shubhangi Soni ; R. Kinge; K. K. Choudhary; Netram Kaurav

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AIP Conference Proceedings 2100, 020082 (2019)

https://doi.org/10.1063/1.5098636

In the present paper, structural and elastic properties of transition metal nitride (MoN) were investigated through effective inter-ionic potential method. The used potential consists of the long-range Coulomb and van der Waals (vdW) interactions and the short-range repulsive interaction of up to second-neighbor ions within the Hafemeister and Flygare approach. First, we have employed the Slater-Kirkwood variational method to estimate the vdW coefficients. The estimated value of the phase transition pressure (Pt) is 7 GPa for *B*3(ZnS) type structure to *B*l(NaCl) type structure, which is consistent with the available experimental data. We have also predicted the elastic properties MoN compound.

Topics

Phase transitions, **Elasticity**, **Nitrides**, **Transition metals**, **Ionic potential**, **Variational methods**

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Published: 13 September 2019

Temperature-dependent transport properties of a FeTe compound

Pavitra Devi Lodhi, Netram Kaurav, K K Choudhary & Y K Kuo

Bulletin of Materials Science **42**, Article number: 269 (2019)

529 Accesses | **2** Citations | Metrics

Abstract

Temperature-dependent transport properties of a FeTe parent compound have been investigated by measurements of electrical resistivity $\rho(T)$, thermal conductivity $\kappa(T)$ and Seebeck coefficient $S(T)$. The sample was synthesized using a standard solid state reaction route *via* vacuum encapsulation and characterized by X-ray diffraction spectroscopy, which indicated a tetragonal phase with the space group $P4/nmm$. The resistivity measurement data of the parent FeTe compound do not exhibit superconductivity however, it shows an anomaly in the temperature-dependent resistivity at around 67 K, which corresponds to structural phase transition in the vicinity of a magnetic phase transition. In the

low temperature regime, Seebeck coefficient, $S(T)$, exhibited an anomalous dip feature and negative throughout the temperature range, indicating an electron-like, single band charge carrier mechanism. We have also estimated the power factor and thermoelectric figure of merit ZT, which is found to be significantly smaller than other compositions of iron chalcogenides.

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Keywords

Thermoelectric properties

thermal conductivity **resistivity**

Seebeck coefficient

RESEARCH ARTICLE | APRIL 24 2019

Theoretical analysis of the structural phases of MnO under high pressure

Saligram Verma; Arvind Jain; K. K. Choudhary; Netram Kaurav

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+ Author & Article Information

AIP Conference Proceedings 2100, 020107 (2019)

https://doi.org/10.1063/1.5098661

In the present paper, we have evaluated the phase transformation and elastic properties of MnO at high pressure by formulating effective interionic interaction potential. The elastic constants, including the long-range Coulomb and van der Waals (vdW) interactions and the short-range repulsive interaction of up to second-neighbor ions within the Hafemeister and Flygare approach, are derived. Assuming that both the ions are polarizable, we employed the Slater-Kirkwood variational method to estimate the vdW coefficients. From the present study, we predict a structural phase transition from NaCl structure (*B*1) to CsCl structure (*B*2). The estimated value of the phase transition pressure (Pt) and the magnitude of the discontinuity in volume at the transition pressure are consistent as compared to the other theoretical data. The variations of elastic constants with pressure follow a systematic trend identical to that observed in others compounds of NaCl type structure family.

Topics

Phase transitions, Elastic modulus, Ions and properties, Transition metal oxides, Variational methods

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CRITERION – 3

MoUs/Linkages/Collaborations

Wadia Institute of Himalayan Geology, Dehradun

Document Title:

Winter Internship of M Sc Students at Wadia Institute of Himalayan Geology, Dehradun

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
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DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Tuteja's Forensic Document Examination and Research Ce

तमसो मा ज्योतिर्गमय

13 A

Activity Title:

Guest Lecture by Mr. H. S. Tuteja from Tuteja's Forensic Document Examination and Research Centre, Indore, under active collaboration between both institutes

H. S. TUTEJA M.Sc.
Retd. Dy. Govt. EXAMINER OF
QUESTIONED DOCUMENTS, Kolkata
EXPERIENCE OF 48 YEARS

S. TUTEJA B.Sc. (Cal.)
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EXAMINATION & RESEARCH CENTRE
INDORE - Ph. 98277-77733

FORMER
Asstt. Central Intelligence officer, grade-I
Asstt. govt. Examiner of Questioned Documents, Dy Govt. Examiner of Questioned Documents Kolkata till 31 May 1996

CRIME EXHIBIT EXAMINATION
Examined about 3000 cases containing many lacs of documents forwarded by CBI, CID of various state Govt.,Public Sector undertakings, Nationalised Banks, Autonomous bodies courts of law, Armed forces including [redacted]URULIA ARMS DROP Case involvement of Peter Blench (Danger to National Security) for Supreme Court Bail Cases.

EVIDENCES
About 700 times in court of India, Court Martial, Departmental Inquiries. With reference to opinion furnished.

RESEARCH AND PUBLISHED WORK.
Author of many Research Papers on important topics of Forensic Documents which were published in Journal of Bureau of Police Research and development CBI Bulletin and in the journal of Indian Academy of Forensic Sciences

TRAINING
Course Director for imparting training to Vigilance Officers of E. Rly., N.Rly., undertaking of Govt. of India (Nationalised Banks) and Trainees of Diploma Course in Document Examination conducted by NICFS & Police Officer Trainees of various states undergoing training in Central Detective training School, Kolkata

MEMBER.
Indian Academy of Forensic Sciences. (IAFSc.) Asst. Editor-Journal of Indian Academy of Forensic Sciences.

PRIVATE CASES EXAMINED
Appox. 3000 cases examined & evidence given in 700 cases after retirement. From 1999-2015

OUTSTANDING CASES
Cases of Royal Family of Holkar State, Sailana, Agar,(Malwa) etc. S.B.I.,S.B.of Indore,Union Bank of India, Central Bank of India, Premier Bank, Brahmin Sahakari Bank, IDBI, LIC, MPSEB, Forest Dept., Panchayat, Cooperatives, Housing Colonies etc.

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[redacted]

30.03.2019

MEMORANDUM OF UNDERSTANDING

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TUTEJA'S FORENSIC DOCUMENT EXAMINATION AND RESEARCH CENTRE, INDORE (M.P.)

and

DEPARTMENT OF FORENSIC SCIENCE
GOVT. HOLKAR (MODEL, AUTONOMOUS) SCIENCE COLLEGE, INDORE (M.P.)
AFFILIATED TO DEVI AHILYA VISHWAVIDYALAYA

Whereas the above named institutions recognize that the academic collaboration would be of mutual benefit and would provide strength in research and education. We jointly enter into a Memorandum of Understanding for the expertise sharing, training, collaborative research, promote projects/internship programs, organization of moot court, visit to court, workshops etc. for learning and training purposes of students, faculties and other associated personnel's.

This memorandum of agreement will become effective from the date of signing and will have duration of 5 years.

Mr. H.S. Tuteja
(Director)
Tuteja's Forensic Document
Examination and Research Centre,
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(Professor and Head)
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Forensic Science Department
Govt. Holkar Science College
Indore (M.P.)

Dr. Suresh T. Silawat
(Principal)
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College, Indore (M.P.)

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Examined about 3000 cases containing many lacs of documents forwarded by CBI, CID of various state Govt., Public Sector undertakings, Nationalised Banks, Autonomous bodies courts of law, Armed forces including [redacted]RULIA ARMS DROP Case [redacted]olvement of Peter Blench (Danger to National Security) for Supreme Court Bail Cases.

EVIDENCES
About 700 times in court of India Court Martial, Departmental Inquiries. With reference to opinion furnished.

RESEARCH AND PUBLISHED WORK.
Author of many Research Papers on important topics of Forensic Documents which were published in Journal of Bureau of Police Research and development CBI Bulletin and in the journal of Indian Academy of Forensic Sciences.

TRAINING
Course Director for imparting training to Vigilance Officers of E Rly., N Rly., undertaking of Govt. of India (Nationalised Banks) and Trainees of Diploma Course in Document Examination [redacted]nducted by NICFS & Police [redacted]cer Trainees of various states undergoing training in Central Detective training School, Kolkata.

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MEMORANDUM OF UNDERSTANDING

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TUTEJA'S FORENSIC DOCUMENT EXAMINATION AND RESEARCH CENTRE, INDORE (M.P.)

and

DEPARTMENT OF FORENSIC SCIENCE
GOVT. HOLKAR (MODEL, AUTONOMOUS) SCIENCE COLLEGE, INDORE (M.P.)
AFFILIATED TO DEVI AHILYA VISHWAVIDYALAYA

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This memorandum of agreement will become effective from the date of signing and wi' have duration of 5 years.

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Tuteja's Forensic Document
Examination and Research Centre,
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Govt. Holkar (Model, Autonomous) Science College, Indore
(M.P.) Pin - 452017
Department of Forensic Science

Memorandum of Understanding
Between
Tuteja's Forensic Document Examination and Research Centre, Indore (M.P.)
And
Department of Forensic Science, Govt. Holkar (Model, Autonomous) Science College, Indore

We jointly enter into a MOU for the Expertise sharing, training, collaborative research, promote projects/ internship programs, organization of moot courts, workshop etc for learning and training purpose of students, faculties and other associated personnel's.

Following Activity has been conducted under this:

- **Faculty Exchange/ Guest Lecture**
  Invited Resource Person:- Mr. H.S. Tuteja
  Seminar on "Job opportunities in Questioned Documents"
  Date: 15/01/2020

Govt. Holkar (Model, Autonomous) Science College, Indore
(M.P.) Pin - 452017
Department of Forensic Science

Date: - 14/01/2020

To,
Mr. H.S. Tuteja,
Document Expert,
Forensic Documents Examination & Research Centre,
Indore, (M.P.)

Subject: - Invitation letter for Expert Lecture in Questioned Document in **"Job Opportunities in Questioned Documents".**

Dear Sir,

Department of Forensic Science, Govt. Holkar (Model, Autonomous) Science College, Indore (M.P.) Pin - 452017 is going to organize an Seminar on " **Job Opportunities in Questioned Documents ".** on 15/01/2020.
We are pleased to inform you that we are inviting you as a resource person on 15/01/2020 in our Programme. We would be delighted with their presence in the Programme.

Vchourey

Dr. V.R. Chourey
HOD
Department of Forensic Science
Govt. Holkar (Autonomous, Model) Science

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
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CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institutes:

With all Govt. Colleges of Madhya Pradesh under the Umbrella of State level NAAC Cell (SLNC), DHE, Bhopal, M.P.

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14 A

Activity Title:

Review Meeting by Member Secretary, State Level NAAC Cell(SLNC)

&

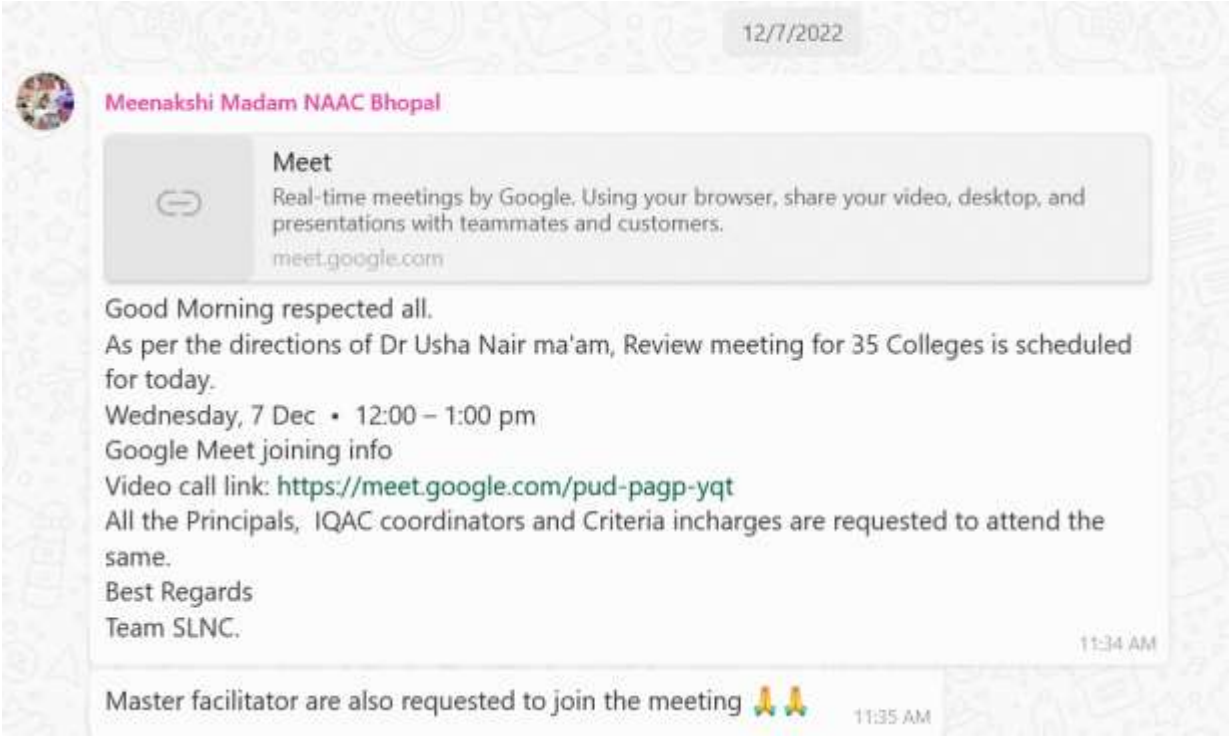
Series of “Enriching Thursdays” for Collaborative Quality Enrichment on various NAAC Parameters every week

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Collaborative Qualitative Initiatives under the Umbrella of State level NAAC Cell (SLNC), DHE, Bhopal, M.P. With all Govt. Colleges of Madhya Pradesh

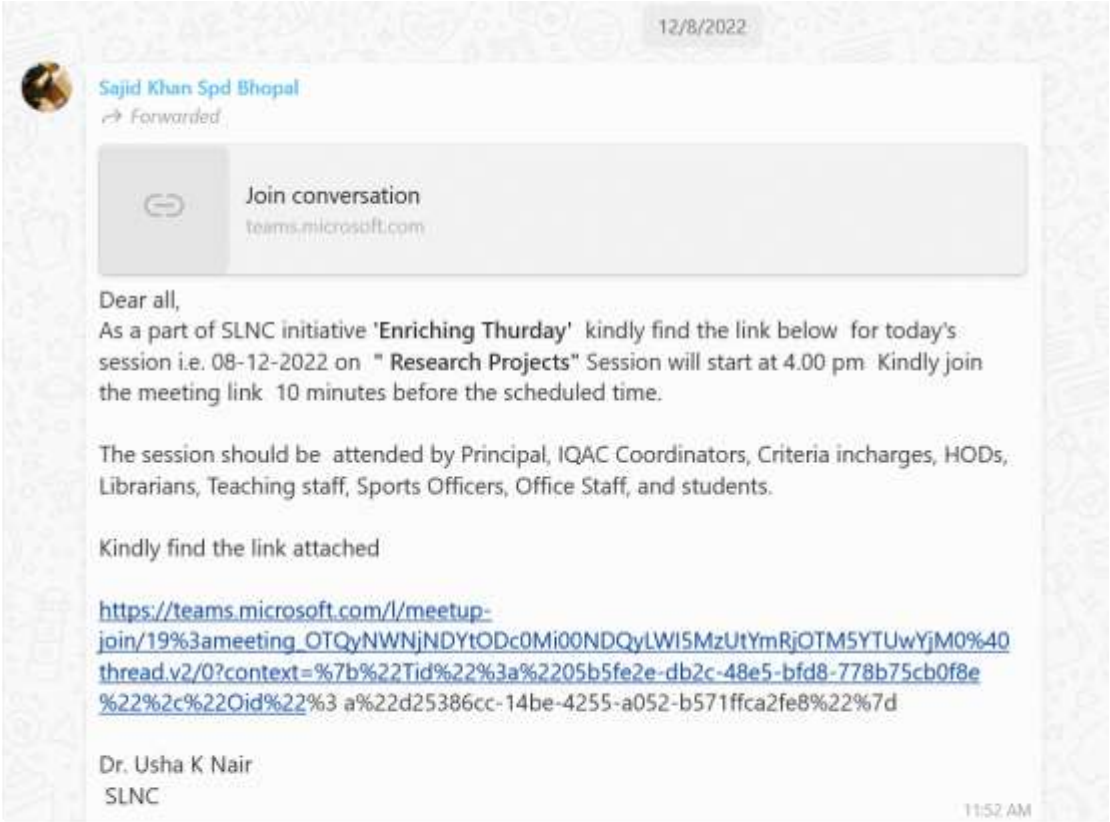
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Dear all,
As a part of SLNC initiative **'Enriching Thurday'** kindly find the link below for today's session i.e. 29-12-2022 on **" SSS & ALUMNI ENGAGEMENT"** Session will start at 4.00 pm Kindly join the meeting link 10 minutes before the scheduled time.

ALL the principals and IQAC coordinators are requested to make proper arrangements for staff to attend online session. The session should be attended by Principal, IQAC Coordinators, Criteria incharges, HODs, Librarians, All Teaching staff, Sports Officers, Office Staff, and students.

Kindly find the link attached
https://teams.microsoft.com/l/meetup-join/19%3ameeting_OTQyNWNjNDYtODc0Mi00NDQyLWI5MzUtYmRjOTM5YTUwYjM0%40thread.v2/0?context=%7b%22Tid%22%3a%2205b5fe2e-db2c-48e5-bfd8-778b75cb0f8e%22%2c%22Oid%22%3a%22d25386cc-14be-4255-a052-b571ffca2fe8%22%7d

Dr. Usha K Nair
SLNC

12:37 PM

GOVT. HOLKAR (MODEL AUTONOMOUS) SCIENCE COLLEGE, INDORE

(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institutes:

Madhya Pradesh Higher Education Quality Improvement Program (MPHEQIP) & Quality Learning Centre (QLC), State Project Directorate, RUSA, DHE, Bhopal.

तमसो मा ज्योतिर्गमय

15 A

Activity Title:

Sensitization Programme on “Environmental Challenges due to Climate Change

स्टेट प्रोजेक्ट डायरेक्टोरेट, रूसा
उच्च शिक्षा विभाग, मध्यप्रदेश (भोपाल फोन नं.- 0755-4001680)
192, एवीएन टॉवर, मेजनाइन फ्लोर, जोन -1, एम.पी.नगर भोपाल
ई-मेल : spdmpwb@gmail.com

क्रमांक 2854/ वि. बै.परि /2021

भोपाल, दिनांक 14 /10/2021

प्रति,

प्राचार्य,
शासकीय महाविद्यालय
(संलग्न सूची अनुसार)

विषय :- शासकीय महाविद्यालयों में 'जलवायु परिवर्तन एवं पर्यावरण कि चुनौतियां' पर संवेदीकरण कार्यशाला|

--00--

विषयांतर्गत लेख है की MPHEQIP व QLC के अंतर्गत महाविद्यालयों में शैक्षिणक सत्र 2021 -22 के दौरान पर्यावरण सम्बन्धी कार्यक्रमों के आयोजन में प्रदेश की सम्बन्धित विशेषज्ञ संस्थाओं के मार्गदर्शन व सहयोग लेने हेतु एक कार्यशाला आयोजित की जा रही है| विवरण निम्नानुसार है :

विशेषज्ञ:	1. श्री. लोकेन्द्र ढक्कर, वरिष्ठ वैज्ञानिक अधिकारी , पर्यावरण नियोजन एवं समन्वय संगठन (EPCO), भोपाल 2. श्री. पी. के. जैन, कार्यालय प्रमुख, केन्द्रीय भू-जल मंडल (CGWB); भोपाल
दिनांक	22 अक्टूबर, 2021
समय	03:00 से 04:30 बजे तक
लिंक	पृथक से प्रेषित की जाएगी

उक्त कार्यक्रम में कृपया अपनी उपस्थिति सुनिश्चित करें|

(दीपक सिंह)
अपर आयुक्त
उच्च शिक्षा, म. प्र
भोपाल, दिनांक 14 /10/2021

पृ. क्रमांक 2855 वि. बै.परि /2021

प्रतिलिपि : -

1. निज सहायक, प्रमुख सचिव, उच्च शिक्षा विभाग, भोपाल, म.प्र.|
2. समस्त क्षेत्रीय अतिरिक्त संचालक की ओर सूचनार्थ|
3. सम्बन्धित नस्ती|

अपर आयुक्त
उच्च शिक्षा, म. प्र

QLC 150 Colleges

S.No	Code	Division	District	College Name
1	2	3	4	5
1	2802	Bhopal	Bhopal	Government Maharani Laxmi Bai Girls P. G. Autonomous College, Bhopal – 462002 (Second Cycle)
2	2803	Bhopal	Bhopal	Sarojini Naidu Government Girls P. G. (Autonomous) College, Shivaji Nagar, Bhopal – 462016 (Third Cycle)
3	2812	Bhopal	Bhopal	Institute for Excellence in Higher Education, Bhopal – 462016 (Third Cycle)
4	2808	Bhopal	Bhopal	Government Arts and Commerce College,Bhopal – 462008 (Second Cycle)
5	3211	Bhopal	Hoshangabad	Government Girls College, Nyas Colony, Hoshangabad, Itarsi – 461111 (Second Cycle)
6	2701	Bhopal	Vidisha	Government Girls College, Vidisha – 464001 (Second Cycle)
7	2804	Bhopal	Bhopal	Government Hamidia Arts & Commerce College, Budhwara, Bhopal, 462001 Madhya Pradesh (Second Cycle)
8	3202	Bhopal	Hoshangabad	Government Home Science College, Hoshangabad, 461001 (Second Cycle)
9	2807	Bhopal	Bhopal	Government Science and Commerce College, Benazeer, Shahjahanbad, Bhopal – 462001 (Second Cycle)
10	2905	Bhopal	Sehore	Shaheed Bhagat Singh Government Degree College, Ashta, Sehore – 466116 (Second Cycle)
11	3001	Bhopal	Raisen	Swami Vivekanand Government College, Raisen – 464551 (First Cycle)
12	3208	Bhopal	Harda	Government Degree College, Timarni, Harda – 461228 (Second Cycle)
13	3102	Bhopal	Betul	Government Girls College, Sadar, Betul – 460001 (Second Cycle)
14	2702	Bhopal	Vidisha	Government Sanjay Gandhi Smriti Post Graduate College, Ganj Basoda, Vidisha – 464221 (Second Cycle)
15	3006	Bhopal	Raisen	Veer Savarkar Government College, Obedullaganj, Raisen – 464993 (First Cycle)
16	3206	Bhopal	Hoshangabad	Government Kusum College, Banapura, Seoni Malwa, Hoshangabad – 461223 (Second Cycle)
17	2801	Bhopal	Bhopal	2801 - Govt Adarsh Motilal Vigyan Mahavidyalaya Bhopal
18	101	Gwalior	Morena	Govt.PG College.Morena
19	3210	Bhopal	Hoshangabad	3210 - Govt Mahatma Gandhi Smrati College Itarsi, Hoshangabad
20	2806	Bhopal	Bhopal	Govt Gitanjali College, Bhopal
21	3101	Bhopal	Betul	Jayawanti Haksar Government P. G. College, Betul – 460001 (Second Cycle)
22	3203	Bhopal	Hoshangabad	Government P. G. College, Shobhapur Road, Pipariya – 461775 (Second Cycle)
23	2901	Bhopal	Sehore	Chandra Shekhar Azad Government Post Graduate (Nodal) College, Sehore – 466001 (Second Cycle)
24	2805	Bhopal	Bhopal	Government P. G. College, BHEL, Mahatma Gandhi Chouraha, Berkhera, Bhopal – 462021 (Second Cycle)
25	3207	Bhopal	Harda	Govt Arts and Commerce College Harda
26	2601	Bhopal	Rajgarh	Govt College Rajgarh
27	3201	Bhopal	Hoshangabad	Govt Narmada College Hoshangabad
28	2705	Bhopal	Vidisha	Govt Lal Bahadur Shastri College, Sironj
29	2603	Bhopal	Rajgarh	Netaji Subhashchandra Bose Govt College, Biora
30	2605	Bhopal	Rajgarh	Govt Swami Vivekanand College Sarangpur, Rajgarh

31	3104	Bhopal	Betul	Govt College Bhaisdehi, Betul
32	2607	Bhopal	Rajgarh	Govt College Khilchipur
33	304	Gwalior	Gwalior	Maharani Laxmi Bai Government College of Excellence, Gwalior, 474009 Madhya Pradesh (Second Cycle)
34	305	Gwalior	Gwalior	Government Kamala Raja Girls Post Graduate Autonomous College, Gwalior – 474001 (Third Cycle)
35	303	Gwalior	Gwalior	Government Model Science College, Gwalior, 474009 (Second Cycle)
36	307	Gwalior	Gwalior	Dr. Bhagwat Sahai Government College, Gwalior – 474003 (First Cycle)
37	401	Gwalior	Datia	Govt. P.G. College (Autonomous), Datia, Madhya Pradesh (Second Cycle)
38	103	Gwalior	Sheopur	Government Post Graduate College, Sheopur – 476337 (First Cycle)
39	301	Gwalior	Gwalior	Shyamlal Pandviya Government Post Graduate College, Morar, Gwalior – 474006 (Second Cycle)
40	302	Gwalior	Gwalior	Vijaya Raje Government Girls Post Graduate College, Garam Sadak Morar, Gwalior – 474001 (Second Cycle)
41	603	Gwalior	Ashoknagar	Govt Nehru PG College, Ashoknagar
42	601	Gwalior	Guna	Govt P G College Guna
43	501	Gwalior	Shivpuri	Govt. Shri Madhavrao Scindia PG Coll Shivpuri
44	201	Gwalior	Bhind	Govt M J S P G College Bhind
45	604	Gwalior	Ashoknagar	Govt Ganesh Shankar Vidyarthi College Mungawali
46	2301	Indore	Indore	Government (Modal Autonomous) Holkar Science College,Indore – 452001 (Third Cycle)
47	2307	Indore	Indore	Bherulal Patidar Government P. G. College, Dongargaon, Mhow, Indore – 453441 (Second Cycle)
48	2402	Indore	Khargone	Government Girls College, Khargone – 451001 (Second Cycle)
49	2401	Indore	Khargone	Government Post Graduate College, Khargone, 451001 (Second Cycle)
50	2303	Indore	Indore	Mata Jijabai Government Girls Post Graduate College (Autonomous), Indore, 452004 (Second Cycle)
51	2501	Indore	Khandwa	Shri. Neelkantheshwar Government P.G. College, Khandwa, 450001 Madhya Pradesh (Second Cycle)
52	2407	Indore	Khargone	Government College, Mandleshwar, Maheshwar, Khargone – 451221 (First Cycle)
53	106	Gwalior	Morena	Govt college Jaura, Morena
54	2103	Indore	Alirajpur	Government Post Graduate College, Dahod Road, Alirajpur, Jhabua – 457887 (Second Cycle)
55	502	Gwalior	Shivpuri	Govt Girls College Shivpuri
56	2101	Indore	Jhabua	Shaheed Chandrashekar Azad Government Post Graduate College, Rajgar Naka, Jhabua – 457661 (Second Cycle)
57	2403	Indore	Badwani	GOVT. P. G. COLLEGE, SENDHWA,A. B. ROAD, SENDHWA DIST-BARWANI MP-451666,SENDHWA,Madhya Pradesh,451666 (First Cycle)
58	2502	Indore	Khandwa	2502 - Govt Girls College Khandwa
59	2304	Indore	Indore	Government Maharani Laxmibai Girls P.G. College, Kila Bhavan, Indore, 452006 Madhya Pradesh (Second Cycle)
60	2302	Indore	Indore	Shri Atal Bihari Vajpayee Government Arts & Commerce College, Indore, 452017 (Second Cycle)
61	2312	Indore	Indore	Government New Law College, Bhawarkua, Indore – 452017 (First Cycle)
62	2411	Indore	Badwani	2411 - Govt College, Sendhawa

63	2305	Indore	Indore	Government Nirbhay Singh Patel Science College, Indore – 452001 (First Cycle)
64	2201	Indore	Dhar	Maharaja Bhoj Govt. PG COLLEGE DHAR
65	2404	Indore	Badwani	Govt Girls College, Badwani
66	2204	Indore	Dhar	Govt College Kukshi Dhar
67	2203	Indore	Dhar	Gov College Manavar Dhar
68	2105	Indore	Jhabua	Govt Mahaveer College, Petlawad, Jhabua
69	3304	Jabalpur	Jabalpur	Government Mankunwar Bai Arts & Commerce Autonomous College for Women, Napier Town, Jabalpur, 482002 Madhya Pradesh (Second Cycle)
70	3401	Jabalpur	Narsinghpur	Government Post Graduate College, Narsinghpur – 487001 (Second Cycle)
71	3301	Jabalpur	Jabalpur	GOVERNMENT MODEL SCIENCE COLLEGE (AUTONOMOUS),Pachpedhi, South Civil Lines,JABALPUR,MadhyaPradesh,482001 (Third Cycle)
72	3601	Jabalpur	Chhindwara	Government Autonomous Post Graduate College, Chhindwara 480001 Madhya Pradesh (Second Cycle)
73	3504	Jabalpur	Dindori	Government Chandra Vijay College, Dindori –481880 (Second Cycle)
74	3307	Jabalpur	Jabalpur	Government Arts College, Panagar, Jabalpur – 483220 (First Cycle)
75	3607	Jabalpur	Chhindwara	Government College, Sausar, Chhindwara – 480106 (Second Cycle)
76	3610	Jabalpur	Chhindwara	Government Degree College, Bichhua, Chhindwara – 480111 (First Cycle)
77	3609	Jabalpur	Chhindwara	Government Science College, Pandhurna, Chhindwara – 480334 (Second Cycle)
78	605	Gwalior	Ashoknagar	Govt Madhav College, Chanderi, Ashoknagar
79	3802	Jabalpur	Balaghat	Government Kamla Nehru Girls College, Near DIET Campus, Balaghat – 481001 (First Cycle)
80	1907	Ujjain	Shajapur	Govt College Kalapipal
81	3803	Jabalpur	Balaghat	Government S. S. P. College, Waraseoni, Balaghat – 481331 (Second Cycle)
82	2205	Indore	Dhar	Govt College, Badnawar, Dhar
83	2311	Indore	Indore	Govt Arts and Commerce College, Rau
84	2810	Bhopal	Bhopal	Govt Swami Vivekanand College,Berasiya,Bhopal
85	2902	Bhopal	Sehore	Govt Girls College Sehore
86	3302	Jabalpur	Jabalpur	3302 - Govt Mahakaushal Arts and Commerce College Jabalpur
87	3311	Jabalpur	Katni	Government Girls' College, Near Nagar Nigam, Mission Chowk, Katni – 483501 (Second Cycle)
88	3306	Jabalpur	Jabalpur	Government Girls' College, Ranjhi, Jabalpur – 482005 (Second Cycle)
89	3604	Jabalpur	Chhindwara	Shri Shri Laxminarayan Government Pench Valley Post Graduate Mahavidyalaya, Khirsadho, Parasia – 480441 (First Cycle)
90	3303	Jabalpur	Jabalpur	GOVERNMENT M.H.COLLEGE OF HOME SCIENCE AND SCIENCE FOR WOMEN,Napier Town, Jabalpur 482002,Jabalpur,Madhya Pradesh,482002 (Third Cycle)
91	3309	Jabalpur	Jabalpur	Government Shyam Sundar Agrawal P. G. College, Sihora, Jabalpur – 483225 (Second Cycle)
92	3602	Jabalpur	Chhindwara	Rajmata Scindia Government Girls College, Chhindwara – 480001 (Second Cycle)
93	3310	Jabalpur	Katni	Government Tilak PG College,Rafi Ahmad Kidwai Ward,Katni - 483501 (Second Cycle)
94	3703	Jabalpur	Seoni	Swami Vivekanand Govt College Lakhanadon Seoni

95	3403	Jabalpur	Narsinghpur	Govt P G College Gadarwada Narsinghpur
96	3806	Jabalpur	Balaghat	Govt College Katangi Balaghat
97	1302	Rewa	Rewa	Government Thakur Ranamat Singh College, Rewa – 486001 (Second Cycle)
98	1303	Rewa	Rewa	Government Girls Post Graduate College, Rewa – 486001 (Second Cycle)
99	1301	Rewa	Rewa	Government Model Science College, Civil Lines, Rewa – 486001 (First Cycle)
100	1402	Rewa	Shahdol	Government Indira Gandhi Home Science Girls College, Shahdol – 484001 (First Cycle)
101	1304	Rewa	Rewa	Government Madhav Sadashivrao Golvalkar College, Civil Lines, Rewa – 486001 (First Cycle
102	1501	Rewa	Sidhi	Sanjay Gandhi Smriti Government P. G. Autonomous College, Sidhi – 486661 (Second Cycle)
103	1404	Rewa	Shahdol	Government Nehru Degree College, Burhar, Shahdol – 484110 (First Cycle)
104	1202	Rewa	Satna	Govt Girls PG College Satna
105	1205	Rewa	Satna	Govt Vivekanand College Maihar
106	1306	Rewa	Rewa	Govt Shahid Kedarnath College Mauganj, Rewa
107	1201	Rewa	Satna	Govt PG College, Satna
108	1506	Rewa	Singrauli	Govt College, Baidhan
109	1203	Rewa	Satna	Govt College Amarpatan, Satna
110	1408	Rewa	Annooppur	Govt Tulsi College, Anooppur
111	1502	Rewa	Sidhi	Govt. Girls PG College Sidhi
112	1002	Sagar	Sagar	Government Autonomous Girls P.G. College of Excellence, Sagar, 470002 Madhya Pradesh (Second Cycle)
113	3701	Jabalpur	Seoni	Govt P G College, Seoni
114	3501	Jabalpur	Mandla	Rani Durgawati PG college, Mandla
115	3801	Jabalpur	Balaghat	Jata Shankar Trivedi Govt PG College Balaghat
116	1007	Sagar	Sagar	Govt. Girls College Bina Sagar - 470113 (Second cycle)
117	801	Sagar	Chhatarpur	Government Maharaja P. G. College (Autonomous), Chhatarpur – 471001 (Second Cycle)
118	703	Sagar	Tikamgarh	Government Post Graduate College, Niwari, Tikamgarh Dist, 472442 Madhya Pradesh (Second Cycle)
119	701	Sagar	Tikamgarh	Government Post-Graduate College,Tikamgarh, 472001 (Second Cycle)
120	1101	Sagar	Damoh	Gyan Chandra Shrivastava Government Post Graduate College, Damoh – 470661 (Second Cycle)
121	901	Sagar	Panna	Chhatrasal Government Post Graduate College, Panna – 488001 (First Cycle)
122	1005	Sagar	Sagar	Government Degree College, Banda, Sagar – 470335 (First Cycle)
123	1102	Sagar	Damoh	Government Kamla Nehru Mahila Mahavidyalaya, Damoh – 470661 (Second Cycle)
124	1103	Sagar	Damoh	Shri Raghvendra Singh Hazari Government Degree College, Hatta, Damoh – 470775 (Second Cycle)
125	1006	Sagar	Sagar	GOVT. P. G. COLLEGE, BINA,Govt. P. G. College, Bina, Near Telephone Exchange, Rajeev Gandhi Ward, Bina,BINA,Madhya Pradesh,470113 (Third Cycle)
126	1001	Sagar	Sagar	Govt. Arts & Commerce College Sagar
127	1004	Sagar	Sagar	Govt Nehru College Deori, Sagar
128	1008	Sagar	Sagar	Govt P G College, Rehli
129	1009	Sagar	Sagar	Govt. Post Graduate College Garhakota, Sagar
130	1104	Sagar	Damoh	Govt College Pathariya
131	1010	Sagar	Sagar	Govt. College, Khurai, Sagar

132	802	Sagar	Chhatarpur	Govt Girls College, Chhatarpur
133	1812	Ujjain	Ujjain	Government Madhav Science College, Ujjain – 456010 (Second Cycle)
134	1603	Ujjain	Neemuch	Government Post Graduate College, Neemuch – 458441 (Second Cycle)
135	1905	Ujjain	Shajapur	Jawahar Lal Nehru Smriti Government Post Graduate College, Shajapur – 465333 (First Cycle)
136	1604	Ujjain	Neemuch	Shri Sitaram Jaju Government Girls College, Neemuch, 458441 Madhya Pradesh (First Cycle)
137	1704	Ujjain	Ratlam	Bhagat Singh Government P. G. College, Jaora, Ratlam – 457226 (First Cycle)
138	1705	Ujjain	Ratlam	Government College, Sailana, Ratlam – 457550 (First Cycle)
139	1702	Ujjain	Ratlam	Government Girls College, Do Batti, Ratlam – 457001 (First Cycle)
140	1801	Ujjain	Ujjain	Government Girls Post Graduate College, Ujjain – 456010 (Second Cycle)
141	1802	Ujjain	Ujjain	Government Kalidas Girls College, Bada Teliwada Chauraha, Ujjain – 456006 (First Cycle)
142	1904	Ujjain	Agarmalwa	Government Nehru Post Graduate College, Agar Malwa, Shajapur – 465441 (First Cycle)
143	1701	Ujjain	Ratlam	Government Post Graduate Arts and Science College, College Road, Infront of Nagar Nigam, Ratlam – 457001 (Second Cycle)
144	1601	Ujjain	Mandsaur	Government Rajeev Gandhi Post Graduate College, Mhow, Neemuch Road, Mandsaur – 458001 (Second Cycle)
145	2002	Ujjain	Dewas	Maharani Pushpmala Raje Puar Government Girls Degree College, Dewas – 455001 (Second Cycle)
146	2001	Ujjain	Dewas	Shri Krishnajirao Powar Government Post Graduate College, Bhopal Square, Dewas – 455001 (Second Cycle)
147	2006	Ujjain	Dewas	GOVERNMENT COLLEGE BAGLI, Gandhi Colony Bgali, Dist. Dewas, Bagli 455227 (First Cycle)
148	1811	Ujjain	Ujjain	Govt Madhav Arts and Commerce College Ujjain
149	1901	Ujjain	Shajapur	Govt Balkrishna Sharma Navin P G College, Shajapur
150	1804	Ujjain	Ujjain	Govt College Badnagar, Ujjain

LIST OF 200 Colleges

S.No.	ollege Coc	Category	Division	District	CollegeName
1	2301	A	Indore	Indore	Govt. Holkar Science College, Indore
2	3302	A	Jabalpur	Jabalpur	Govt Mahakaushal Arts and Commerce College Jabalpur
2	305	A	Gwalior	Gwalior	Govt Kamlaraje Girls P G College Gwalior
3	1002	A	Sagar	Sagar	Govt PG girls college Sagar
4	2303	A	Indore	Indore	Mata Jijabai Girls PG college, Indore
5	2803	A	Bhopal	Bhopal	Govt Sarojini Naidu Girls P G College Bhopal
6	601	A	Gwalior	Guna	Govt P G College Guna
7	1001	A	Sagar	Sagar	Govt. Arts & Commerce College Sagar
8	2304	A	Indore	Indore	Govt. M.L.B. PG Girls College Indore
9	3101	A	Bhopal	Betul	Govt Jaywanti Haksar P G College, Betul
11	304	A	Gwalior	Gwalior	Excellence college Gwalior
12	2801	A	Bhopal	Bhopal	Govt Adarsh Motilal Vigyan Mahavidyalaya Bhopal
13	303	A	Gwalior	Gwalior	Govt Srimant Madhavrao SindhiaScience College Gwalior
14	2403	A	Indore	Badwani	Govt P G College Badwani
15	3301	A	Jabalpur	Jabalpur	Govt. Science College, Jabalpur
16	2302	A	Indore	Indore	Gov Arts and Commerce College Indore
17	302	A	Gwalior	Gwalior	Govt Girls P G College, Morar
18	2201	A	Indore	Dhar	Maharaja Bhoj Govt. PG COLLEGE DHAR
19	3303	A	Jabalpur	Jabalpur	Govt. M H College Jabalpur
20	1201	A	Rewa	Satna	Govt PG College, Satna
21	2806	A	Bhopal	Bhopal	Geetanjali Govt. Girls PG College, Bhopal
22	2812	A	Bhopal	Bhopal	Institute for excellence Bhopal
23	1302	A	Rewa	Rewa	Govt Thakur Ranmat Singh College Rewa
24	2313	A	Indore	Indore	Govt Arts and Commerce College, Rau
25	3601	A	Jabalpur	Chhindwara	Govt. PG College, chhindwara
26	1812	A	Ujjain	Ujjain	Govt Madhav Science College Ujjain
27	2802	A	Bhopal	Bhopal	Govt. MLB Girls PG College, Bhopal
28	1303	A	Rewa	Rewa	Govt Girls P G College Rewa
29	1601	A	Ujjain	Mandsour	Rajiv Gandhi Govt. P.G. College Mandsaur
30	3701	A	Jabalpur	Seoni	Govt P G College, Seoni
31	1811	B	Ujjain	Ujjain	Govt Madhav Arts and Commerce College Ujjain
32	2701	B	Bhopal	Vidisha	Govt Girls College Vidisha
33	2807	B	Bhopal	Bhopal	Govt. Benazir College, Bhopal
34	3001	B	Bhopal	Raisen	Govt Swami Vivekanand College Raisen
35	603	B	Gwalior	Ashoknagar	Govt Nehru PG College, Ashoknagar
36	3201	B	Bhopal	Hoshangabad	Govt Narmada College Hoshangabad
37	2901	B	Bhopal	Sehore	Chandra Shekhar Azad Gov College Sehore
38	501	B	Gwalior	Shivpuri	Govt. Shri Madhavrao Scindia PG Coll Shivpuri
39	3401	B	Jabalpur	Narsinghpur	Govt P G College narshingpur
40	1101	B	Sagar	Damoh	Gov PG College Damoh
41	3307	B	Jabalpur	Jabalpur	Govt College Panagar Jabalpur
42	2804	B	Bhopal	Bhopal	Govt. Hamidia PG College Bhopal
43	801	B	Sagar	Chhatarpur	Gov Maharaja College Chatarpur
44	3202	B	Bhopal	Hoshangabad	Govt Home Science Girls P G College Hoshangabad
45	3501	B	Jabalpur	Mandla	Rani Durgawati PG college, Mandla
46	1701	B	Ujjain	Ratlam	Govt Arts and Science P G College Ratlam
47	901	B	Sagar	Panna	Govt Chhatrasal P G College Panna
48	2307	B	Indore	Indore	Bherulal Patidar Govt P G College, Mhow
49	3801	B	Jabalpur	Balaghat	Jata Shankar Trivedi Govt PG College Balaghat
50	1603	B	Ujjain	Neemuch	Swami Vivekanand Govt P G College Neemuch
51	1205	B	Rewa	Satna	Govt Vivekanand College Maihar
52	1801	B	Ujjain	Ujjain	Govt Girls PG College Ujjain
53	2501	B	Indore	Khandwa	Govt Shri Nilkantheshwar P G College Khandwa

54	3602	B	Jabalpur	Chhindwara	Rajmata Sindhiya Govt Girls College Chhindwara
55	401	B	Gwalior	Datia	Govt P G College Datia
56	701	B	Sagar	Tikamgarh	Govt P G College Tikamgarh
57	2001	B	Ujjain	Dewas	Govt Krishnajirao Pawar P G College Dewas
58	1202	B	Rewa	Satna	Govt Girls PG College Satna
59	1501	B	Rewa	Sidhi	Govt Sanjay Gandhi Smrati College, Sidhi
60	2101	B	Indore	Jhabua	Govt Shahid Chandrshekhar P G College Jhabua
61	2401	B	Indore	Khargone	Govt P G College, Khargone
62	2808	C	Bhopal	Bhopal	Govt Arts & Commerce College Malviya Hostel, Bhopal
63	606	C	Gwalior	Guna	Govt Girls College, Chachoda, Guna
64	2902	C	Bhopal	Sehore	Govt Girls College Sehore
65	2601	C	Bhopal	Rajgarh	Govt College Rajgarh
66	2905	C	Bhopal	Sehore	S.B.S. Govt College Ashta sehore
67	3006	C	Bhopal	Raisen	Govt College, Obedullaganj
68	106	C	Gwalior	Morena	Govt college Jaura, Morena
69	502	C	Gwalior	Shivpuri	Govt Girls College Shivpuri
70	3603	C	Jabalpur	Chhindwara	GOV DEGREE COLLEGE TAMIA DISTT. CHHINDWARA
71	3004	C	Bhopal	Raisen	Pandit Deendayal Upadhyay Govt Coll Begamganj
72	2810	C	Bhopal	Bhopal	Govt Swami Vivekanand College,Berasiya,Bhopal
73	605	C	Gwalior	Ashoknagar	maharaja Bhoj Govt. PG COLLEGE DHAR
74	101	C	Gwalior	Morena	Govt.PG College.Morena
75	1005	C	Sagar	Sagar	Govt College Banda, Sagar
76	1008	C	Sagar	Sagar	Govt P G College, Rehli
77	1808	C	Ujjain	Ujjain	Govt College Tarana
78	609	C	Gwalior	Guna	Govt College Raghogarh Guna
79	3306	C	Jabalpur	Jabalpur	Govt Girls College, Ranjhi, Jabalpur
80	1103	C	Sagar	Damoh	Govt College Hata Damoh
81	207	C	Gwalior	Bhind	Govt College, Mehgaon, Bhind
82	604	C	Gwalior	Ashoknagar	Govt Ganesh Shankar Vidyarthi College Mungawali
83	2004	C	Ujjain	Dewas	Govt College, Kannod, Dewas
84	705	C	Sagar	Tikamgarh	Govt College Prithvipur
85	307	C	Gwalior	Gwalior	Govt Bhagawat Sahay College, Gwalior
86	2410	C	Indore	Khargone	Govt College Bhikangaon, Khargone
87	3802	C	Jabalpur	Balaghat	Govt Kamla Nehru Arts College, Balaghat
88	3212	C	Bhopal	Hoshangabad	Govt Arts, Comm and Sci College, Sukhtawa
89	3002	C	Bhopal	Raisen	Govt Girls College, Raisen
90	2203	C	Indore	Dhar	Gov College Manavar Dhar
91	503	C	Gwalior	Shivpuri	Govt Chhatrasal College Pichhore
92	2702	C	Bhopal	Vidisha	Govt Sanjay Gandhi Smrati College Ganjbasoda, Vidisha
93	2103	C	Indore	Alirajpur	Govt PG College Alirajpur
94	802	C	Sagar	Chhatarpur	Govt Girls College, Chhatarpur
95	3003	C	Bhopal	Raisen	Govt College Bareli Raisen
96	2404	C	Indore	Badwani	Govt Girls College, Badwani
97	3609	C	Jabalpur	Chhindwara	Govt Science College Pandurna Chhindwara
98	1506	C	Rewa	Singrauli	Govt College, Baidhan
99	1406	C	Rewa	Shahdol	RK Shukla Smriti Govt. P.G. College Beohari Shahdol
100	3102	C	Bhopal	Betul	GOVT. GIRLS COLLEGE BETUL
101	1102	C	Sagar	Damoh	Govt Kamla Nehru Girls College, Damoh
102	3708	C	Bhopal	Betul	Govt College, Shahpur, Betul
103	3604	C	Jabalpur	Chhindwara	Govt Pench Valley College Parasiya
104	2205	C	Indore	Dhar	Govt College, Badnawar, Dhar
105	201	C	Gwalior	Bhind	Govt M J S P G College Bhind
106	1104	C	Sagar	Damoh	Govt College Pathariya
107	3104	C	Bhopal	Betul	Govt College Bhaisdehi, Betul
108	3210	C	Bhopal	Hoshangabad	Govt Mahatma Gandhi Smrati College Itarsi, Hoshangabad
109	3607	C	Jabalpur	Chhindwara	Govt Arts College, Sausar, Chhindwara

110	2605	C	Bhopal	Rajgarh	Govt Swami Vivekanand College Sarangpur, Rajgarh
111	804	C	Sagar	Chhatarpur	Raja Harpalsingh Govt College Harpalpur Chhatarpur
112	1805	C	Ujjain	Ujjain	Govt Vikram College Khachrod Ujjain
113	3807	C	Jabalpur	Balaghat	Govt College Lanji
114	1004	C	Sagar	Sagar	Govt Nehru College Deori, Sagar
115	2503	C	Indore	Burhanpur	Govt Jawaharlal Nehru College, Nepanagar, Burhanpur
116	3211	C	Bhopal	Hoshangabad	Govt Girls College, Itarsi, Hoshangabad
117	3610	C	Jabalpur	Chhindwara	Govt College Bichhua Chhindwara
118	3505	C	Jabalpur	Mandla	Govt. College Nainpur, Mandla
119	3310	C	Jabalpur	Katni	Govt Tilak College Katni
120	2206	C	Indore	Dhar	Shri Rajendra Suri Govt. College Saradarpur-Rajgarh
121	3304	C	Jabalpur	Jabalpur	Govt M K B Arts and Commerce College Jabalpur
122	2105	C	Indore	Jhabua	Govt Mahaveer College, Petlawad, Jhabua
123	2607	C	Bhopal	Rajgarh	Govt College Khilchipur
124	803	C	Sagar	Chhatarpur	Govt Chhatrasal Maharaja College, Maharajpur, Chhatarpur
125	2312	C	Indore	Indore	Govt New Law College, Indore
126	3805	C	Jabalpur	Balaghat	Govt College, Paraswada, Balaghat
127	1009	C	Sagar	Sagar	Govt. Post Graduate College Garhakota, Sagar
128	301	C	Gwalior	Gwalior	Govt shyamlal pandaviya college, morar,gwalior
129	2802	C	Indore	Indore	Govt College, Depalpur, Indore
130	3704	C	Jabalpur	Seoni	Govt Arts and Commerce College, Kewlari, Seoni
131	1304	C	Rewa	Rewa	Govt Madhav Sadashiv Rao Golbalkar College, Rewa
132	1010	C	Sagar	Sagar	Govt. College, Khurai, Sagar
133	1301	C	Rewa	Rewa	Govt Model Adarsh Science College Rewa
134	2309	C	Indore	Indore	Govt College, Sanwer, Indore
135	703	C	Sagar	Tikamgarh	Govt College Niwari Tikamgarh
136	3504	C	Jabalpur	Dindori	Govt Chandravijay College Dindhori
137	2502	C	Indore	Khandwa	Govt Girls College Khandwa
138	3203	C	Bhopal	Hoshangabad	Govt P G college Pipariya
139	2407	C	Indore	Khargone	Govt College Mandaleshwar, Khargone
140	1409	C	Rewa	Annooppur	Govt College Kotma Anooppur
141	3804	C	Jabalpur	Balaghat	Govt Shankarlal Patel Arts & Law College Waraseoni Balaghat
142	1306	C	Rewa	Rewa	Govt Shahid Kedarnath College Mauganj, Rewa
143	1907	C	Ujjain	Shajapur	Govt College Kalapipal
144	3507	C	Jabalpur	Mandla	Govt College, Bhuabichhiya, Mandla
145	3402	C	Jabalpur	Narsinghpur	Govt Shyamsundar Mushran Girls College, Narsinghpur
146	2202	C	Indore	Dhar	Govt Girls College Dhar
147	3706	C	Jabalpur	Seoni	GOVT. DEGREE COLLEGE CHHAPARA
148	1901	C	Ujjain	Shajapur	Govt Balkrishna Sharma Navin P G College, Shajapur
149	3206	C	Bhopal	Hoshangabad	Govt Kusum College, Seonimalwa
150	1407	C	Rewa	Shahdol	Govt Arts and Comm College, Jaysinghnagar, Shahdol
151	1507	C	Rewa	Sidhi	Govt. arts and Commerce College, Majhauli, Sidhi
152	1807	C	Ujjain	Ujjain	Govt College, Mahidpur, Ujjain
153	3207	C	Bhopal	Harda	Govt Arts and Commerce College Harda
154	3703	C	Jabalpur	Seoni	Swami Vivekanand Govt College Lakhanadon Seoni
155	1006	C	Sagar	Sagar	Govt. PG College Bina
156	2204	C	Indore	Dhar	Govt College Kukshi Dhar
157	2107	C	Indore	Alirajpur	Govt College, Bhawra, Alirajpur
158	1308	C	Rewa	Rewa	Govt Thakur Someshwar Singh College, Naigarhi, Rewa
159	1402	C	Rewa	Shahdol	Govt Indira Gandhi Home Science College Shahdol
160	1307	C	Rewa	Rewa	Govt. S.V. college Teonthar
161	1904	C	Ujjain	Agar Malwa	Govt Nehru P G College, Agarmalwa, Shajapur
162	1502	C	Rewa	Sidhi	Govt. Girls PG College Sidhi
163	3309	C	Jabalpur	Jabalpur	Govt Shyam Sundar Agrawal College Sihora, Jabalpur

164	2305	C	Indore	Indore	Govt Nirbhay Singh Patel Science College, Indore
165	2402	C	Indore	Khargone	Govt Girls College Khargone
166	1802	C	Ujjain	Ujjain	Govt Kalidas Girls College, Ujjain
167	1404	C	Rewa	Shahdol	Govt Nehru Degree College, Budhar
168	2012	C	Ujjain	Dewas	Govt Science College, Dewas
169	2007	C	Ujjain	Dewas	Govt College, Hatpipalya, Dewas
170	1203	C	Rewa	Satna	Govt College Amarpatan, Satna
171	1705	C	Ujjain	Ratlam	Govt College Sailana
172	2412	C	Indore	Badwani	Govt College, Niwali, Badwani
173	1704	C	Ujjain	Ratlam	Govt Bhagatsingh P G College, Jaora
174	1408	C	Rewa	Annooppur	Govt Tulsi College, Anooppur
175	103	C	Gwalior	Shivpuri	Govt College Sheopur
176	1905	C	Ujjain	Shajapur	Govt Jawaharlal Nehru Smrati College Shujalpur
177	2603	C	Bhopal	Rajgarh	Netaji Subhashchandra Bose Govt College, Biora
178	1604	C	Ujjain	Neemuch	SRJ GOVT. GIRLS P.G. COLLEGE NEEMUCH
179	3605	C	Jabalpur	Chhindwara	Govt College, Junardev , Chhindwara
180	1706	C	Ujjain	Ratlam	Govt College Alot Ratlam
181	2002	C	Ujjain	Dewas	Girls college Dewas
182	1412	C	Rewa	Annooppur	Govt Degree College, Pushparajgarh, Anooppur
183	1804	C	Ujjain	Ujjain	Govt College Badnagar, Ujjain
184	1806	C	Ujjain	Ujjain	Govt Arts Science Commerce College, Nagda, Ujjain
185	2208	C	Indore	Dhar	Govt College, Dhamnod, Dhar
186	3809	C	Jabalpur	Balaghat	Govt College, Malajkhand, Balaghat
187	2405	C	Indore	Khargone	Govt College, Badwaha
188	1702	C	Ujjain	Ratlam	Govt Girls College ratlam
189	3403	C	Jabalpur	Narsinghpur	Govt P G College Gadarwada Narsinghpur
190	1413	C	Rewa	Annooppur	Govt College, Jaithari, Anooppur
191	1908	C	Ujjain	Agar Malwa	Govt College, Nalkheda, Agar
192	3311	C	Jabalpur	Katni	Govt Girls College, Katni
193	3806	C	Jabalpur	Balaghat	Govt College Katangi Balaghat
194	1615	C	Ujjain	Mandsour	Govt College Suwasra
195	2411	C	Indore	Badwani	Govt College, Sendhawa
196	2805	C	Bhopal	Bhopal	Govt P G College, BHEL
197	2707	C	Bhopal	Vidisha	Govt College, Vidisha
198	2904	C	Bhopal	Sehore	Govt College, Nasrullaganj, Sehore
199	3208	C	Bhopal	Timrani	Govt College Timrani
200	2705	C	Bhopal	Vidisha	Govt Lal Bahadur Shastri College, Sironj

GOVT. HOLKAR (MODEL AUTONOMOUS)
SCIENCE COLLEGE, INDORE
(An ISO 9001:2015 & ISO 14001:2015 Certified Instituion)

DVV DOCUMENT

CRITERION – 6

Government, Leadership and Management

Metric No. : 6.5.3

Collaborative Institute:

Department of Geography,
MLSU, Udaipur, Rajasthan

तमसो मा ज्योतिर्गमय

16 A

Activity Title:

Various objectives undertaken for the year 2022 in the Electoral Information System for Governance and Developmental Planning: A G-Governance Initiative

मोहनलाल सुखाड़िया विश्वविद्यालय, उदयपुर
MOHANLAL SUKHADIA UNIVERSITY: UDAIPUR

NAAC ACCREDITED 'A' GRADE STATE UNIVERSITY

No.F./RUSA/Gen/MLSU/2020/ 6067

Dated : 25-06-2020
6/07

ORDER

With reference to request submitted by Nodal Officer RUSA, MLSU, Udaipur in reference to letter No. F30(16)SPD/RUSA/2016/178 dated 31 March, 2020 of SPD, I am directed to convey administrative sanction for Research and Innovation project under component 10 or RUSA 2.0 of MHRD as per details given below:

S.No.	Department	Principal Investigator	Co-Investigator	Project Title	TOTAL Amount Sanctioned	Ist Instalment
1	Geography	Prof. Seema Jalan	Dr. Shailesh Chaure, Dr. Urmi Sharma	Electoral Information System for Governance and Developmental Planning: A G-Governance Initiative	5725000	2862500

Yours faithfully,

REGISTRAR

Copy to :

1. The Dean/Director, _____
2. The Comptroller, MLSU, Udaipur
3. The Head, Department of _____
4. The Nodal Officer, RUSA-MLSU, Udaipur
5. Person Concerned
6. Guard file

DY. REGISTRAR

Progress Report for RUSA 2.0 Projects

Report 2022

Name of Department

Department of Geography, Faculty of Earth Sciences, Mohanlal Sukhadia University

Project Title

Electoral Information System for Governance and Developmental Planning: A G-Governance Initiative

Date of Commencement of Project

Administrative Sanction: No. F./RUSA/Gen/MLSU/2020/6367 dated: 06-07-2020

Financial Sanction: PD/OS/SPD-(RUSA-Phase-II/CSA-1-(3)/2020-21/243 dated: 20/ 21-08-2020

Name of PI and /or Co-PI

Principal Investigator (PI) : Prof. Seema Jalan
Department of Geography, MLSU, Udaipur

Co-PI :

1. Dr. Shailesh Chaure,
   Associate Professor of Geology
   Govt. Holkar Science College, Indore
2. Ms. Urmi Sharma
   Assistant Professor
   Department of Geography, MLSU, Udaipur

1. Approved objectives/work plan of project

This project aims to develop and provide a rich geo-spatial information system for various governing bodies, elected representatives of respective constituencies, and state election system which has data including election statistics, socio-economic, ethnic, political issues, census, infrastructure, and developmental information about a particular area on a single platform.

This information will serve as a spatially enabled informed decision-making tool for policy-makers in effective governance and citizen-centric developmental planning.

The main objective of this project is to develop an application for G-governance entitled 'Electoral Information System for Governance and Developmental Planning (EIS-GDP)' - a web mapping application which will enable dynamic and interactive mapping of selected attributes at two levels:

- Assembly and Parliamentary constituencies of Rajasthan
- Tonk Assembly constituency

Comprehensive electoral statistics at Assembly Constituency level for the entire state.

In the first phase database will be created only for post-delimitation assembly elections. The work may be extended to pre-delimitation assembly elections and Lok Sabha elections in subsequent phases.

Comprehensive database with selected attributes relevant to governance and developmental planning at various administrative levels.

2. Objectives achieved

The first phase of the project is about to get completed with all the pages/tabs working as per the functionality given in the wireframe. The second and the final phase of the development work is yet to be started.

Following are the objectives achieved-

- Research for various election statistics
- GIS layers digitization and updation

- Identification of statistical data
- Database creation in GIS format
- Training and workshop for project staff
- Identifying tools and functionalities to be integrated into the portal
- Designing of wireframe of the portal
- Identifying technology architecture for the portal
- Development of a prototype of the portal
- Master database creation and sorting for the final development
- Understanding UI and UX of the portal and implementing updation
- Development of various tabs in the portal for different kinds of GIS Visualizations
- Designing of wireframe of the portal
- Field survey for phase 2 primary database generation.

3. Brief description of methodology/techniques/approach adopted

Various technologies and frameworks were discussed at the beginning of the project.

Both perpetual and open-source technologies were looked into and finally following open-source technologies were used both for development and GIS Analysis.

- GIS Software – QGIS
- Database Solution – PostgreSQL and PostGIS
- Front-End technologies – HTML, CSS, JavaScript
- Back-End Server – Geo Server
- Frameworks – Open layers, Chart.JS

4. Summary of work done so far and analysis of the result

Since the inception of this study, the project has been going on in a structured manner and all the team members have been assigned designated tasks to carry out as per their respective skillset, domain expertise, and experience.

Team members are regularly having meetings and discussions with their project PI and Co-PIs and under their guidance, the project has been pacing very well as per the mentioned timeline (mentioned under the point – project progress).

Below mentioned are the targets completed so far.

- Collected various datasets from different sources that can be arranged in a geospatial format.
- Digitizing and rectifying datasets (shapefile of Rajasthan Assemblies) so that they can be used to join other attributes with shapefiles.
- Prepared election boundaries of all 200 assembly constituencies of Rajasthan.
- Prepared boundaries of all 33 districts of Rajasthan.
- Preparation of election boundaries for all 25 Parliamentary constituencies of Rajasthan.
- Prepared election statistics for all 3 assembly elections of Rajasthan (Post-delimitation) i.e., 2008, 2013, and 2018 in a spatial format.
- Prepared election statistics for all 3 parliamentary elections of Rajasthan (Post-delimitation) i.e., 2009, 2014, and 2019 in a spatial format.
- Also checked the authenticity of population datasets calculated spatially concerning ground data.
- Collection of statistical datasets from sources such as election statistics reports, ADR reports, and various other forms of information.
- Arranging non-spatial datasets into a set template and finally converting it into spatial data for further analysis.
- Carried out various GIS-based analyses using both open source and perpetual licensed-based software.
- Setting up a development environment using various technologies available in open source and licensed-based technologies.
- Identified pros and cons of both sides of technologies.
- Understanding technical aspects and various frameworks available for portal development.
- Developed a wireframe of the final portal to be developed along with required functionalities and tabs.
- Explored all possible and available technologies that can be used for a Web-GIS mapping application and accordingly started with the development framework
- Understood hierarchy of Web-GIS architecture (Desktop, Middleware, Server, and Mobile) and how to link this using one common method as guided by the expert in a 3-day Web-GIS training (mentioned in the report below).
- Developed a fully functional prototype portal GUI using a rich mapping interface library.

- Added basic functionalities needed in a web mapping application with map panel and legend panel.
- Added an advanced attribute query tool with attribute selector and viewer.
- Added various layers of the base map to support better viewing capability for the user.
- Added an important tool to get information out of a basic map to the user in a very simple grid format.
- Finally, as per the project proposal released a limited tender for Web-based Geo-Portal development.
- After taking inputs from the prototype and discussing with PIs, have designed a wireframe in a phased manner for the portal which will be shared with the developer.
- Finalised all functionalities and tools to be integrated into the geoportal.
- Worked on database needed in a sorted approach which would be needed for the portal features and functionalities in a phased manner.
- Designed Wireframe for all the pages of Portal along with its User Interface Design.
- Any necessary changes or inputs if required, were made.
- Currently in 1st phase of portal development, all the main pages have been developed completely along with the integration of the database.
- These pages include Home Tab, State-GIS Tab, Trends Tab, and Compare Tab which is focused on State level GIS Data visualization.
- In Home Tab, on click year-wise dynamic visualizations for the state have been shown like No. of Polling booths, Year of Election, Political Parties, Elected Party, Voter Turnout, Total Electorate, and Total Candidates have been shown for previous three elections.
- Also, dynamic visualizations for all assembly and parliamentary constituencies have been shown like the winning candidate's name, winner candidate's party, voter turnout, per cent of votes received by the winner, and vote share of the top five parties have been shown in a form of a pie-chart.
- In the State-GIS tab, Dynamic visualization is displayed as per the user's attribute query for different sorts of spatial analysis.
- In the Trends tab, a user will be able to compare different attributes in the form of statistical diagrams like scatterplots, bar graphs, line graphs, and histograms.
- In Compare Tab, users will be able to compare attributes of different years in the form of synchronised maps. For example, users will be able to view maps of winning parties

overstate assembly and parliamentary elections of different years for a better comparison of elections trends.

- User will also be able to print or save the displayed statistical diagram in a pdf format.
- One more Tab (About Us) is still under the development phase as content for the same is yet to be finalized.
- Updated the latest SH and NH network of Rajasthan along with its symbology.
- As part of the project's second phase, completed Land use (Master Plan) and Land cover maps of the Tonk assembly constituency.
- Updated secondary level amenities/point of interest database for complete Tonk assembly constituency.
- Updated village-level GIS data.
- A field survey was carried out for 36 Gram Panchayats and Tonk Municipal areas in which GPS-based information like polling booths and various other amenities was gathered.
- A questionnaire-based survey was also done for Panchayat Sarpanch regarding various issues and developmental challenges faced by them. Inputs from localities were also taken.
- All this information has been sorted out in GIS format and will be mapped finally on the portal with necessary attributes.
- As per the project proposal, released a limited tender for the second phase of web-based Geo-Portal development.
- Wireframe has been designed for the second phase of the development which includes only a single page or tab which will be having all sorts of functionality required for visualization as mentioned under the project proposal.
- The Second phase of the portal will be focused on the Tonk assembly constituency ward wise election results and developmental issues, Panchayat wise election results and developmental issues along with booth level election data for the past three elections of the Assembly, Parliamentary, and Municipal Elections.
- Database and GIS layers for the second phase are completed with minor changes and corrections to be made.
- Layers for the second phase include amenities (points of interest), administrative boundaries, election boundaries, road network, and thematic layers.
- Once the database and GIS layers are completed, they will be integrated into the portal.

16 B

Activity Title:

Database creation, validation for next phase from both primary and secondary data of Dungarpur and Banswara district

मोहनलाल सुखाड़िया विश्वविद्यालय, उदयपुर
MOHANLAL SUKHADIA UNIVERSITY: UDAIPUR
NAAC ACCREDITED 'A' GRADE STATE UNIVERSITY

No.F./RUSA/Gen/MLSU/2020/ 6366

Dated : 25-06-2020
6/07

ORDER

With reference to request submitted by Nodal Officer RUSA, MLSU, Udaipur in reference to letter No. F30(16)SPD/RUSA/2016/178 dated 31 March, 2020 of SPD, I am directed to convey administrative sanction for Research and Innovation project under component 10 or RUSA 2.0 of MHRD as per details given below:

S.No.	Department	Principal Investigator	Co-Investigator	Project Title	TOTAL Amount Sanctioned	Ist Instalment
1	Geography	Dr. D.S. Chouhan	Prof. Seema Jalan, Dr. Shailesh Chaure	Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS	3004000	1502000

Yours faithfully,

REGISTRAR

Copy to :
1. The Dean/Director, _____
2. The Comptroller, MLSU, Udaipur
3. The Head, Department of _____
4. The Nodal Officer, RUSA-MLSU, Udaipur
5. Person Concerned
6. Guard file

DY. REGISTRAR

Project Progress Report

January, 2023

Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS

Date of Issue of Order by the University - 20-08-2020

Date of Issue of Financial Sanction by the University - 21-08-2020

Professor Seema Jalan
Head and Co-Principal Investigator

Dr. D. S. Chouhan
Principal Investigator
And Assistant Professor

Dr. Shailesh Chaure
Co-Principal Investigator
Government Holkar Science College, Indore (M.P)

Department of Geography
Faculty of Earth Science
Mohanlal Sukhadia University
Udaipur, Rajasthan, India, 313001

Project Staff

S. No.	Status	Name	Designation
1	PI	Dr. D. S. Chouhan	Assistant Professor Department of Geography MLS University, Udaipur, Raj.
2	Co-PI	Prof. Seema Jalan	Professor Department of Geography MLS University, Udaipur, Raj.
3	Co- PI	Dr. Shailesh Chaure	Associate Professor Govt. Holkar Science College Indore, Madhya Pradesh

CONTENT

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1. **TITLE:** Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS

2. INTRODUCTION

Study Area

The study area comprises of the two districts of Dungarpur and Banswara. Also the project will be covering all the tehsils and villages present in Dungarpur and Banswara districts based on Census 2011.

This project proposal is being submitted under the discipline of 'Geography' (specifically Resource Geography) but in approach, relevance and content it is interdisciplinary in nature spanning across Geography, Environment Science, Geology, Geo-Chemistry. Water quality is a major issue of the world in current scenario. A good water quality is essential to a healthy life and whole ecosystem because water quality issues influence living beings and natural environment. The proposed research will be a significant contribution to research and designing various policies related to drinking water, health and sanitation.

Water quality and health bear close inter-relationship to each other. Water quality is fundamental to human development, well-being and health. Providing access to safe water is one of the most effective instruments in promoting health. Water is not only essential to life but intimately interwoven with quality of life across the world. Access to enough clean water is crucial in everyday life for every person in the world. Changes in the quality, quantity, natural cycles of water and water systems have far-reaching impacts on all aspects of human life. As the human population continues to grow and the global clean water supply is reduced by consumption, contamination and climate change, water issues will only increase in complexity and importance.

Presently all Government organizations like Ministry of Water Resources India, World Health Organization (WHO) and various State Ground Water Departments are doing efforts to asses quality of water and monitor both surface and ground water resources. Also the causes and transmission of waterborne disease are under assessment because the quality of water, whether used for drinking, domestic purposes, food production or recreational purposes has an important impact on health. Contaminated or poor quality can cause epidemics and it can contribute to high rates of microbial infestation of water sources on large scale. Initiatives to manage and improve water quality not only supports general public health, but often promote Field survey development of the citizens. This document aims at demonstrating an approach for the assessment of water quality and its impact on health of the people living and consuming

water from sources present in the vicinity of citizens living in an area and will sets out a probable strategy adopted by Government of India and Rajasthan to manage water quality with a view to protecting and promoting human health in Vagad Region of Rajasthan.

3. APPROVED OBJECTIVES OF THE PROJECT

Detailed objectives of the project are as under:

(i) To assess the ground and surface water quality of Vagad Region in context of geographical and demographic characteristics of the region.

(ii) To understand the difference between ground and surface water quality in Vagad Region.

(iii) To identify the general sources of contaminants of groundwater in Vagad Region.

(iv) To identify poor water quality buffer zones using Geo-Statistical Interpolation methods in Vagad Region.

(v) To understand the impact of water quality on human health in Vagad Region.

(vi) To identify the causes and magnitude of dwindling quantity and deteriorating quality of water resource in the Vagad Region.

(vii) Conduct a Pilot Study and Survey in Dungarpur Tehsil with all the objectives related to the major project.

(viii) To generate detailed and enhanced spatio-temporal database readily accessible to common man and decision makers in form of an interactive Web-GIS based application in a user-friendly interface.

(ix) To examine the water management policy currently being followed in the Vagad Region.

(x) To suggest water harvesting and other solutions for a sustainable water supply in the Vagad Region.

(xi) To create awareness among the people of Vagad Region regarding problems related to water quality and measures of prevention.

4. WORK ACCOMPLISHED AND OBJECTIVES ACHIEVED

The following work was accomplished and results achieved since the beginning of the project:

- Geo Referencing of the Census 2011 Atlas Census Maps of the Vagad Region i.e. the districts of Dungarpur and Banswara.

- Geo Referencing of the Census 2011 Atlas Census Maps of all 9 individual tehsils of the districts of Dungarpur and Banswara with all the census village boundaries.
- Digitization of the Vector Boundaries of all the villages of all 9 tehsils of the districts of Dungarpur and Banswara using the above mentioned geo-referenced Census 2011 Atlas Maps into ESRI Shapefile format.
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- Preparation of the vector format data of Geological Structure Layer for the Dungarpur and Banswara districts using the Geology data provided by the Geological Survey India, Bhukosh Portal.
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- Preparation of the vector format data of Lithology Layer for the Dungarpur and Banswara districts using the Lithology data provided by the Geological Survey India, Bhukosh Portal.
- Preparation of Dungarpur Tehsil GWD Sites point feature vector format shapefile representing the location of the GWD water quality report data sites by quarrying the "GWD Assets" GIS Layer on the Rajasthan Government Ground Water "Rajdharaa" GIS Portal and comparing the GWD Water Quality Asset Location Names written in GWD Ground Water Quality Report for Grid Analysis and identification of zones and villages in Dungarpur Tehsil with no water quality monitoring by the Ground Water Department (GWD) or water quality data is not available.
- Attribution of the above mentioned GWD Sites point feature vector shapefile with water quality attributes taken from GWD Water Quality Report, 2014 of Dungarpur.
- Preparation of vector format grid shapefile for the Vagad region consisting of individual grid cells of dimensions of 5 Km. length and 5 Km. breadth for Grid analysis to select

villages for approximately spatially even distribution of villages for Water Quality Sample Collection and Field survey under the Pilot Project Study of Dungarpur Tehsil.

- Preparation of Pilot Project Sampling Sites point feature vector format shapefile representing the location of the villages selected for the Water Quality Sample Collection and Field survey under Pilot Project Study of Dungarpur Tehsil.
- Attribution of the above prepared Pilot Project Sampling Location Site shapefile with attributes viz. Village Name, Village Census Location Code, Sample No., Sample Name, Water Testing Lab Results viz. Sample Registration No., pH, Taste, Odour, Turbidity, TDS, Hardness, Alkalinity, Chloride, Fluoride, Sulphate, Nitrate, Iron, Faecal Coliform, E. Coli level etc.
- Performing Kriging Interpolation Operation over the parameters and attribute values in the GWD Site Layer for assessment of correct interpolation method to be used for the pilot study as well as main project, also for preparation of a research paper on Comparative Study of Better Interpolation Method for Water Quality Monitoring and Prediction.
- Preparation of Survey Schedule or Questionnaire for the Pilot Project of Dungarpur Tehsil completed.
- Conducted Pilot Study Field survey and Water Sample Collection at 21 selected locations in Dungarpur Tehsil.
- Conducted Field survey and Water Sample Collection Survey in 200 villages in Banswara district.
- Organization of results of field survey data collected in field survey and results of the physico-chemical testing of water samples collected in the field by the laboratory is under progress.

5. BRIEF DESCRIPTION OF THE METHODOLOGY

The following points describe briefly about the methodology adopted for the project:

- Georeferencing of Census Maps 2011 for the digitization of the study area boundaries in GIS vector data format.
- Attribution of the study area vector data boundaries and village vector data boundaries with Census 2011 population and census location codes.

- Preparation of Geology, Lithology and Geomorphology vector data
- Preparation of 5km by 5km spatial grid polygon layer for the selection of the villages for conducting the field survey and field water sample collection drive in Banswara and Dungarpur districts.
- Preparation of field survey schedules for the field survey and preparation of label for the water sample bottles to be used in field.
- Recording and compilation of data collected in field survey and lab testing results of 14 water quality parameters from each surveyed location in the study area.
- Preparation of GIS point feature vector data of surveyed location in the field survey containing data from field survey and lab test results of the water samples.
- Geo-Statistical and Interpolation Analysis on the above prepared GIS point feature vector data layer of surveyed location in the field survey containing data from field survey and lab test results of the water samples.
- Compilation of the results of the analysis done.
- Preparation of Web-GIS Application with all the required functionalities and reporting tools integrated.
- Preparation of Maps Layouts and Final Project Report.

6. OUTCOME OF THE WORK DONE SO FAR

The following points illustrate the outcomes of the work done so far in the project:

- Geo-referencing and digitization of all the study area GIS vector data boundaries of Vagad region - Dungarpur and Banswara districts done based upon the Census 2011.
- Attribution of the digitized GIS vector data boundaries of Vagad region - Dungarpur and Banswara districts done up to the village level based upon the Census 2011.
- Preparation of the GIS vector data boundaries of the Geology, Lithology, Waterbodies and Geomorphology of the entire study area was completed.
- Preparation of the field survey Schedules and Water Samples Labels was completed.
- Conduction of the pilot survey of 21 villages of tehsil Dungarpur was completed.
- Approximately 400 water sample collected from Banswara & Dungarpur districts.
- Field survey of approximately 800 families have been completed.

7. PUBLICATIONS

- Research Paper Title: "Spatial Variability of Groundwater Quality Parameters With Geo-Statistical Interpolation Method Using Ordinary Kriging and GIS (Case Study: Dungarpur Tehsil, Rajasthan, India)" based on the State Ground Water Department Rajasthan Pre-Monsoon 2014 data was published in Journal of Geomatics, Vol. 16, No. 2, Oct. 2022 by Indian Society of Geomatics.

8. CONFERENCE, WORKSHOP AND TRAINING ORGANISED

- A three day Web-GIS Training was conducted in the Department of Geography, Mohanlal Sukhadia University, Udaipur, Rajasthan from 7th to 9th January, 2021 under RUSA 2.0 Project by Prof. Seema Jalan, Co-PI & Head of Department. Mr. Mohammed Ali S., was the resource person from Rajasthan State Remote Sensing Centre, Jodhpur (Rajasthan). Details of the training are mentioned with photographs in a separate annexure (Annexure I) with this report.

9. PROJECT WORK STATUS, WORK REMAINING, FUTURE WORK PLAN AND TIMELINE

Months (after issue of FS on 20.8.2020)	**Targets**	**Status**	**Remarks**
November, 2020	• Procurement of equipment, software, furniture, books, data etc. • Appointment of Staff	• Completed as per priority. Will be procured as required with the progress of the project. • Completed in November, 2020.	

March, 2021	• Preparation of questionnaire • Data collection ,compilation and preparation • Field data collection and primary survey	• Completed in March, 2021 • Completed • Pilot survey of the same has been completed in March,2021	
July, 2021	• Generation of Geospatial database • Web application development	Completed	
Mar. 2022	• Layer finalization, attribution and analysis as per the next phase of the project. • Database creation, validation for next phase from both primary and secondary data of Dungarpur and Banswara district. • Field Survey and Water Sample Collection of Banswara District.	Field Survey and Water Sample Collection of Banswara & Dungarpur District Completed. Database schema creation completed. Compilation of data collected in survey and water sample lab testing results.	
Dec. 2023	• Preparation of GIS Vector Data Layers of Compilation of Survey and Water Quality Lab Test Results of Both Dungarpur and Banswara districts.	Remaining	Time Required 2 Month
Dec. 2023	• Geo-Statistical Analysis and Project Report Preparation	Remaining	Time Required 2 Months

16 C

Activity Title:

Various objectives undertaken for the year 2021 in the Electoral Information System for Governance and Developmental Planning: A G-Governance Initiative

मोहनलाल सुखाड़िया विश्वविद्यालय, उदयपुर
MOHANLAL SUKHADIA UNIVERSITY: UDAIPUR

NAAC ACCREDITED 'A' GRADE STATE UNIVERSITY

No.F./RUSA/Gen/MLSU/2020/ 6067

Dated : 25-06-2020
6/07

ORDER

With reference to request submitted by Nodal Officer RUSA, MLSU, Udaipur in reference to letter No. F30(16)SPD/RUSA/2016/178 dated 31 March, 2020 of SPD, I am directed to convey administrative sanction for Research and Innovation project under component 10 or RUSA 2.0 of MHRD as per details given below:

S.No.	Department	Principal Investigator	Co-Investigator	Project Title	TOTAL Amount Sanctioned	Ist Instalment
1	Geography	Prof. Seema Jalan	Dr. Shailesh Chaure, Dr. Urmi Sharma	Electoral Information System for Governance and Developmental Planning: A G-Governance Initiative	5725000	2862500

Yours faithfully,

REGISTRAR

Copy to :

1. The Dean/Director, _____
2. The Comptroller, MLSU, Udaipur
3. The Head, Department of _____
4. The Nodal Officer, RUSA-MLSU, Udaipur
5. Person Concerned
6. Guard file

DY. REGISTRAR

Progress Report for RUSA 2.0 Projects

Report 2021

Name of Department

Department of Geography, Faculty of Earth Sciences, Mohanlal Sukhadia University

Project Title

Electoral Information System for Governance and Developmental Planning: A G-Governance Initiative

Date of Commencement of Project

Administrative Sanction: No. F./RUSA/Gen/MLSU/2020/6367 dated: 06-07-2020

Financial Sanction: PD/OS/SPD-(RUSA-Phase-II/CSA-1-(3)/2020-21/243 dated: 20/ 21-08-2020

Name of PI and /or Co-PI

Principal Investigator (PI)	:	Prof. Seema Jalan Department of Geography, MLSU, Udaipur
Co-PI	:	1. Dr. Shailesh Chaure, Associate Professor of Geology Govt. Holkar Science College, Indore 2. Ms. Urmi Sharma Assistant Professor Department of Geography, MLSU, Udaipur

Purpose

This project aims to develop and provide a rich geospatial information system for various governing bodies, elected representatives of respective constituencies, and state election system which has data including election statistics, socio-economic, ethnic, political issues, census, infrastructure, and developmental information about a particular area on a single platform.

This information will serve as a spatially enabled informed decision-making tool for policy-makers in effective governance and citizen-centric developmental planning.

Brief objective of the project

To develop an application for G-governance entitled 'Electoral Information System for Governance and Developmental Planning (EIS-GDP)' - a web mapping application which will enable dynamic and interactive mapping of selected attributes at two levels:

- Assembly and Parliamentary constituencies of Rajasthan
- Tonk Assembly constituency

Comprehensive electoral statistics at Assembly Constituency level for the entire state.

In the first phase database will be created only for post-delimitation assembly elections. The work may be extended to pre-delimitation assembly elections and Lok Sabha elections in subsequent phases.

Comprehensive database with selected attributes relevant to governance and developmental planning at various administrative levels.

Work done so far and results achieved

Since the inception of this study, the project has been going on in a structured manner and all the team members have been assigned designated tasks to carry out as per respective skillset, domain expertise, and experience.

Team members are regularly having weekly meetings and discussions with their project PI and Co-PIs and under their guidance the project has been pacing very well as per the mentioned timeline (mentioned under the point – project progress).

Below mentioned are the targets completed so far.

- Collected various datasets from different sources that can be arranged in a geo-spatial format.
- Digitizing and rectifying datasets (shapefile of Rajasthan assemblies) so that it can be used to join other attributes with shape files.
- Prepared election boundaries of all 200 assembly constituencies of Rajasthan.
- Prepared boundaries of all 33 districts of Rajasthan.
- Preparation of election boundaries for all 25 Parliamentary constituencies of Rajasthan.
- Prepared election statistics for all 3 assembly elections of Rajasthan (Post-delimitation) i.e., 2008, 2013, and 2018 in a spatial format.
- Prepared election statistics for all 3 parliamentary elections of Rajasthan (Post-delimitation) i.e., 2009, 2014, and 2019 in a spatial format.
- Also checked the authenticity of population datasets calculated spatially with reference to ground data.
- Collection of statistical datasets from sources such as election statistics reports, ADR reports, and various other forms of information.
- Arranging non-spatial datasets into a set template and finally converting it into spatial data for further analysis.
- Carried out various GIS-based analysis using both open source and perpetual licensed based software.
- Setting up a development environment using various technologies available in open source and licensed based technologies.
- Identified pros and cons of both sides of technologies.
- Understanding technical aspect and various libraries available for portal development.
- Developed a wireframe of the final portal to be developed along with required functionalities and tabs.
- Explored all possible and available technologies that can be used for a Web-GIS mapping application and accordingly started with the development framework

- Understood hierarchy of Web-GIS architecture (Desktop, Middleware, Server, and Mobile) and how to link this using one common method as guided by the expert in a 3-day Web-GIS training (mentioned in the report below).
- Developed a prototype portal GUI using a rich mapping interface library.
- Added basic functionalities needed in a web mapping application with map tree panel and legend panel.
- Added an advance spatial query tool with attribute selector and viewer.
- Added various layers of base map to support better viewing capability to the user.
- Added an important tool to get information out of a basic map to the user in a very simple grid format.
- Finally, as per project proposal released a limited tender for a Web based Geo-Portal development.
- After taking inputs from prototype and discussing with PIs, have designed wireframe in phased manner for the portal which will be shared to the developer.
- Finalised all functionalities and tools to be integrated in the geoportal.
- Worked on database needed in a sorted approach which would be needed for the portal features and functionalities in a phased manner.
- Any necessary change or inputs if required, were made.
- Currently phase 2 of portal is being developed which includes detailed GIS visualizations of ACs and PCs of Rajasthan.
- Advance query panel has been added for better visualization and interpretation of election statistics.
- Along with statistical data, major road network of Rajasthan will also be displayed.
- Wireframe for further pages (yet to be developed) for trend analysis has also been designed on an initial level.

Workshop/Training Organized

- A 3-Day training on Web-GIS was also carried out at the GIS lab of Department of Geography, MLSU, Udaipur by the expert from the Regional Space Application Centre, Indian Space Research Organization, Jodhpur, Rajasthan (7^{th}-9^{th} January, 2021)
- Project fellows got exposure to current trends and technologies in open-source web-GIS.

- The training was mostly focused on technological aspects such as-
    a) Web-GIS architecture
    b) Front-end technologies
    c) Back-end technologies
    d) Middleware technologies
    e) Server-side technologies
    f) Mobile GIS
    g) Desktop GIS



Figure 1: Participants during Web-GIS training workshop

Field work Report

A mock GPS based Field survey was conducted for second phase of the project in Tonk Assembly constituency during last week of March, 2021. In this survey project Staff was volunteered with two other field surveyors. Latest Hand-held GPS devices were used to collect field level information. This survey focused on collecting geo-tagged information and pictures of municipal Tonk area and Arniya Kedar panchayat.

Project staff was also closely cooperated with local leaders and politicians of the Tonk Assembly.

Below mentioned is the information collected from field survey.

- Point of interest data from Ward no. 10 and Arniya Kedar panchayat were collected such as major landmarks, government offices, primary health centres, schools, Anganwadi centres, and polling stations (GPS survey).

- Ground control points were collected using GPS from various parts of Tonk assembly in order to Geo-reference map of municipal area with respect to ground level information.
- Polling station location information was collected from all wards of municipal Tonk (GPS survey).
- Hard copies of polling catchment area maps (hand drawn) were gathered.
- Municipal map of Tonk has been collected.
- Gathered location of all police station and police HQ for Tonk district.
- Map showing location of police stations along with their catchment area for Tonk district was gathered from Police department.

All this information was rectified, corrected, and was put in GIS format (in actual scale) and various analysis were done which will be incorporated on the portal.

With this mock survey, project team also got an idea on how to proceed for the main survey and what all necessary information has to be collected from secondary sources which will be helpful in primary survey.



Figure 2: Project Staff during GPS based field survey



Figure 3: A snapshot of from sarpanch office during field survey

Project Progress according to original plan

As per the original plan of the project, there have been many hurdles during the project in view of the following circumstances:

1. Acquisition of the College and the Department building for State Assembly elections at initial stage of the project delayed the work of establishment of basic infrastructure
2. Complete closure of the University and concerned Government Departments consequent upon COVID induced lockdown.
3. Travel restrictions have severely affected timeline for data collection and field work.

Updated tentative project timeline of the project is as shown in the figure below:

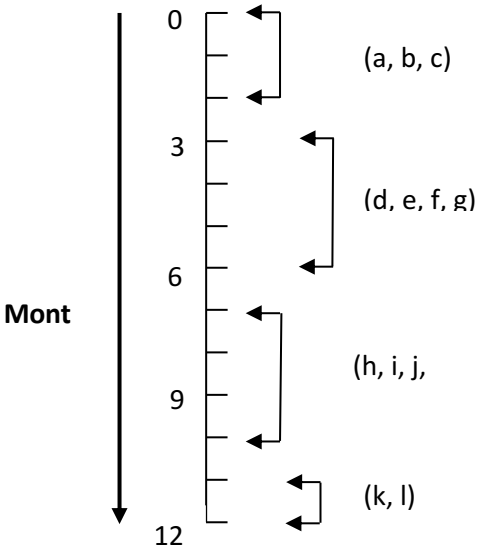


Figure 4: Project timeline hierarchy

a) Procurement of equipment, software and study material and Appointment of staff.
b) Data collection & compilation.
c) Prototype development and procurement of survey instruments.
d) Field data collection and primary mock survey.
e) Wireframe finalization and outsourcing for portal development.
f) Generation of geospatial database for 1st phase of development and its validation.
g) Generation of geospatial database for 1st phase of development and its validation.
h) Layer finalization and analysis as per next phase of project.
i) Field survey for phase 2.
j) Database creation, validation for phase 2 from both primary and secondary data.
k) GIS based Analysis for Phase 2 and any other pending work from both the phases.
l) Report preparation.

Approximate timing for project completion

Major part of the project work involves data collection (field survey) and the progress of the project has been severely compromised due to COVID-19 pandemic. The circumstances are extremely uncertain in the view of possible third wave of the pandemic.

Request for extension of project period has already been submitted vide letter No. MLSU/Geog./ RUSA 2.0/ 2021/ SJ/ 571 dated April 17, 2021 for extension till May, 2022 (*Annexure 1 (i)*). However due to COVID situation and consequential effects, it is likely that further extension of 06 months will be essentially required. **Likely timeline for completion of project amidst COVID situation is November, 2022.**

16 D

Activity Title:

Preparation of questionnaire, Data collection ,compilation and preparation; Field data collection and primary survey in the collobrative research project

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No.F./RUSA/Gen/MLSU/2020/ 6366

Dated : 25-06-2020
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Yours faithfully,

REGISTRAR

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3. The Head, Department of _____
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6. Guard file

DY. REGISTRAR

Project Progress Report

January, 2023

Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS

Date of Issue of Order by the University - 20-08-2020

Date of Issue of Financial Sanction by the University - 21-08-2020

Professor Seema Jalan
Head and Co-Principal Investigator

Dr. D. S. Chouhan
Principal Investigator
And Assistant Professor

Dr. Shailesh Chaure
Co-Principal Investigator
Government Holkar Science College, Indore (M.P)

Department of Geography
Faculty of Earth Science
Mohanlal Sukhadia University
Udaipur, Rajasthan, India, 313001

Project Staff

S. No.	Status	Name	Designation
1	PI	Dr. D. S. Chouhan	Assistant Professor Department of Geography MLS University, Udaipur, Raj.
2	Co-PI	Prof. Seema Jalan	Professor Department of Geography MLS University, Udaipur, Raj.
3	Co- PI	Dr. Shailesh Chaure	Associate Professor Govt. Holkar Science College Indore, Madhya Pradesh

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1. **TITLE:** Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS

2. INTRODUCTION

Study Area

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This project proposal is being submitted under the discipline of 'Geography' (specifically Resource Geography) but in approach, relevance and content it is interdisciplinary in nature spanning across Geography, Environment Science, Geology, Geo-Chemistry. Water quality is a major issue of the world in current scenario. A good water quality is essential to a healthy life and whole ecosystem because water quality issues influence living beings and natural environment. The proposed research will be a significant contribution to research and designing various policies related to drinking water, health and sanitation.

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Presently all Government organizations like Ministry of Water Resources India, World Health Organization (WHO) and various State Ground Water Departments are doing efforts to asses quality of water and monitor both surface and ground water resources. Also the causes and transmission of waterborne disease are under assessment because the quality of water, whether used for drinking, domestic purposes, food production or recreational purposes has an important impact on health. Contaminated or poor quality can cause epidemics and it can contribute to high rates of microbial infestation of water sources on large scale. Initiatives to manage and improve water quality not only supports general public health, but often promote Field survey development of the citizens. This document aims at demonstrating an approach for the assessment of water quality and its impact on health of the people living and consuming

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- Preparation of Dungarpur Tehsil GWD Sites point feature vector format shapefile representing the location of the GWD water quality report data sites by quarrying the "GWD Assets" GIS Layer on the Rajasthan Government Ground Water "Rajdharaa" GIS Portal and comparing the GWD Water Quality Asset Location Names written in GWD Ground Water Quality Report for Grid Analysis and identification of zones and villages in Dungarpur Tehsil with no water quality monitoring by the Ground Water Department (GWD) or water quality data is not available.
- Attribution of the above mentioned GWD Sites point feature vector shapefile with water quality attributes taken from GWD Water Quality Report, 2014 of Dungarpur.
- Preparation of vector format grid shapefile for the Vagad region consisting of individual grid cells of dimensions of 5 Km. length and 5 Km. breadth for Grid analysis to select

villages for approximately spatially even distribution of villages for Water Quality Sample Collection and Field survey under the Pilot Project Study of Dungarpur Tehsil.

- Preparation of Pilot Project Sampling Sites point feature vector format shapefile representing the location of the villages selected for the Water Quality Sample Collection and Field survey under Pilot Project Study of Dungarpur Tehsil.
- Attribution of the above prepared Pilot Project Sampling Location Site shapefile with attributes viz. Village Name, Village Census Location Code, Sample No., Sample Name, Water Testing Lab Results viz. Sample Registration No., pH, Taste, Odour, Turbidity, TDS, Hardness, Alkalinity, Chloride, Fluoride, Sulphate, Nitrate, Iron, Faecal Coliform, E. Coli level etc.
- Performing Kriging Interpolation Operation over the parameters and attribute values in the GWD Site Layer for assessment of correct interpolation method to be used for the pilot study as well as main project, also for preparation of a research paper on Comparative Study of Better Interpolation Method for Water Quality Monitoring and Prediction.
- Preparation of Survey Schedule or Questionnaire for the Pilot Project of Dungarpur Tehsil completed.
- Conducted Pilot Study Field survey and Water Sample Collection at 21 selected locations in Dungarpur Tehsil.
- Conducted Field survey and Water Sample Collection Survey in 200 villages in Banswara district.
- Organization of results of field survey data collected in field survey and results of the physico-chemical testing of water samples collected in the field by the laboratory is under progress.

5. BRIEF DESCRIPTION OF THE METHODOLOGY

The following points describe briefly about the methodology adopted for the project:

- Georeferencing of Census Maps 2011 for the digitization of the study area boundaries in GIS vector data format.
- Attribution of the study area vector data boundaries and village vector data boundaries with Census 2011 population and census location codes.

- Preparation of Geology, Lithology and Geomorphology vector data
- Preparation of 5km by 5km spatial grid polygon layer for the selection of the villages for conducting the field survey and field water sample collection drive in Banswara and Dungarpur districts.
- Preparation of field survey schedules for the field survey and preparation of label for the water sample bottles to be used in field.
- Recording and compilation of data collected in field survey and lab testing results of 14 water quality parameters from each surveyed location in the study area.
- Preparation of GIS point feature vector data of surveyed location in the field survey containing data from field survey and lab test results of the water samples.
- Geo-Statistical and Interpolation Analysis on the above prepared GIS point feature vector data layer of surveyed location in the field survey containing data from field survey and lab test results of the water samples.
- Compilation of the results of the analysis done.
- Preparation of Web-GIS Application with all the required functionalities and reporting tools integrated.
- Preparation of Maps Layouts and Final Project Report.

6. OUTCOME OF THE WORK DONE SO FAR

The following points illustrate the outcomes of the work done so far in the project:

- Geo-referencing and digitization of all the study area GIS vector data boundaries of Vagad region - Dungarpur and Banswara districts done based upon the Census 2011.
- Attribution of the digitized GIS vector data boundaries of Vagad region - Dungarpur and Banswara districts done up to the village level based upon the Census 2011.
- Preparation of the GIS vector data boundaries of the Geology, Lithology, Waterbodies and Geomorphology of the entire study area was completed.
- Preparation of the field survey Schedules and Water Samples Labels was completed.
- Conduction of the pilot survey of 21 villages of tehsil Dungarpur was completed.
- Approximately 400 water sample collected from Banswara & Dungarpur districts.
- Field survey of approximately 800 families have been completed.

7. PUBLICATIONS

- Research Paper Title: "Spatial Variability of Groundwater Quality Parameters With Geo-Statistical Interpolation Method Using Ordinary Kriging and GIS (Case Study: Dungarpur Tehsil, Rajasthan, India)" based on the State Ground Water Department Rajasthan Pre-Monsoon 2014 data was published in Journal of Geomatics, Vol. 16, No. 2, Oct. 2022 by Indian Society of Geomatics.

8. CONFERENCE, WORKSHOP AND TRAINING ORGANISED

- A three day Web-GIS Training was conducted in the Department of Geography, Mohanlal Sukhadia University, Udaipur, Rajasthan from 7th to 9th January, 2021 under RUSA 2.0 Project by Prof. Seema Jalan, Co-PI & Head of Department. Mr. Mohammed Ali S., was the resource person from Rajasthan State Remote Sensing Centre, Jodhpur (Rajasthan). Details of the training are mentioned with photographs in a separate annexure (Annexure I) with this report.

9. PROJECT WORK STATUS, WORK REMAINING, FUTURE WORK PLAN AND TIMELINE

Months (after issue of FS on 20.8.2020)	**Targets**	**Status**	**Remarks**
November, 2020	• Procurement of equipment, software, furniture, books, data etc. • Appointment of Staff	• Completed as per priority. Will be procured as required with the progress of the project. • Completed in November, 2020.	

March, 2021	• Preparation of questionnaire • Data collection ,compilation and preparation • Field data collection and primary survey	• Completed in March, 2021 • Completed • Pilot survey of the same has been completed in March,2021	
July, 2021	• Generation of Geospatial database • Web application development	Completed	
Mar. 2022	• Layer finalization, attribution and analysis as per the next phase of the project. • Database creation, validation for next phase from both primary and secondary data of Dungarpur and Banswara district. • Field Survey and Water Sample Collection of Banswara District.	Field Survey and Water Sample Collection of Banswara & Dungarpur District Completed. Database schema creation completed. Compilation of data collected in survey and water sample lab testing results.	
Dec. 2023	• Preparation of GIS Vector Data Layers of Compilation of Survey and Water Quality Lab Test Results of Both Dungarpur and Banswara districts.	Remaining	Time Required 2 Month
Dec. 2023	• Geo-Statistical Analysis and Project Report Preparation	Remaining	Time Required 2 Months

16 E

Activity Title:

Generation of Geospatial database; Web application development in the collobrative research project

मोहनलाल सुखाड़िया विश्वविद्यालय, उदयपुर
MOHANLAL SUKHADIA UNIVERSITY: UDAIPUR
NAAC ACCREDITED 'A' GRADE STATE UNIVERSITY

No.F./RUSA/Gen/MLSU/2020/ 6366

Dated : 25-06-2020
6/07

ORDER

With reference to request submitted by Nodal Officer RUSA, MLSU, Udaipur in reference to letter No. F30(16)SPD/RUSA/2016/178 dated 31 March, 2020 of SPD, I am directed to convey administrative sanction for Research and Innovation project under component 10 or RUSA 2.0 of MHRD as per details given below:

S.No.	Department	Principal Investigator	Co-Investigator	Project Title	TOTAL Amount Sanctioned	Ist Instalment
1	Geography	Dr. D.S. Chouhan	Prof. Seema Jalan, Dr. Shailesh Chaure	Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS	3004000	1502000

Yours faithfully,

REGISTRAR

Copy to :
1. The Dean/Director, _____
2. The Comptroller, MLSU, Udaipur
3. The Head, Department of _____
4. The Nodal Officer, RUSA-MLSU, Udaipur
5. Person Concerned
6. Guard file

DY. REGISTRAR

Project Progress Report

January, 2023

Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS

Date of Issue of Order by the University - 20-08-2020

Date of Issue of Financial Sanction by the University - 21-08-2020

Professor Seema Jalan
Head and Co-Principal Investigator

Dr. D. S. Chouhan
Principal Investigator
And Assistant Professor

Dr. Shailesh Chaure
Co-Principal Investigator
Government Holkar Science College, Indore (M.P)

Department of Geography
Faculty of Earth Science
Mohanlal Sukhadia University
Udaipur, Rajasthan, India, 313001

Project Staff

S. No.	Status	Name	Designation
1	PI	Dr. D. S. Chouhan	Assistant Professor Department of Geography MLS University, Udaipur, Raj.
2	Co-PI	Prof. Seema Jalan	Professor Department of Geography MLS University, Udaipur, Raj.
3	Co- PI	Dr. Shailesh Chaure	Associate Professor Govt. Holkar Science College Indore, Madhya Pradesh

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7	Publications	9
8	Conference, Workshop and Training Organized	9
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1. **TITLE:** Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS

2. INTRODUCTION

Study Area

The study area comprises of the two districts of Dungarpur and Banswara. Also the project will be covering all the tehsils and villages present in Dungarpur and Banswara districts based on Census 2011.

This project proposal is being submitted under the discipline of 'Geography' (specifically Resource Geography) but in approach, relevance and content it is interdisciplinary in nature spanning across Geography, Environment Science, Geology, Geo-Chemistry. Water quality is a major issue of the world in current scenario. A good water quality is essential to a healthy life and whole ecosystem because water quality issues influence living beings and natural environment. The proposed research will be a significant contribution to research and designing various policies related to drinking water, health and sanitation.

Water quality and health bear close inter-relationship to each other. Water quality is fundamental to human development, well-being and health. Providing access to safe water is one of the most effective instruments in promoting health. Water is not only essential to life but intimately interwoven with quality of life across the world. Access to enough clean water is crucial in everyday life for every person in the world. Changes in the quality, quantity, natural cycles of water and water systems have far-reaching impacts on all aspects of human life. As the human population continues to grow and the global clean water supply is reduced by consumption, contamination and climate change, water issues will only increase in complexity and importance.

Presently all Government organizations like Ministry of Water Resources India, World Health Organization (WHO) and various State Ground Water Departments are doing efforts to asses quality of water and monitor both surface and ground water resources. Also the causes and transmission of waterborne disease are under assessment because the quality of water, whether used for drinking, domestic purposes, food production or recreational purposes has an important impact on health. Contaminated or poor quality can cause epidemics and it can contribute to high rates of microbial infestation of water sources on large scale. Initiatives to manage and improve water quality not only supports general public health, but often promote Field survey development of the citizens. This document aims at demonstrating an approach for the assessment of water quality and its impact on health of the people living and consuming

water from sources present in the vicinity of citizens living in an area and will sets out a probable strategy adopted by Government of India and Rajasthan to manage water quality with a view to protecting and promoting human health in Vagad Region of Rajasthan.

3. APPROVED OBJECTIVES OF THE PROJECT

Detailed objectives of the project are as under:

(i) To assess the ground and surface water quality of Vagad Region in context of geographical and demographic characteristics of the region.

(ii) To understand the difference between ground and surface water quality in Vagad Region.

(iii) To identify the general sources of contaminants of groundwater in Vagad Region.

(iv) To identify poor water quality buffer zones using Geo-Statistical Interpolation methods in Vagad Region.

(v) To understand the impact of water quality on human health in Vagad Region.

(vi) To identify the causes and magnitude of dwindling quantity and deteriorating quality of water resource in the Vagad Region.

(vii) Conduct a Pilot Study and Survey in Dungarpur Tehsil with all the objectives related to the major project.

(viii) To generate detailed and enhanced spatio-temporal database readily accessible to common man and decision makers in form of an interactive Web-GIS based application in a user-friendly interface.

(ix) To examine the water management policy currently being followed in the Vagad Region.

(x) To suggest water harvesting and other solutions for a sustainable water supply in the Vagad Region.

(xi) To create awareness among the people of Vagad Region regarding problems related to water quality and measures of prevention.

4. WORK ACCOMPLISHED AND OBJECTIVES ACHIEVED

The following work was accomplished and results achieved since the beginning of the project:

- Geo Referencing of the Census 2011 Atlas Census Maps of the Vagad Region i.e. the districts of Dungarpur and Banswara.

- Geo Referencing of the Census 2011 Atlas Census Maps of all 9 individual tehsils of the districts of Dungarpur and Banswara with all the census village boundaries.
- Digitization of the Vector Boundaries of all the villages of all 9 tehsils of the districts of Dungarpur and Banswara using the above mentioned geo-referenced Census 2011 Atlas Maps into ESRI Shapefile format.
- Attribution of the above digitized approximately 2500 villages' vector polygon features of the districts of Dungarpur and Banswara with attributes viz. Village Name, Village Census Location Code, District Name, District Census Location Code, Tehsil Name, Town Name, Town Census Location Code, Village Population Census 2011 etc.
- Preparation of the vector format data of Geological Structure Layer for the Dungarpur and Banswara districts using the Geology data provided by the Geological Survey India, Bhukosh Portal.
- Preparation of the vector format data of Geomorphological Structure Layer for the Dungarpur and Banswara districts using the Geomorphology data provided by the Geological Survey India, Bhukosh Portal.
- Preparation of the vector format data of Lineament Form Layer for the Dungarpur and Banswara districts using the Lineament Form data provided by the Geological Survey India, Bhukosh Portal.
- Preparation of the vector format data of Lithology Layer for the Dungarpur and Banswara districts using the Lithology data provided by the Geological Survey India, Bhukosh Portal.
- Preparation of Dungarpur Tehsil GWD Sites point feature vector format shapefile representing the location of the GWD water quality report data sites by quarrying the "GWD Assets" GIS Layer on the Rajasthan Government Ground Water "Rajdharaa" GIS Portal and comparing the GWD Water Quality Asset Location Names written in GWD Ground Water Quality Report for Grid Analysis and identification of zones and villages in Dungarpur Tehsil with no water quality monitoring by the Ground Water Department (GWD) or water quality data is not available.
- Attribution of the above mentioned GWD Sites point feature vector shapefile with water quality attributes taken from GWD Water Quality Report, 2014 of Dungarpur.
- Preparation of vector format grid shapefile for the Vagad region consisting of individual grid cells of dimensions of 5 Km. length and 5 Km. breadth for Grid analysis to select

villages for approximately spatially even distribution of villages for Water Quality Sample Collection and Field survey under the Pilot Project Study of Dungarpur Tehsil.

- Preparation of Pilot Project Sampling Sites point feature vector format shapefile representing the location of the villages selected for the Water Quality Sample Collection and Field survey under Pilot Project Study of Dungarpur Tehsil.
- Attribution of the above prepared Pilot Project Sampling Location Site shapefile with attributes viz. Village Name, Village Census Location Code, Sample No., Sample Name, Water Testing Lab Results viz. Sample Registration No., pH, Taste, Odour, Turbidity, TDS, Hardness, Alkalinity, Chloride, Fluoride, Sulphate, Nitrate, Iron, Faecal Coliform, E. Coli level etc.
- Performing Kriging Interpolation Operation over the parameters and attribute values in the GWD Site Layer for assessment of correct interpolation method to be used for the pilot study as well as main project, also for preparation of a research paper on Comparative Study of Better Interpolation Method for Water Quality Monitoring and Prediction.
- Preparation of Survey Schedule or Questionnaire for the Pilot Project of Dungarpur Tehsil completed.
- Conducted Pilot Study Field survey and Water Sample Collection at 21 selected locations in Dungarpur Tehsil.
- Conducted Field survey and Water Sample Collection Survey in 200 villages in Banswara district.
- Organization of results of field survey data collected in field survey and results of the physico-chemical testing of water samples collected in the field by the laboratory is under progress.

5. BRIEF DESCRIPTION OF THE METHODOLOGY

The following points describe briefly about the methodology adopted for the project:

- Georeferencing of Census Maps 2011 for the digitization of the study area boundaries in GIS vector data format.
- Attribution of the study area vector data boundaries and village vector data boundaries with Census 2011 population and census location codes.

- Preparation of Geology, Lithology and Geomorphology vector data
- Preparation of 5km by 5km spatial grid polygon layer for the selection of the villages for conducting the field survey and field water sample collection drive in Banswara and Dungarpur districts.
- Preparation of field survey schedules for the field survey and preparation of label for the water sample bottles to be used in field.
- Recording and compilation of data collected in field survey and lab testing results of 14 water quality parameters from each surveyed location in the study area.
- Preparation of GIS point feature vector data of surveyed location in the field survey containing data from field survey and lab test results of the water samples.
- Geo-Statistical and Interpolation Analysis on the above prepared GIS point feature vector data layer of surveyed location in the field survey containing data from field survey and lab test results of the water samples.
- Compilation of the results of the analysis done.
- Preparation of Web-GIS Application with all the required functionalities and reporting tools integrated.
- Preparation of Maps Layouts and Final Project Report.

6. OUTCOME OF THE WORK DONE SO FAR

The following points illustrate the outcomes of the work done so far in the project:

- Geo-referencing and digitization of all the study area GIS vector data boundaries of Vagad region - Dungarpur and Banswara districts done based upon the Census 2011.
- Attribution of the digitized GIS vector data boundaries of Vagad region - Dungarpur and Banswara districts done up to the village level based upon the Census 2011.
- Preparation of the GIS vector data boundaries of the Geology, Lithology, Waterbodies and Geomorphology of the entire study area was completed.
- Preparation of the field survey Schedules and Water Samples Labels was completed.
- Conduction of the pilot survey of 21 villages of tehsil Dungarpur was completed.
- Approximately 400 water sample collected from Banswara & Dungarpur districts.
- Field survey of approximately 800 families have been completed.

7. PUBLICATIONS

- Research Paper Title: "Spatial Variability of Groundwater Quality Parameters With Geo-Statistical Interpolation Method Using Ordinary Kriging and GIS (Case Study: Dungarpur Tehsil, Rajasthan, India)" based on the State Ground Water Department Rajasthan Pre-Monsoon 2014 data was published in Journal of Geomatics, Vol. 16, No. 2, Oct. 2022 by Indian Society of Geomatics.

8. CONFERENCE, WORKSHOP AND TRAINING ORGANISED

- A three day Web-GIS Training was conducted in the Department of Geography, Mohanlal Sukhadia University, Udaipur, Rajasthan from 7th to 9th January, 2021 under RUSA 2.0 Project by Prof. Seema Jalan, Co-PI & Head of Department. Mr. Mohammed Ali S., was the resource person from Rajasthan State Remote Sensing Centre, Jodhpur (Rajasthan). Details of the training are mentioned with photographs in a separate annexure (Annexure I) with this report.

9. PROJECT WORK STATUS, WORK REMAINING, FUTURE WORK PLAN AND TIMELINE

Months (after issue of FS on 20.8.2020)	**Targets**	**Status**	**Remarks**
November, 2020	• Procurement of equipment, software, furniture, books, data etc. • Appointment of Staff	• Completed as per priority. Will be procured as required with the progress of the project. • Completed in November, 2020.	

March, 2021	• Preparation of questionnaire • Data collection ,compilation and preparation • Field data collection and primary survey	• Completed in March, 2021 • Completed • Pilot survey of the same has been completed in March,2021	
July, 2021	• Generation of Geospatial database • Web application development	Completed	
Mar. 2022	• Layer finalization, attribution and analysis as per the next phase of the project. • Database creation, validation for next phase from both primary and secondary data of Dungarpur and Banswara district. • Field Survey and Water Sample Collection of Banswara District.	Field Survey and Water Sample Collection of Banswara & Dungarpur District Completed. Database schema creation completed. Compilation of data collected in survey and water sample lab testing results.	
Dec. 2023	• Preparation of GIS Vector Data Layers of Compilation of Survey and Water Quality Lab Test Results of Both Dungarpur and Banswara districts.	Remaining	Time Required 2 Month
Dec. 2023	• Geo-Statistical Analysis and Project Report Preparation	Remaining	Time Required 2 Months

16 F

Activity Title:

Procurement of equipment, software, furniture, books, data etc., Appointment of Staff in the collobrative research project

मोहनलाल सुखाड़िया विश्वविद्यालय, उदयपुर
MOHANLAL SUKHADIA UNIVERSITY: UDAIPUR
NAAC ACCREDITED 'A' GRADE STATE UNIVERSITY

No.F./RUSA/Gen/MLSU/2020/ 6366

Dated : 25-06-2020
6/07

ORDER

With reference to request submitted by Nodal Officer RUSA, MLSU, Udaipur in reference to letter No. F30(16)SPD/RUSA/2016/178 dated 31 March, 2020 of SPD, I am directed to convey administrative sanction for Research and Innovation project under component 10 or RUSA 2.0 of MHRD as per details given below:

S.No.	Department	Principal Investigator	Co-Investigator	Project Title	TOTAL Amount Sanctioned	Ist Instalment
1	Geography	Dr. D.S. Chouhan	Prof. Seema Jalan, Dr. Shailesh Chaure	Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS	3004000	1502000

Yours faithfully,

REGISTRAR

Copy to :
1. The Dean/Director, _____
2. The Comptroller, MLSU, Udaipur
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DY. REGISTRAR

Project Progress Report

January, 2023

Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS

Date of Issue of Order by the University - 20-08-2020

Date of Issue of Financial Sanction by the University - 21-08-2020

Professor Seema Jalan
Head and Co-Principal Investigator

Dr. D. S. Chouhan
Principal Investigator
And Assistant Professor

Dr. Shailesh Chaure
Co-Principal Investigator
Government Holkar Science College, Indore (M.P)

Department of Geography
Faculty of Earth Science
Mohanlal Sukhadia University
Udaipur, Rajasthan, India, 313001

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Project Staff

S. No.	Status	Name	Designation
1	PI	Dr. D. S. Chouhan	Assistant Professor Department of Geography MLS University, Udaipur, Raj.
2	Co-PI	Prof. Seema Jalan	Professor Department of Geography MLS University, Udaipur, Raj.
3	Co- PI	Dr. Shailesh Chaure	Associate Professor Govt. Holkar Science College Indore, Madhya Pradesh

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1. **TITLE:** Impact of Water Quality on Health in Vagad Region of Rajasthan: An Application in Web-GIS

2. INTRODUCTION

Study Area

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water from sources present in the vicinity of citizens living in an area and will sets out a probable strategy adopted by Government of India and Rajasthan to manage water quality with a view to protecting and promoting human health in Vagad Region of Rajasthan.

3. APPROVED OBJECTIVES OF THE PROJECT

Detailed objectives of the project are as under:

(i) To assess the ground and surface water quality of Vagad Region in context of geographical and demographic characteristics of the region.

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- Digitization of the Vector Boundaries of all the villages of all 9 tehsils of the districts of Dungarpur and Banswara using the above mentioned geo-referenced Census 2011 Atlas Maps into ESRI Shapefile format.
- Attribution of the above digitized approximately 2500 villages' vector polygon features of the districts of Dungarpur and Banswara with attributes viz. Village Name, Village Census Location Code, District Name, District Census Location Code, Tehsil Name, Town Name, Town Census Location Code, Village Population Census 2011 etc.
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- Attribution of the above prepared Pilot Project Sampling Location Site shapefile with attributes viz. Village Name, Village Census Location Code, Sample No., Sample Name, Water Testing Lab Results viz. Sample Registration No., pH, Taste, Odour, Turbidity, TDS, Hardness, Alkalinity, Chloride, Fluoride, Sulphate, Nitrate, Iron, Faecal Coliform, E. Coli level etc.
- Performing Kriging Interpolation Operation over the parameters and attribute values in the GWD Site Layer for assessment of correct interpolation method to be used for the pilot study as well as main project, also for preparation of a research paper on Comparative Study of Better Interpolation Method for Water Quality Monitoring and Prediction.
- Preparation of Survey Schedule or Questionnaire for the Pilot Project of Dungarpur Tehsil completed.
- Conducted Pilot Study Field survey and Water Sample Collection at 21 selected locations in Dungarpur Tehsil.
- Conducted Field survey and Water Sample Collection Survey in 200 villages in Banswara district.
- Organization of results of field survey data collected in field survey and results of the physico-chemical testing of water samples collected in the field by the laboratory is under progress.

5. BRIEF DESCRIPTION OF THE METHODOLOGY

The following points describe briefly about the methodology adopted for the project:

- Georeferencing of Census Maps 2011 for the digitization of the study area boundaries in GIS vector data format.
- Attribution of the study area vector data boundaries and village vector data boundaries with Census 2011 population and census location codes.

- Preparation of Geology, Lithology and Geomorphology vector data
- Preparation of 5km by 5km spatial grid polygon layer for the selection of the villages for conducting the field survey and field water sample collection drive in Banswara and Dungarpur districts.
- Preparation of field survey schedules for the field survey and preparation of label for the water sample bottles to be used in field.
- Recording and compilation of data collected in field survey and lab testing results of 14 water quality parameters from each surveyed location in the study area.
- Preparation of GIS point feature vector data of surveyed location in the field survey containing data from field survey and lab test results of the water samples.
- Geo-Statistical and Interpolation Analysis on the above prepared GIS point feature vector data layer of surveyed location in the field survey containing data from field survey and lab test results of the water samples.
- Compilation of the results of the analysis done.
- Preparation of Web-GIS Application with all the required functionalities and reporting tools integrated.
- Preparation of Maps Layouts and Final Project Report.

6. OUTCOME OF THE WORK DONE SO FAR

The following points illustrate the outcomes of the work done so far in the project:

- Geo-referencing and digitization of all the study area GIS vector data boundaries of Vagad region - Dungarpur and Banswara districts done based upon the Census 2011.
- Attribution of the digitized GIS vector data boundaries of Vagad region - Dungarpur and Banswara districts done up to the village level based upon the Census 2011.
- Preparation of the GIS vector data boundaries of the Geology, Lithology, Waterbodies and Geomorphology of the entire study area was completed.
- Preparation of the field survey Schedules and Water Samples Labels was completed.
- Conduction of the pilot survey of 21 villages of tehsil Dungarpur was completed.
- Approximately 400 water sample collected from Banswara & Dungarpur districts.
- Field survey of approximately 800 families have been completed.

7. PUBLICATIONS

- Research Paper Title: "Spatial Variability of Groundwater Quality Parameters With Geo-Statistical Interpolation Method Using Ordinary Kriging and GIS (Case Study: Dungarpur Tehsil, Rajasthan, India)" based on the State Ground Water Department Rajasthan Pre-Monsoon 2014 data was published in Journal of Geomatics, Vol. 16, No. 2, Oct. 2022 by Indian Society of Geomatics.

8. CONFERENCE, WORKSHOP AND TRAINING ORGANISED

- A three day Web-GIS Training was conducted in the Department of Geography, Mohanlal Sukhadia University, Udaipur, Rajasthan from 7th to 9th January, 2021 under RUSA 2.0 Project by Prof. Seema Jalan, Co-PI & Head of Department. Mr. Mohammed Ali S., was the resource person from Rajasthan State Remote Sensing Centre, Jodhpur (Rajasthan). Details of the training are mentioned with photographs in a separate annexure (Annexure I) with this report.

9. PROJECT WORK STATUS, WORK REMAINING, FUTURE WORK PLAN AND TIMELINE

Months (after issue of FS on 20.8.2020)	**Targets**	**Status**	**Remarks**
November, 2020	• Procurement of equipment, software, furniture, books, data etc. • Appointment of Staff	• Completed as per priority. Will be procured as required with the progress of the project. • Completed in November, 2020.	

March, 2021	• Preparation of questionnaire • Data collection ,compilation and preparation • Field data collection and primary survey	• Completed in March, 2021 • Completed • Pilot survey of the same has been completed in March,2021	
July, 2021	• Generation of Geospatial database • Web application development	Completed	
Mar. 2022	• Layer finalization, attribution and analysis as per the next phase of the project. • Database creation, validation for next phase from both primary and secondary data of Dungarpur and Banswara district. • Field Survey and Water Sample Collection of Banswara District.	Field Survey and Water Sample Collection of Banswara & Dungarpur District Completed. Database schema creation completed. Compilation of data collected in survey and water sample lab testing results.	
Dec. 2023	• Preparation of GIS Vector Data Layers of Compilation of Survey and Water Quality Lab Test Results of Both Dungarpur and Banswara districts.	Remaining	Time Required 2 Month
Dec. 2023	• Geo-Statistical Analysis and Project Report Preparation	Remaining	Time Required 2 Months