



<b>Department : Chemistry</b>		
<b>Academic Year : 2024-25</b>		
<b>Sr. No.</b>	<b>Programme Code</b>	<b>Name of the Programme</b>
01.	1764	M. Sc. Chemistry

## Contents

<b>S. N.</b>	<b>Name of Student</b>	<b>Page No.</b>
1.	Aakash	1-3
2.	Khogeshwari Sahu	4-8
3.	Ayush shukla	9-11
4.	Arti ravindra	12-14
5.	Arpita gupta	15-17
6.	Varsa rani gupta	18-20
7.	Bindiya rani patel	21-24
8.	Subhashchand	25-27
9.	Dillip bhoi	28-30
10.	Kamalesh pradhan	31-33
11.	Parmanand Yadav	34-36
12.	Divya rani kurrey	37-39
13.	Ganpat janghel	40-42
14.	Sagarika Priyadarshini sahu	43-49
15.	Antara chowdhury	50-53
16.	Savita devi	54-56
17.	Swetlana Prerna ram	57-59
18.	Tanuja patel	60-62
19.	Isha baghmar	63-65

**गुरु घासीदास विश्वविद्यालय**  
(केन्द्रीय विश्वविद्यालय अधिनियम 2009 क्र. 25 के अंतर्गत स्थापित केन्द्रीय विश्वविद्यालय)  
**कोनी, बिलासपुर - 495009 (छ.ग.)**



**Guru Ghasidas Vishwavidyalaya**  
(A Central University Established by the Central Universities Act 2009 No. 25 of 2009)  
**Koni, Bilaspur - 495009 (C.G.)**

20.	Mayank goutam	66-68
21.	Kalyani bharti	69-71
22.	Mudavath hanumanthu	72-74
23.	Rakshi Pradhan	75-81
24.	Rekha tirkey	82-84
25.	Satya tamboli	85-88
26.	Shruti rai	89-92
27.	Shyama rani kar	93-97
28.	Tushar Ranjan sarangi	98-102

**सध्यक्ष/Head**  
**रसायन शास्त्र विभाग**  
Deptt. of Chemistry  
गुरु घासीदास विश्वविद्यालय,  
Guru Ghasidas Vishwavidyalaya,  
बिलासपुर 495009 (छ.ग.)  
Bilaspur 495009 (C.G.)

Signature and Seal of the Head

# **Synthesis of copper Oxide Nanoparticles and its Applications**

**A Project Report Submitted to**

**Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.**



*In partial fulfillment of the requirement for the degree of*

**Master of Science  
in  
Chemistry**

**Submitted by**

**Aakash**

**M.Sc. 4<sup>th</sup> Sem**

**Enrollment No. GGV/23/07201**

**Roll No. 23104101**

**Supervisor**

**Dr. Bhaskar Sharma**

**Assistant Professor**

**Department of Chemistry**

**Guru Ghasidas Vishwavidyalaya**

**May 2025**

*Nishy*  
*16-05-25*



## FORWARDING CERTIFICATE

This is to certify that *Mr. Aakash* has carried out the project in the Department of Certificate Chemistry, Guru Ghasidas Vishwavidyalaya (A Central university), Bilaspur (C.G.) on the topic "*Synthesis of Copper Nanoparticles and its Applications*".

This project is submitted to partially fulfil the requirements for the degree of M.Sc. in Chemistry and forwarded to the examiner for evaluation.

I wish him every success in her life.

Signature of the HOD

Prof. Khemchand Dewangan, professor

Department of Chemistry, G.G.V.

Bilaspur(C.G.) अध्यक्ष / Head  
रसायन शास्त्र विभाग  
Dept. of Chemistry  
गुरु गणेशदास विश्वविद्यालय,  
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बिलासपुर 495009 (छ.ग.)  
Bilaspur 495009 (C.G.)

## TABLE OF CONTENTS

1. Abstract	1
2. Introduction	1-6
3. Materials and Methods	6-9
3.1 Materials	
3.2 Preparation of Aloe vera Extract	
3.3 Synthesis of Copper Oxide Nanoparticles	
6. Applications	9-10
4. Results and discussion	10-15
9. Conclusion	15-16
10. Reference	16-18

# Sequestration of organic dyes using mixed MOF and pomegranate leaf ash

*A Project Report Submitted to*

**Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.**



*In partial fulfillment of the requirement for the degree of*

**Master of Science  
in  
Chemistry**

**Submitted by**

**Khogeshwari Sahu**

**Supervisor**

**Prof. Charu Arora**

**M.Sc.4<sup>th</sup> Sem (Physical Chemistry)**

**Department of Chemistry**

**Enrollment No.- GGV/23/07219**

**Guru Ghasidas Vishwavidyalaya**

**Roll No.- 23104133**

**May 2025**

Prof. Charu Arora



Department of Chemistry  
Guru Ghasidas Vishwavidyalaya  
Bilaspur-495009, C.G.

## CERTIFICATE

This is to certify that *M s. Khogeshwari Sahu* has completed the project dissertation entitled "**Sequestration of organic dyes using mixed MOF and pomegranate leaf ash**" under my supervision for the partial fulfillment of required degree of "**Master of Science in Chemistry**". She has worked diligently, methodically and also collected the literature very sincerely. During this project work she has learnt about various aspects of chemical science to the entitled topic.

To the best of my knowledge and belief of the project

- 1) is original and has not been submitted anywhere for award of any degree.
- 2) Fulfills the requirement of the Ordinance relating to the M.Sc. degree of the university.

I wish her every success in the future life.

Date: 15.5.25

Place: Bilaspur, C.G.

Signature of the Supervisor

*Charu Arora*

# Guru Ghasidas Vishwavidyalaya

(A Central University established under Central Universities Act 2009)

Prof. K. Dewangan  
Head of the Department



Department of Chemistry  
Guru Ghasidas Vishwavidyalaya  
Bilaspur-495009, C.G.

## FORWARDING CERTIFICATE

This is to certify that *M s. Khogeshwari Sahu* has completed the project work entitled as “*Sequestration of organic dyes using mixed MOF and pomegranate leaf ash*” under the supervision of *Prof. Charu Arora* for the partial fulfillment of required degree of “*Master of Science in Chemistry*”.

To the best of my knowledge and belief of the project

- 1) is original and has not been submitted anywhere for award of any degree.
- 2) Fulfills the requirement of the Ordinance relating to the M.Sc. degree of the university.

I recommend the project report be forwarded to the respective examiners for evaluation.

Date:

  
15.05.2025

Place: Bilaspur, C.G.

Signature of the HoD

अध्यक्ष/Head  
रसायन शास्त्र विभाग  
Dept. of Chemistry  
गुरु घासीदास विश्वविद्यालय,  
Guru Ghasidas Vishwavidyalaya,  
बिलासपुर 495009 (छ.ग.)  
Bilaspur 495009 (C.G.)



**“ Removal of Methylene Blue (MB) dye from wastewater by the using of Fe-Cr-BDC metal organic framework (MOF) ”**

**TABLE OF CONTENTS**

<b>Entry</b>	<b>Content</b>	<b>Page No.</b>
<b>1.</b>	Introduction	<b>07</b>
<b>2.</b>	Literature Review	<b>16</b>
<b>3.</b>	Aim and objective	<b>17</b>
<b>4.</b>	Material and methods	<b>18</b>
<b>5.</b>	Result and discussion	<b>20</b>
<b>6.</b>	Conclusion	<b>2</b>

**“Effective removal of fuchsin basic (FB) dye and malachite green (MG) dye from pomegranate leaf (*Punica granatum*) ash”**

**TABLE OF CONTENTS**

<b>Entry</b>	<b>Content</b>	<b>Page No.</b>
<b>1.</b>	Introduction	<b>29</b>
<b>2.</b>	Aim and objective	<b>35</b>
<b>3.</b>	Material and methods	<b>36</b>
<b>4.</b>	Result and discussion	<b>38</b>
<b>5.</b>	Conclusion	<b>46</b>
<b>6.</b>	References	<b>47</b>

# **Ancient Methods on Corrosion control: A scientific review on metallurgical marvel**

*A Project Report Submitted to*

**Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.**



*In partial fulfillment of the requirement for the degree of*

**Master of Science  
in  
Chemistry**

**Submitted by**

**Ayush Shukla**

**M.Sc. 4<sup>th</sup> Sem**

**Enrollment No. GGV/20/07017**

**Roll No.2310411**

**Supervisor**

**Dr. Bhaskar Sharma**

**Assistant Professor**

**Department of Chemistry**

**Guru Ghasidas Vishwavidyalaya**

*Nishy*  
*15-05-2025*

**May 2025**

# Guru Ghasidas Vishwavidyalaya

(A Central University established under Central Universities Act 2009)

Prof. K. Dewangan  
Head of the Department



Department of Chemistry  
Guru Ghasidas Vishwavidyalaya  
Bilaspur - 495009, C.G.

## FORWARDING CERTIFICATE

This is to certify that *Mr. Ayush Shukla* has completed the project work entitled as "*Ancient methods of corrosion control: A scientific review on metallurgical marvels*" under the supervision of *Dr. Bhaskar Sharma*, for the partial fulfillment of required degree of "*Master of Science in Chemistry*".

To the best of my knowledge and belief of the project

- 1) is original and has not been submitted anywhere for award of any degree.
- 2) Fulfills the requirement of the Ordinance relating to the M.Sc. degree of the university.

I recommend the project report be forwarded to the respective examiners for evaluation.

Date: 15/05/25

Place: Bilaspur, C.G.

Signature of the HoD

अध्यक्ष / Head  
रासायन शास्त्र विभाग  
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बिलासपुर 495009 (C.G.)

## TABLE OF CONTENTS

Entry	Content	Page No.
1.	Abstract	01
2.	Introduction	02
3.	The Delhi Iron Pillar: Metallurgical and Environmental Insights	03-08
4.	The Dhar Iron Pillar: A Forgotten Giant	09-13
5.	Egyptian Meteoritic Iron: An Early Use of Exotic Materials	14-17
6.	Ancient Chinese Bronzes: Self-Protecting Artifacts	18-19
7.	Comparative analysis of corrosion mechanism	20
8.	Analytical Techniques Used	20
9.	Conclusion And Future directions	21
10.	References	22-23



**Department of Chemistry**  
**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G)**  
**(A Central University)**

**CERTIFICATE**

This is Certified that, **ARTI RAVINDRA** has carried out this literature survey-based project under my supervision in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G) on the topic: "**Exploring the Multifaceted World of Nanocarbon: Structure, Properties, and Emerging Applications**". She has worked diligently; methodically and collected the literature very sincerely and carefully. During this project works has learnt about various synthesis and application related to entitled topic.

I wish every success in her carrier and life.

SUBMITTED BY

**ARTI RAVINDRA**

MSc. Chemistry (IV Sem.)

Roll no: 23104110

SUPERVISED BY

**PROF. MANORAMA**

Department of Chemistry

(GGV Bilaspur)




Department of Chemistry  
Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G)  
(A Central University)

**FORWARDING CERTIFICATE**

This is to certify that, **ARTI RAVINDRA** has carried out this literature survey Based on project in the department of Chemistry, Guru Ghasidas Vishwavidyalaya (A central Universities), Bilaspur (C.G) on the topic: “**Exploring the Multifaceted World of Nanocarbon: Structure, Properties, and Emerging Applications**”. This project submitted for the partial fulfillment of required degree of MSc. n Chemistry and Forwarded to examiner for evaluation.

I Wish every success in her life.

Date: 15.05.25

  
15.05.2025  
**Prof. K.D. Dewangan**  
(Head, department Chemistry)  
Guru Ghasidas Vishwavidyalaya  
Bilaspur (C.G)



Department of chemistry

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**

(A Central University Established by Central Universities Act  
2009 No. 25 of 2009).

**FORWARDING CERTIFICATE**

This is to certify that, ARPITA GUPTA has carried out this literature survey based on project in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya (A Central University), Bilaspur(C.G.) on the topic "**Modified Electrodes As Electrochemical Sensors** " This project submitted for the partial fulfilment of required degree of M.Sc. in Chemistry and forwarded to examiner for evaluation.

I wish every success in her life.

  
15-05-2025

**PROF. KHEMCHAND DEWANGAN.**

(Head, Department of Chemistry)

GURU GHASIDAS VISHWAVIDYALAYA

BILASPUR, CG.





Department of Chemistry

Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

(A Central University Established by Central  
Universities Act 2009 No. 25 of 2009)

### CERTIFICATE

This is to certify that, **ARPITA GUPTA** has carried out this literature survey-based project under my supervision in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) on the topic "MODIFIED ELECTRODES AS ELECTROCHEMICAL SENSORS" she has worked diligently; methodically and collected the literature very sincerely and carefully. During this project works she has learnt about various organic synthesis related to entitled topic.

SUBMITTED BY

**ARPITA GUPTA**

M.Sc. Chemistry (IV Sem.)

Roll No. 23104109

  
SUPERVISED BY

**PROF. MANORAMA**

(Professor)

Department of chemistry




गुरु घासीदास विश्वविद्यालय, बिलासपुर  
Guru Ghasidas Vishwavidyalaya, Bilaspur

A Central University established by the Central Universities Act 2009 No. 25 of 2009



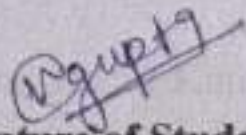
## FORWARDING CERTIFICATE

This is to certify that the project work entitled "**Bio-inspired Novel Synthesis of Reduced Graphene Oxide by Using *Cicer arietinum* (chana bhaji) Leaf Extract and its Characterization**" submitted by **Varsha Rani Gupta** (M.sc. IV semester) Department of Chemistry, Guru Ghasidas Vishwavidyalaya Bilaspur (C.G.) under the supervision of **Prof. Manorama** for the partial fulfillment of requirements for the degree of M.Sc. in Chemistry and forwarded to the examiner for evaluation. I wish her every success in her life.

  
(Signature of H.O.D.)

Head

Department Of Chemistry

  
(Signature of Student)

Varsha Rani Gupta

# Green Synthesis of Iron Oxide ( $\text{Fe}_3\text{O}_4$ ) Nanoparticles

A Project submitted to

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**



*In partial fulfillment*

*For the award of the degree*

*Of*

**Master of Science  
in**

**Chemistry**

**by**

**Bindiya Rani Patel**

Under the Guidance of

**Dr. Bhaskar Sharma**

**Research center**

**Department of Chemistry,**

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**

**May 2025**



## FORWARDING CERTIFICATE

This is to certify that *Miss. Bindiya Rani Patel* has carried out the project in the Department of Certificate Chemistry, Guru Ghasidas Vishwavidyalaya (A Central university), Bilaspur (C.G.) on the topic "*Green Synthesis of Iron Oxide (Fe<sub>3</sub>O<sub>4</sub>) Nanoparticles*".

This project is submitted for the partial fulfilment of requirements for the degree of **M.Sc. in Chemistry** and forwarded to examiner for evolution.

I wish her every success in her life.

**Signature of the HOD**

**Prof. Khemchand**

**Dewangan,**

**HOD**

Department of Chemistry, G.G.V.  
Bilaspur (C.G.)

अध्यक्ष / Head  
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## TABLE OF CONTENTS

S.NO.	TOPIC	PAGE NO.
1.	<i>INTRODUCTION</i>	1
2.	<i>IRON AND IRON OXIDE NANOPARTICLES</i>	2
3.	<i>SYNTHESIS OF IRON OXIDE NANOPARTICLES</i>	3
4.	<i>METHODS FOR THE PREPARATION OF IRON OXIDE NANOPARTICLES</i>	4-11
5.	<i>CHEMICAL CHARACTERISTICS OF IRON OXIDE NANOPARTICLES</i>	12-13
6.	<i>GREEN APPROACH FOR THE SYNTHESIS OF NANOPARTICLES</i>	14-17
7.	<i>EXPERIMENTAL SECTION</i>	17-22
8.	<i>RESULT AND DISCUSSION</i>	23-24
9.	<i>APPLICATION OF IRON OXIDE NANOPARTICLES</i>	25-32
10.	<i>CONCLUSION</i>	33-34
11.	<i>REFERENCE</i>	35-43

**DESIGN AND SYNTHESIS OF A 2,4- DINITROPHENYLHYDRAZONE  
BASED SELECTIVE AND SENSITIVE FLUOROSCENT COLORIMETRIC  
CHEMOSENSOR FOR UNAMBIGUOUS DETECTION OF S-2 IONS**

*A Project submitted to*

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**



*In partial fulfillment*

*For the award of the degree*

*Of*

*Master of Science in*

**Chemistry**

**by**

**Subhashchand**

**Roll No. - 23104157**

Under the Guidance of

**Dr. Gautam Kumar Patra**

*Research Center Department of  
Chemistry.*

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G)**

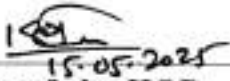
**May 2025**



## FORWARDING CERTIFICATE

This is to certify that *Mr. Subhashchand* has carried out the project in the Department of Certificate Chemistry, Guru Ghasidas Vishwavidyalaya (A Central university), Bilaspur (C.G.) on the topic "Design and synthesis of a 2,4- dinitrophenylhydrazone based selective and sensitive fluorescent chemosensor for unambiguous detection of  $S^{2-}$  ions" This project is submitted for the partial fulfilment of requirements for the degree of M.Sc. in Chemistry and forwarded to examiner for evolution.

I wish her every success in her life.

  
15-05-2025

Signature of the HOD

Prof. Khemchand

Dewangan, Professor

Department of Chemistry, G.G.V.

Bilaspur (C.G.)

अध्यक्ष/Head  
रसायन शास्त्र विभाग  
Dept. of Chemistry  
गुरु घासीदास विश्वविद्यालय,  
Guru Ghasidas Vishwavidyalaya  
बिलासपुर 495009 (छ.ग.)  
बिलासपुर 495009 (C.G.)

  
15-05-2025

# CONTENT

	PG.NO.
1 INTRODUCTION	
2 EXPERIMENT	1-2
2.2 MATERIAL AND MEASUREMENT	2-8
2.3 SYNTHESIS OF LIGAND	
2.4 PREPARATION OF STOCK FOR PHOTOPHYSICAL MEASUREMENT	
2.5 COLORIMETRIC AND UV-VIS SPECTRAL STUDIES	
2.6 FLUOROSCENCE STUDIES	
2.7 DETECTION LIMIT OF L	
2.7 JOBS PLOT MEASUREMENT	
2.8 COMPETITION WITH	
2.9COLORIMETRIC TEST KIT	
3 RESULT AND DISCUSSION	8-11
4 CONCLUSION	11
5 REFERENCE	12-13



A  
Project Report  
ON  
**Design of a TREN-based chemosensor for  
selective colorimetric detection of Ni<sup>2+</sup> ion and  
turn-on fluorometric detection of Zn<sup>2+</sup> ion.**



**SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT  
FOR THE DEGREE OF**

**Master of Science  
In Chemistry**

**Submitted by:  
Dillip Bhoi  
Roll No-23104120  
Enrollment No-GGV/23/07209  
Supervisor  
Dr. G.K. PATRA**

**Department of Chemistry  
GURU GHASIDAS VISHWAVIDYALAYA  
(A Central University)  
2023- 2025**



रसायन विज्ञान  
Department of Chemistry  
गुरु घासीदास विश्वविद्यालय, बिलासपुर-495009, छत्तीसगढ़  
Guru Ghasidas Vishwavidyalaya, Bilaspur-495009, Chhattisgarh  
(A Central University established by the Central University Act 2009 No. 25 of 2009)  
<https://www.new.ggu.ac.in/>



Prof. Khemchand  
Dewangan  
Professor  
Head of Department

Department of Chemistry  
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Contact: 9691012090, 9935269379

Ref. No.

### FORWARDING CERTIFICATE

This is to certify that **Dillip Bhoi** has completed the project work entitled "*Design of a TREN based chemosensor for selective colorimetric detection of Ni<sup>2+</sup> ion and turn on fluorometric detection of Zn<sup>2+</sup> ion*" under the supervision of **Prof. Goutam Kumar Patra**, for the partial fulfillment of the required degree of "**Master of Science in Chemistry**".

I wish him every success in his future life.

Date: 15/05/2025

Place: Bilaspur

Signature of the HOD  
Prof. Khemchand Dewangan  
GURUGHASIDAS VISHWAVIDYALAYA  
(A CENTRAL UNIVERSITY)

BILASPUR, CG  
अध्यक्ष/Head  
रसायन शास्त्र विभाग  
Deptt. of Chemistry  
गुरु घासीदास विश्वविद्यालय,  
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बिलासपुर 495009 (छ.ग.)  
Bilaspur 495009 (C.G.)

## Table of Content

	Page No
1. ABSTRACT	2
2. INTRODUCTION	2
2.1 Schiff Base	2-5
2.2 Chemosensor	5-9
3. LITERATURE REVIEW	9-13
4. EXPERIMENT	13
4.1 Material And General Information	13
4.2 Synthesis and Characterization Of Ligand	14
4.3 UV Visible Titration	15
4.4 Jobs Plot	15
5. RESULT AND DISCUSSION	16
5.1 FTIR Analysis Of Ligand	16
5.2 <sup>1</sup> H NMR Spectroscopic Analysis	17
5.3 <sup>13</sup> C NMR Spectroscopic Analysis	18
5.4 UV Visible Study	19
5.5 pH Effect	22
5.6 Reversibility Test	23
5.7 Fluorescence Studies Of L towards Different ions	23
6. CONCLUSION	26
7. REFERENCE	27

**A  
PROJECT REPORT  
ON**

**DESIGN AND SYNTHESIS OF A 5-HYDROXY 2-METHOXYBENZALDEHYDE-BASED SCHIFF BASE AS A FLUORESCENT TURN-OFF CHEMOSENSOR FOR SELECTIVE DETECTION OF  $\text{Cu}^{2+}$  IONS.**

**SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE DEGREE OF M.Sc  
CHEMISTRY**



**Department of Chemistry**

**GURU GHASIDAS VISHWAVIDYALAYA  
(A Central University A<sup>++</sup> Grade Accredited By NAAC)**

**2023-2025**

**Supervisor:  
Prof. G. K. PATRA  
GURU GHASIDAS VISHWAVIDYALAYA  
(A CENTRAL UNIVERSITY A<sup>++</sup> GRADE  
ACCREDITED BY NAAC) BILASPUR, C.G.**

**Submitted by:  
KMALESH PRADHAN  
M. Sc. Inorganic Chemistry,  
IV<sup>th</sup> Semester  
Roll No. 23104131**

Prof. KHEMCHAND DEWANGAN (HOD)  
Department of Chemistry  
Guru Ghasidas Vishwavidyalaya, Bilaspur  
[A Central University A\*\* Grade Accredited By NAAC  
BILASPUR, C.G.]

---

FORWARDING CERTIFICATE

This is to certify that KMALESH PRADHAN (M.Sc. Inorganic Chemistry) has been completed a project on "DESIGN AND SYNTHESIS OF A 5-HYDROXY-2-METHOXYBENZALDEHYDE-BASED SCHIFF BASE AS A FLUORESCENT TURN-OFF CHEMOSENSOR FOR SELECTIVE DETECTION OF Cu<sup>2+</sup> IONS" under the supervision of Prof. G. K. PATRA. This project work is submitted for the partial fulfillment of the required degree in chemistry and forwarded to the Examiner for evaluation.

I wish his every success in the future life.

  
K.D. 2025

Signature  
Prof. KHEMCHAND DEWANGAN  
HEAD OF DEPARTMENT OF CHEMISTRY  
GURU GHASIDAS VISHWAVIDYAL  
(A Central University A\*\* Grade Accredited By NAAC)  
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iv

अध्यक्ष/Head  
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# CONTENTS

	PAGE NO.
1. ABSTRACT	1
2. INTRODUCTION	1-10
2.1. SCHIFF BASE	1
2.2. CHEMO-SENSOR	3
3. LITERATURE REVIEW	9-12
4. AIMS AND OBJECTIVES	13
5. EXPERIMENTAL PART	13-17
5.1. MATERIALS AND GENERAL INFORMATION	13
5.2. SYNTHESIS AND CHARACTERISATION	13-15
5.2.1. Synthesis and characterization of 3,3'-((1Z,1'Z)- (((1E,2E)-1,2-diphenylethane-1,2-diylidene)bis(hydrazine-2,1- diylidene))bis(methaneylylidene))bis(4-methoxyphenol)	14
5.3. ION SENSING	17
5.3.1. Photo physical measurements	17
5.4. STOICHIOMETRY DETERMINATION	17
5.4.1. Job's plot measurements	17
6. RESULTS AND DISCUSSION	17-20
6.1. Cation sensing	17
6.1.1. UV-Vis spectroscopic detection	17
6.1.2. Fluorometric studies of the probe L	22
7. CONCLUSION	22
8. REFERENCES	22-24

Multifunctional Schiff base capped Silver nanoparticle for selective and sensitive colorimetric detection for  $Zr^{4+}$  and fluorometric detection of  $Cd^{2+}$  ion

*A Dissertation Submitted*

*To*

*Department of Chemistry  
School of Study of Physical Sciences  
( Guru Ghasidas Vishwavidyalaya )*



*In partial fulfillment of the requirement for the Degree of Master  
Science in Chemistry*

**By**

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**Roll No – 23104142**

**Enrollment No – GGV/23/07225**

**Under the Supervision of**

**Prof G.K. Patra**

**Professor**

**( Department of Chemistry )**

**( April- May 2025 )**



गुरु घासीदास विश्वविद्यालय, बिलासपुर

**Guru Ghasidas Vishwavidyalaya, Bilaspur**

(A Central University established by the Central Universities Act 2009 No. 25 of 2009 )

**FORWARDING CERTIFICATE**

This is to certify that **Parmanand Yadav** (M.Sc. Chemistry 4<sup>th</sup> Sem ) has been completed a project on **“Multifunctional Schiff base capped silver nanoparticle for selective and sensitive colorimetric detection for Zr<sup>4+</sup> and fluorometric detection of Cd<sup>2+</sup> ion ”** under the supervision of Prof. G.K. Patra This project work is submitted for the partial fulfillment of degree of Master of Science in **Chemistry** and forwarded to Examiner for evaluation.

I wish his every success in the future.

Date 15/05/25

  
( Signature )

**Prof. Khemchand Dewangan**  
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## Tables of Content

Sl. No	Topic	Page No
1.	Introduction	1-2
2.	Experimental section	
	2.1 Materials	2-7
	2.2 Instruments	
	2.3 Synthesis of Schiff base, 2,3-diphenyl-5,6,7,8-tetrahydroquinoxaline (DTH)	
	2.4 Synthesis of Schiff base capped Ag NPs (DTH@AgNPs) (L)	
	2.5 UV-Visible sensing procedure	
	2.6 Fluorescence sensing procedure	
3.	Results and Discussion	7-16
	3.1 Synthesis and characterization of the probe DTH and AgNPs of DTH (DTH@AgNPs) (L)	
	3.2 DFT study	
	3.3 FTIR analysis	
	3.4 P-XRD spectrum of L	
	3.5 Morphology analysis of DTH@AgNPs	
	3.6 Colorimetric Sensing study of DTH@AgNPs	
	3.7 Fluorometric Sensing study of DTH@AgNPs	
4.	Conclusion	16
5.	References	17-19

**A Project Report**  
**On**  
**Synthesis and Characterization of  $\text{LaNiO}_3$  and  $\text{LaFeO}_3$**   
**Perovskite Materials Using Sol-gel Method**



**Submitted for**  
*Partial Fulfilment of the Requirement for the Degree of*  
*Master of Science in Chemistry*

**Session 2023-2025**

**GUIDED BY**

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To the best of our knowledge, the work presented in this project is original and has not been submitted anywhere. I recommend that the project report be forwarded to the respective examiners for evaluation. I wish her all the success in her career and life.

**Dr. Ashish Kumar Singh**

Professor

Department of Chemistry  
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DEPARTMENT OF CHEMISTRY  
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I wish her every success in her life.

  
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(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



### DECLARATION

I hereby declare that the project work presented in the project entitled "**Synthesis and Characterization of  $\text{LaNiO}_3$  and  $\text{LaFeO}_3$  perovskite material using Sol-gel Method**" submitted as partial fulfilment of M.Sc. in Analytical Chemistry has been performed by me in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur, under the guidance of **Dr. Ashish Kumar Singh**. The work presented in the project dissertation is original and will remain the intellectual property of the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.).

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## TABLE OF CONTENTS

<b>Entry</b>	<b>Content</b>	<b>Page No.</b>
1.	<b>Introduction</b>	<b>2-8</b>
2.	<b>Experimental</b>	<b>8</b>
3.	<b>Electrode Preparation</b>	<b>9</b>
4.	<b>Instrumentation</b>	<b>9-11</b>
5.	<b>Characterisation Techniques</b>	<b>11</b>
6.	<b>Result and Discussion</b>	<b>12-14</b>
7.	<b>Applications</b>	<b>15-17</b>
8.	<b>Conclusion</b>	<b>17</b>
9.	<b>References</b>	<b>17-22</b>

# *Synthesis of Zinc Oxide Nanoparticles and its Applications*

*A Project Report Submitted to*

**Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.**



*In partial fulfillment of the requirement for the degree of*

**Master of Science  
in  
Chemistry**

**Submitted by**

**Ganpat janghel**

**M.Sc. 4<sup>th</sup> Sem**

**Enrollment No. GGV/23/07212**

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**Guru Ghasidas Vishwavidyalaya**

**May 2025**



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This is to certify that *Mr. Ganpat Janghel* has carried out the project in the Department of Certificate Chemistry, Guru Ghasidas Vishwavidyalaya (A Central university), Bilaspur (C.G.) on the topic "*Synthesis of Zinc Oxide Nanoparticles and Its Applications*".

This project is submitted to partially fulfil the requirements for the degree of M.Sc. in Chemistry and forwarded to the examiner for evaluation.

I wish him every success in her life.

*K.D.*

### Signature of the HoD

Prof. Khemchand Dewangan, professor  
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*Nishy*  
*TS-5-2025*



## **TABLE OF CONTENTS**

<b>1. Abstract</b>	<b>1</b>
<b>2. Introduction</b>	<b>1-4</b>
2.1 Nanotechnology and Zinc Oxide Nanoparticles	
2.2 Green Synthesis Approaches	
2.3 Role of Aloe vera in Nanoparticle Synthesis	
2.4 Importance of Ultrasonic Irradiation	
2.5 Objectives of the Study	
<b>3. Materials and Methods</b>	<b>5-9</b>
3.1 Materials	
3.2 Preparation of Aloe vera Extract	
3.3 Synthesis of Zinc Oxide Nanoparticles	
<b>4. Characterization Techniques</b>	<b>10</b>
4.1 UV-Visible Spectroscopy	
4.2 Fourier Transform Infrared Spectroscopy (FTIR)	
4.3 X-Ray Diffraction (XRD)	
4.4 Scanning Electron Microscopy (SEM)	
<b>5. Results</b>	<b>11-14</b>
<b>6. Discussion</b>	<b>14-16</b>
6.1 Interpretation of UV-Vis, FTIR, XRD, SEM Results	
6.2 Comparison with Previous Studies	
6.3 Advantages of Green Synthesis	
6.4 Limitations and Challenges	
<b>7. Applications</b>	<b>16-18</b>
7.1 UV-Blocking Applications	
7.2 Antimicrobial Applications	
7.3 Photocatalytic and Environmental Applications	
7.4 Biomedical Applications	
7.5 Electronics and Sensors	
7.6 Agricultural and Packaging Applications	
<b>8. Conclusion</b>	<b>18-19</b>
<b>9. Reference</b>	<b>19-23</b>

**A Project Report**

**On**

**Synthesis and Characterization of  $\text{LaMO}_3$  (M = Mn, Co) by Sol-Gel Method**



**Submitted for**

*Partial Fulfilment of the Requirement for the Degree  
of Master of Science in Chemistry*

**Session 2023-2025**

**GUIDED BY**

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(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



## DEPARTMENT OF CHEMISTRY

**GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)**

(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



# CERTIFICATE

This is to certify that **Ms. Sagarika Priyadarsini Sahoo** has carried out this project under my supervision in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) on the topic “**Synthesis and Characterization of  $\text{LaMO}_3$  (M = Mn, Co) by Sol-Gel Method**”.

She has worked diligently, methodically and collected the literature very sincerely and carefully. During this project work, she has learnt about various synthesis and characterization techniques related to the entitled topics.

To the best of our knowledge, the work presented in this project is original and has not been submitted anywhere. I recommend that the project report be forwarded to the respective examiners for evaluation. I wish her all the success in her career and life.

**Dr. Ashish Kumar Singh**  
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I wish her every success in her life.

**Prof. Khemchand Dewangan**  
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DEPARTMENT OF CHEMISTRY  
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(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



## DECLARATION

I hereby declare that the project work presented in the project entitled topic “**Synthesis and Characterization of  $\text{LaMO}_3$  ( $\text{M} = \text{Mn, Co}$ ) by Sol-Gel Method**” submitted as partial fulfilment of M.Sc. in Physical Chemistry has been performed by me in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur, under the guidance of **Dr. Ashish Kumar Singh**.

The work presented in the project dissertation is original and will remain intellectual property of the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.).

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## ACKNOWLEDGEMENT

I would like to express my profound gratitude and grateful regards to my supervisor, **Dr. Ashish Kumar Singh**, Professor, Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.), who has given their benevolent co-operation at every stage of project work and without their guidance, this work would hardly have been completed.

I am grateful to **Prof. Khemchand Dewangan**, Head, Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.), who has been helping and facilitating during my project work.

I express my thanks to **Prof. H. S. Tewari**, Dean, School of Physical Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.), for his cooperation and encouragement.

I extend my earnest thanks to **Prof. G. K. Patra, Prof. C. Arora, Prof. S. K. Singh, Prof. Manorama, Dr. U. P. Azad, Dr. S. B. Singh, Dr. B. Sharma, Dr. A. Shrivastava, Dr. S. Banerjee, Dr. N. Kumari, Dr. B. L. Sahu**, Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) for helping me in conducting laboratory work as well as in data completion.

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I am also thankful to my classmates and my relatives who always encouraged and inspired me. Words can never convey my deep gratitude and grateful regards to my parents and family for their affection, faith and patience during the whole of the project.

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# CONTENTS

<b>S.NO.</b>	<b>TITLE</b>	<b>PAGE NO.</b>
1.	Abstract	1
2.	Introduction	1-7
3.	Experimental Section	7-9
	a. Materials	7
	b. Synthesis	7-8
	c. Instrumentation	8-9
4.	Characterization techniques	9-10
5.	Results and Discussion	11-13
	a. FTIR analysis	11
	b. X-ray diffraction study	12
	c. Electrochemical analysis	13
6.	Applications	13-14
7.	Conclusion	14
8.	References	15-18

# **[pmIm]OH as Base and Solvent for MW-Assisted Pd-Catalyzed Cyanation Reactions Aryl Halides**

A Project submitted to

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**



*In partial fulfillment*

*For the award of the degree*

*Of*

**Master of Science  
in**

**Chemistry**

**by**

**Antara Chowdhury**

Under the Guidance of

**Dr. Subhash Banerjee**

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**Department of Chemistry,**

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**

**MAY 2025**





## CERTIFICATE OF THE SUPERVISOR

This is to certify that the work incorporated in the major project "*[pmIm]OH as Base and solvent for MW-Assisted Pd-Catalyzed Cyanation Reactions Aryl Halides*", is a record of research work carried out by *Antara Chowdhury* bearing Roll No. 23104106, Enrollment No. GGV/20/07009 under my guidance and supervision for the award of Degree of the *Master of Science* in Chemistry at the Guru Ghasidas Vishwavidyalaya, Bilaspur, (CG) India.

To the best of my knowledge and belief the major dissertation synopsis i) Embodies the work of the candidate herself, ii) Has duly been completed, iii) Fulfils the requirement of the Ordinance relating to the Master of Science in chemistry degree of the University is up to the desired standard both in respect of contents and language for being referred to the examiners.

(Signature of the Supervisor)

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## **TABLE OF CONTENTS**

<b>Sl. No</b>	<b>Topic</b>	<b>Page No.</b>
<b>Chapter 1:</b>	<b>Introduction and Importance of cyanation</b>	2-6
<b>Chapter 2:</b>	<b>Literature review</b>	7-52
2.1.	Literature review based on cyanation of aryl halide	7-51
2.2.	Conclusion based on literature report	52-52
<b>Chapter 3:</b>	<b>Present Work</b>	53-64
3.1.	Preparation of ionic liquid [pmIm]Br	54-55
3.2.	Preparation of ionic liquid [pmIm]OH	56-58
3.3.	Preparation of ionic liquid Pd[pmIm]OH	58-59
3.4	Cyanation of Iodobenzene	59-60
3.5	Characterization of cyanobenzene	61-62
<b>Chapter 4:</b>	<b>Conclusion</b>	63-64
<b>Chapter 5:</b>	<b>References</b>	65-72

# **Pd Doped NiCo<sub>2</sub>O<sub>4</sub> for C-H Activation Reactions**

**A Project submitted to**

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**



*In partial fulfillment*

*For the award of the degree*

*Of*

**Master of Science**

**in**

**Chemistry**

**by**

**Savita Devi**

Under the Guidance of

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**Department of Chemistry,**

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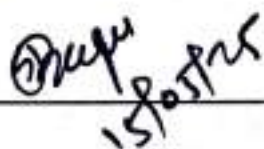
**May 2025**



## CERTIFICATE OF THE SUPERVISOR

This is to certify that the work incorporated in the major project "*Pd Doped NiCo<sub>2</sub>O<sub>4</sub> for C-H Activation Reactions*", is a record of research work carried out by *Savita Devi* bearing Roll No. 23104152, Enrollment No. GGV/20/07060 under my guidance and supervision for the award of Degree of the *Master of Science* in Chemistry at the Guru Ghasidas Vishwavidyalaya, Bilaspur, (CG) India.

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## TABLE OF CONTENTS

Sl. No	Topic	Page No.
<b>Chapter-1:</b>	<b>Introduction and Importance of C-H functionalization reactions.</b>	01-03
<b>Chapter-2:</b>	<b>Literature review</b>	04-43
2.1.	Literature review based on First-Row Transition Metal-Mediated C-H Functionalization Reactions	05-42
2.2.	Conclusion based on literature report	43-43
<b>Chapter-3:</b>	<b>Present Work</b>	44-47
3.1.	Synthesis of 2-Phenylbenzothiazole using Pd-doped NiCo <sub>2</sub> O <sub>4</sub> as a catalyst	45-46
3.2.	Characterization of 2-Phenylbenzothiazole	47-47
<b>Chapter-4:</b>	<b>Conclusion</b>	48-49
<b>Chapter-5:</b>	<b>References</b>	50-62

# **Task-Specific Acidic Ionic Liquid for One-Pot Synthesis of Pyrano Chromenes**

A Project submitted to

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**



*In partial fulfillment*

*For the award of the degree*

*of*

**Master of Science**

**in**

**Chemistry**

**By**

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**May 2025**





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This is to certify that the work incorporated in the major project "*Task-Specific Acidic Ionic Liquid for One-Pot Synthesis of Pyrano Chromenes*", is a record of research work carried out by *Swetlana Prerna Ram* bearing RollNo.23104159, Enrollment No.GGV/20/07065 under my guidance and supervision for the award of Degree of the *Master of Science* in Chemistry in the Guru Ghasidas Vishwavidyalaya, Bilaspur, (CG) India.

To the best of my knowledge and belief the major dissertation synopsis i) Embodies the work of the candidate herself, ii) Has duly been completed, iii) Fulfils the requirement of the Ordinance relating to the Master of Science in Chemistry degree of the University is up to the desired standard both in respect of contents and language for being referred to the examiners.

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## TABLE OF CONTENTS

Sl. No	Topic	Page No.
<b>Chapter-1:</b>	<b>Introduction and Importance of Green Chemistry</b>	01-02
1.1.	General introduction	02-02
<b>Chapter-2:</b>	<b>Principles of Green Chemistry</b>	03-08
2.1.	Principles	04-08
<b>Chapter-3:</b>	<b>Green Solvents in Organic Synthesis</b>	09-13
3.1.	Introduction	10-10
3.2.	Water	11-11
3.3.	Fluorous Solvent	11-12
3.4.	Ionic Liquid	12-12
3.5.	Organic Carbonates	12-12
3.6.	Supercritical Carbon Dioxide	13-13
3.7.	Biosolvent	13-13
<b>Chapter-4:</b>	<b>Ionic Liquids As Green Reaction Medium And Catalyst In Organic Synthesis</b>	14-13
4.1.	Introduction of Ionic Liquids:	15-15
4.2.	Synthesis of Ionic Liquids:	15-16
4.3.	Properties of Ionic Liquids:	16-16
4.4.	Applications of Ionic Liquids:	16-17
4.5.	Current Research Trends:	17-17
4.6.	Different generations of ionic liquids:-	17-20
4.7.	Types of Ionic Liquids:	20-21
4.8.	Conclusion	21-21
<b>Chapter-5:</b>	<b>Advantages of Ionic Liquids</b>	22-25
<b>Chapter-6:</b>	<b>Literature Reviews on the synthesis of Task-specific Ionic liquids and their applications</b>	26-66



## TABLE OF CONTENTS

Sl. No	Topic	Page No.
<b>Chapter-1:</b>	<b>Introduction and Importance of Green Chemistry</b>	01-02
1.1.	General introduction	02-02
<b>Chapter-2:</b>	<b>Principles of Green Chemistry</b>	03-08
2.1.	Principles	04-08
<b>Chapter-3:</b>	<b>Green Solvents in Organic Synthesis</b>	09-13
3.1.	Introduction	10-10
3.2.	Water	11-11
3.3.	Fluorous Solvent	11-12
3.4.	Ionic Liquid	12-12
3.5.	Organic Carbonates	12-12
3.6.	Supercritical Carbon Dioxide	13-13
3.7.	Biosolvent	13-13
<b>Chapter-4:</b>	<b>Ionic Liquids As Green Reaction Medium And Catalyst In Organic Synthesis</b>	14-13
4.1.	Introduction of Ionic Liquids:	15-15
4.2.	Synthesis of Ionic Liquids:	15-16
4.3.	Properties of Ionic Liquids:	16-16
4.4.	Applications of Ionic Liquids:	16-17
4.5.	Current Research Trends:	17-17
4.6.	Different generations of ionic liquids:-	17-20
4.7.	Types of Ionic Liquids:	20-21
4.8.	Conclusion	21-21
<b>Chapter-5:</b>	<b>Advantages of Ionic Liquids</b>	22-25
<b>Chapter-6:</b>	<b>Literature Reviews on the synthesis of Task-specific Ionic liquids and their applications</b>	26-66

<b>Chapter-7:</b>	<b>Microwave Assisted Synthesis of Task-Specific Ionic Liquid for One-Pot Multi-component Organic Synthesis</b>	<b>67-66</b>
7.1.	MW-assisted preparation of 1-butyl-3-methyl imidazolium Bromide, [pmIm]Br	67-69
7.2.	MW-assisted preparation of 1-Acetyl-3-methyl imidazolium Chloride, [AcMIm]Cl:	69-69
7.3.	Application of Ionic Liquids as Catalyst and Reaction Medium in the One-pot Multi-component Synthesis of Pyran Chromene Derivatives	70-75
7.4	Conclusion	75-75
7.5.	Experimental procedure for the synthesis of 2-amino-5-oxo-4-phenyl-4,5-dihydropyrano[3,2-c]chromene-3-carbonitrile	76-76
<b>Chapter-8:</b>	<b>References</b>	<b>77-86</b>

# **Microwave Assisted Ionic Liquid Mediated Rapid Synthesis of Covalent Organic Polymer**

A Project submitted to

**Guru Ghasidas Vishwavidyalaya; Bilaspur (C.G.)**



*In partial fulfillment*

*For the award of the degree*

*Of*

**Master of Science  
in**

**Chemistry**

**by**

**Tanuja Patel**

Under the Guidance of

**Dr. Subhash Banerjee**

**Research center**

**Department of  
Chemistry;**

**Guru Ghasidas Vishwavidyalaya; Bilaspur (C.G)**

**May 2025**





## CERTIFICATE OF THE SUPERVISOR

This is to certify that the work incorporated in the major project "*Microwave Assisted Ionic Liquid Mediated Rapid Synthesis of Covalent Organic Polymer*"; is a record of research work carried out by *Tanuja Patel* bearing Roll No. 23104160; Enrollment No. GGV/20/07067 under my guidance and supervision for the award of Degree of the *Master of Science* in microbiology degree at the Guru Ghasidas Vishwavidyalaya; Bilaspur, (CG) India.

To the best of my knowledge and belief the major dissertation synopsis i) Embodies the work of the candidate herself; ii) Has duly been completed; iii) Fulfils the requirement of the Ordinance relating to the Master of Science in chemistry degree of the University is up to the desired standard both in respect of contents and language for being referred to the examiners.

(Signature of the Supervisor)

**Dr. Subhash Banerjee**  
Associate Professor  
Department of Chemistry; G.G.V. Bilaspur (C.G)

## **TABLE OF CONTENTS**

<b>Sl. No</b>	<b>Topic</b>	<b>Page No.</b>
<b>Chapter-1:</b>	<b>Introduction</b>	01-03
<b>Chapter-2:</b>	<b>Literature review</b>	
2.1.	Literature review based on covalent organic frameworks	04-51
2.1.1	Linkage of COFs	05-12
2.1.2	Synthetic method of COFs	12-16
2.1.3	application of COFs	16-51
<b>Chapter-3:</b>	<b>Present Work</b>	52-61
3.1.	Introduction	53
3.2.	Experimental section	54-57
3.2.1.	Chemicals	54
3.2.2.	COPs Preparation	54-57
3.3.	Characterization of COPs	58-61
3.3.1	FTIR Analysis	58-60
3.3.2	XRD Analysis	60-61
<b>Chapter-4:</b>	<b>Future perspective and conclusion</b>	62-64
<b>Chapter-5:</b>	<b>References</b>	65-74





## CERTIFICATE OF THE SUPERVISOR

This is to certify that the work incorporated in the major project "*Pd Doped NiCo<sub>2</sub>O<sub>4</sub> for C-H Activation Reactions*", is a record of research work carried out by *Savita Devi* bearing Roll No. 23104152, Enrollment No. GGV/20/07060 under my guidance and supervision for the award of Degree of the *Master of Science* in Chemistry at the Guru Ghasidas Vishwavidyalaya, Bilaspur, (CG) India.

To the best of my knowledge and belief the major dissertation synopsis i) Embodies the work of the candidate herself, ii) Has duly been completed, iii) Fulfils the requirement of the Ordinance relating to the Master of Science in chemistry degree of the University is up to the desired standard both in respect of contents and language for being referred to the examiners.

(Signature of the Supervisor)

**Dr. Subhash Banerjee**

Associate Professor

Department of Chemistry, G.G.V. Bilaspur (C.G)

## TABLE OF CONTENTS

Sl. No	Topic	Page No.
<b>Chapter-1:</b>	<b>Introduction and Importance of C-H functionalization reactions.</b>	01-03
<b>Chapter-2:</b>	<b>Literature review</b>	04-43
2.1.	Literature review based on First-Row Transition Metal-Mediated C-H Functionalization Reactions	05-42
2.2.	Conclusion based on literature report	43-43
<b>Chapter-3:</b>	<b>Present Work</b>	44-47
3.1.	Synthesis of 2-Phenylbenzothiazole using Pd-doped NiCo <sub>2</sub> O <sub>4</sub> as a catalyst	45-46
3.2.	Characterization of 2-Phenylbenzothiazole	47-47
<b>Chapter-4:</b>	<b>Conclusion</b>	48-49
<b>Chapter-5:</b>	<b>References</b>	50-62



*Topic: - Synthesis and characterization, application and properties of the Schiff base for the amino acid.*

*A Dissertation submitted*

*To*

*Guru Ghasidas Vishwavidyalaya*



**A Dissertation Submitted in Partial Fulfilment for Degree of  
M.Sc. chemistry**

**By**

**Isha Baghmar**

Enrollment No. GGV/23/07214 & Roll No. 23104127

**Under the Supervision of**

**Dr. Suryabhan Singh**

(Assistant Professor, Dept. Of chemistry)

Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

May ,2025



**Department of chemistry**  
**Guru Ghasidas Vishwavidyalaya**  
(A Central University Established Under the Central  
Universities Act, 25 of 2009) Bilaspur, Chhattisgarh, India

Date.....

Bilaspur

**CERTIFICATE FROM THE SUPERVISOR**

This is to certify that Isha Baghmar worked on a postgraduate dissertation project entitled "Synthesis and characterization, application and properties of the Schiff base for the amino acid" under my supervision for 4 months and this work has not been formed the basis for the award of any other similar title. It represents entirely independent work on the part of the candidate.

**Dr. Suryabhan Singh**

**Assistant professor**

Department of chemistry

Guru Ghasidas Vishwavidyalaya, Bilaspur

<b>1.</b>	<b>INTRODUCTION</b>	<b>1</b>
<b>2.</b>	<b>SCHIFF BASE</b>	<b>2</b>
<b>2.1</b>	<b>MACHENISM</b>	<b>3 - 5</b>
<b>3.</b>	<b>EXPERIMENTAL PART</b>	<b>6 - 7</b>
<b>3.1</b>	<b>MATERIALS AND METHOD</b>	<b>6-7</b>
<b>3.2</b>	<b>PREPRATION OF SCHIFF BASE</b>	<b>8 - 12</b>
<b>4.</b>	<b>CHARACTERIZATION</b>	<b>13 - 17</b>
<b>4.1</b>	<b>IR AND UV SPECTRA</b>	<b>13 - 17</b>
<b>5.</b>	<b>RESULT AND DISCUSSION</b>	<b>18</b>
<b>6.</b>	<b>APPLICATIONS</b>	<b>19 - 23</b>
<b>7.</b>	<b>CONCLUSION</b>	<b>23</b>
<b>8.</b>	<b>REFRENCES</b>	<b>24 - 26</b>

**Guru Ghasidas Vishwavidyalaya**  
**(A Central University)**  
**Bilaspur (C.G.) 495001, India**



A Literature based Project Report on  
"Cation and Anion Sensing based on 'Turn ON' fluorescence"

A Project Thesis Submitted for  
Partial Fulfilment of the Requirement for the Degree of  
M.Sc. in Chemistry

Session:-2024-2025

UNDER THE GUIDANCE OF  
Dr. Suryabhan Singh  
(Assistant Professor)  
Department of Chemistry  
Guru Ghasidas Vishwavidyalaya

SUBMITTED BY  
Mayank Gautam  
M.Sc.(Chemistry)  
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Department of Chemistry

Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)

(A Central University Established by Central Universities Act 2009 No. 25 of 2009)

**CERTIFICATE**

This is to certify that, MAYANK GAUTAM has carried out this literature survey-based project under my supervision in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) on the topic "Cation and Anion Sensing based on Turn 'ON' Fluorescence "

He has worked diligently; methodically and collected the literature very sincerely and carefully. During this project works he has learnt about various organic synthesis related to entitled topic.

I wish every success in his career and life.

SUBMITTED BY

Mayank Gautam

M.Sc.Chemistry (IVSem.)

Roll No. 23104138

A handwritten signature in black ink, appearing to read 'Suryabhan Singh', with a stylized flourish at the end.

SUPERVISED BY

Dr.Suryabhan Singh

(Assistant Professor)

Department of Chemistry

GGV Bilaspur (C.G.)

## **TABLE OF CONTENT**

<b>SNo</b>	<b>CONTENT</b>	<b>PAGE NO.</b>
	<b>ABSTRACT</b>	<b>1</b>
<b>1</b>	<b>INTRODUCTION</b>	<b>1-3</b>
<b>2</b>	<b>REVIEW OF LITERATURE</b>	<b>4-9</b>
<b>3</b>	<b>METHODOLOGY</b>	<b>9-11</b>
<b>4</b>	<b>ANALYSIS</b>	<b>11-14</b>
<b>5</b>	<b>APPLICATION AND FUTURE ASPECT</b>	<b>14-16</b>
<b>6</b>	<b>CONCLUSION</b>	<b>17</b>
<b>7</b>	<b>REFERENCES</b>	<b>18-20</b>



DEPARTMENT OF CHEMISTRY

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR

[A Central University Established by the central universities act, 2009 No. 25 of 2009]

A PROJECT REPORT

ON

“HETEROBIMETALLIC COMPLEX AND THEIR  
APPLICATION IN CATALYSIS”

Master of Science IV Semester

Session: 2024 – 2025

SUPERVISOR

Dr. SURYABHAN SINGH

ASSISTANT PROFESSOR

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GURU GHASIDAS CENTRAL UNIVERSITY

BILASPUR C.G

SUBMITTED BY

KALYANI BHARTI

M.Sc IV SEMESTER

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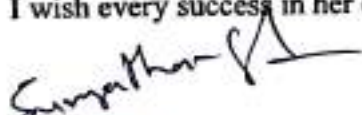
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GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR

[A Central University Established by the Central Universities Act, 2009 No. 25 of 2009]

CERTIFICATE

This is to certify that KALYANI BHARTI has carried out this literature survey-based project under my supervision in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) on the topic "HETEROBIMETALLIC COMPLEXES AND THEIR APPLICATION IN CATALYSIS" He has worked diligently, methodically and collected the literature very sincerely and carefully. During this project work, she has learnt about various syntheses and applications related to the topic.

I wish every success in her career and life.

  
SUPERVISOR

Dr. SURYABHAN SINGH  
ASSISTANT PROFESSOR  
DEPARTMENT OF CHEMISTRY  
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BILASPUR C.G

SUBMITTED BY  
KALYANI BHARTI  
M.Sc IV SEMESTER  
ROLL NO. 23104130

  
15525



## CONTENT

- 1 ABSTRACT**
- 2 INTRODUCTION**
- 3 LITERATURE REVIEW**
- 4 METHODOLOGY**
- 5 APPLICATION**
- 6 DISCUSSION**
- 7 CONCLUSION**
- 8 REFERENCE**

**Topic: - "Synthesis and characterization of bimetallic complexes using cationic and anionic complexes:"**

*A Dissertation submitted*

*To*

***Guru Ghasidas Vishwavidyalaya***



**A Dissertation Submitted in Partial Fulfilment for Degree of**

**M.Sc. chemistry**

**By**

**Mudavath Hanumanthu**

**Enrollment No. GGV/23/07222 & Roll No. 23104139**

**Under the Supervision of**

**Dr. Suryabhan Singh**

**(Assistant Professor, Dept.of chemistry)**

**Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)**

**May ,2025**



Department of chemistry

Guru Ghasidas Vishwavidyalaya

(A Central University Established Under the Central  
Universities Act, 25 of 2009) Bilaspur, Chhattisgarh, India

Date:.....

Bilaspur

**CERTIFICATE FROM THE SUPERVISOR**

This is to certify that Mudavath Hanumanthu worked on a postgraduate dissertation project entitled "To synthesis and characterization of bimetallic complexes using by cation and anion complexes:" under my supervision for 4 months and this work has not been formed the basis for the award of any other similar title. It represents entirely independent work on the part of the candidate. .

**Dr. Suryabhan Singh**

**Assistant professor**

Department of chemistry

Guru Ghasidas Vishwavidyalaya, Bilaspur

1.	Introduction	
2.	Experimental	
2.1	Material and Instruments	
2.2	Synthesis	
2.2.1	Synthesis of starting material complex	
2.2.2	Synthesis of bimetallic complex	
A)	Synthesis of bimetallic complex using $[\text{Cu}(\text{SCN})_3]^{2-}$ and $[\text{Ni}(\text{en})_3]^{2+}$	
B)	Synthesis of bimetallic complex using $[\text{Ag}(\text{SCN})_3]^{2-}$ and $[\text{Ni}(\text{en})_3]^{2+}$	
C)	Synthesis of bimetallic complex using $\text{K}_3[\text{Fe}(\text{C}_2\text{O}_4)_3] \cdot 3\text{H}_2\text{O}$ and $[\text{Ni}(\text{en})_3]^{2+}$	
D)	Synthesis of bimetallic complex using $[\text{Cu}(\text{SCN})_3]^{2-}$ and $[\text{Co}(\text{en})_3 \text{Cl}_2]^+$	
3.	Characterization	
4.	Results and discussion	
5.	Conclusion	
6.	References	

AN  
EXPERIMENTAL BASED PROJECT REPORT

On

SYNTHESIS AND CHARACTERIZATION OF  
LANTHANUM BASED DOUBLE PEROVSKITE



Submitted for

Partial Fulfilment of the Requirement for the Degree of Master of  
Science in Chemistry

Session 2023-2025

GUIDED BY

**Dr. Ashish Kumar Singh**

Professor

Department of Chemistry

Guru Ghasidas Vishwavidyalaya,

Bilaspur (C.G.)

SUBMITTED BY

**Ms. Rakshi Pradhan**

M.Sc. IV Semester

Roll No. 23104146

Enroll No. GGV/23/07228

*Nishu*  
*15-5-25*

DEPARTMENT OF CHEMISTRY

GURU GHASIDAS VISHWAVIDYALAYA, Bilaspur (C.G.) 495009, India

(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



DEPARTMENT OF CHEMISTRY  
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)  
(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



## CERTIFICATE

This is to certify that **Ms. Rakshi Pradhan** has carried out this experimental based project work under my supervision in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) on the topic "**SYNTHESIS AND CHARACTERIZATION OF LANTHANUM BASED DOUBLE PEROVSKITE**".

She has worked diligently, methodically and also collected the literature very sincerely and carefully. During this project work she has learnt about various organic transformation and new synthetic technique related to the entitled topics.

To the best of our knowledge the work presented in this project is original and has not been submitted anywhere. I recommended the project report to be forwarded to the respective examiners for evaluation. I wish her all the success in her career and life.

Date:

Place: Bilaspur (C.G.)

  
**Dr. Ashish Kumar Singh**  
Professor

Department of Chemistry  
Guru Ghasidas Vishwavidyalaya  
Bilaspur (C.G.) 495009, India



DEPARTMENT OF CHEMISTRY  
GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)  
(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



## FORWARDING CERTIFICATE

This is to certify that **Ms. Rakshi Pradhan** has carried out this experimental based project work in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) on the topic **“SYNTHESIS AND CHARACTERIZATION OF LANTHANUM BASED DOUBLE PEROVSKITE”**. This project is submitted for the partial fulfilment of requirements for the degree of M.Sc. in Physical Chemistry and forwarded to examiner for evaluation.

I wish her every success in his life.

Date: 15/05/2025

Place: Bilaspur (C.G.)

  
**Prof. Khemchand Dewangan**  
Head, Department of Chemistry,  
Guru Ghasidas Vishwavidyalaya,  
Bilaspur (C.G.) 495009, India

अध्यक्ष/Head  
रासायनिक विभाग  
Dept. of Chemistry  
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बिलासपुर 495009 (C.G.)  
बिलासपुर 495009 (C.G.)



## DECLARATION

I hereby declare that the experimental-based project work presented in the project entitled **“SYNTHESIS AND CHARACTERIZATION OF LANTHANUM BASED DOUBLE PEROVSKITE”** submitted as partial fulfilment of M.Sc. in Physical Chemistry has been performed by me in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur under the guidance of **Prof. Ashish Kumar Singh**.

The work presented in the project dissertation is original and will remain intellectual property of Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.).

Date:  
Place: Bilaspur (C.G.)

**Ms. Rakshi Pradhan**  
M.Sc. IV Semester  
(Physical Chemistry)  
Roll No. 23104146  
Enroll. No. GGV/23/07228



## ACKNOWLEDGEMENT

I would like to express my sincere gratitude to my supervisor **Dr. Ashish Kumar Singh**, Professor, Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) under whose guidance, the present project work has been brought to completion my leaps up in thankfulness for the benevolent, time, constant help and valuable throughout the project.

I wish to acknowledge **Prof. Khemchand Dewangan** (Head, Department of Chemistry, Guru Ghasidas Vishwavidyalaya) who gave me opportunity to undergo project work and his valuable suggestion during my M.Sc. in Chemistry course.

I express my thanks to **Prof. H. S. Tiwari**, Dean, School of Physical Sciences, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.), for his cooperation and encouragement.

I extend my earnest thanks to Prof. G. K. Patra, Prof. S. K. Singh, Prof. C. Arora, Dr. S. K. Thakur, Prof. Manorama, Dr. B. Sharma, Dr. A. Shrivastava, Dr. S. Banerjee, Dr. B. Mondal, Dr. U. P. Azad, Dr. S. B. Singh, Dr. N. Kumari, Dr. B. L. Sahu, Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) for helping me in conducting laboratory work as well as in completion.

I would also like to thank research scholar Pappu Shriwas for his continuous guidance throughout the period.

I would also express my deep sense of gratitude to my classmates, parents and family members for their encouragement and support throughout, which always inspired me.

Date:  
Place: Bilaspur (C.G.)

Ms. Rakshi Pradhan  
M. Sc. IV Semester  
(Physical Chemistry)

## CONTENTS

Abstract

1. Introduction

2. Experimental section

2.1. Materials

2.2. Synthesis

2.3. Instrumentation

3. Characterization techniques

4. Results and Discussion

4.1. Characterization by FTIR analysis

4.2. Characterization by XRD analysis

4.3. Characterization by electrochemical analysis

5. Conclusion

Reference

## 1. INTRODUCTION

Electrochemical water splitting represents a crucial method for generating green hydrogen. The advancement of energy production and the safe guarding of the environment are critical for achieving sustainable development. However, the reliance on fossil fuels, which contribute significantly to environmental degradation, presents substantial challenges in the conversion and storage of clean energy, as well as in the degradation of pollutants [1]. A particularly promising approach to address these issues involves the development of electrochemical processes capable of converting water, carbon dioxide, and nitrogen into valuable products such as hydrogen [2], hydrocarbons [3], oxygenates [4], and ammonia [5]. Electrocatalysis, which utilizes applied electricity to facilitate catalytic reactions, is recognized for its ability to convert electrical energy into chemical energy, while photocatalysis harnesses solar energy for similar transformations [6]. Both methodologies necessitate the use of efficient catalysts to enhance reaction efficiencies. Among the various catalysts, noble metals like gold, silver, palladium, and iridium are favoured for their superior performance in (electro)photocatalytic reactions [7-8]. However, the prohibitive cost of these catalysts poses a significant barrier to their widespread use, underscoring the urgent need for the design and development of cost-effective, earth-abundant alternatives for these applications. Perovskite oxides ( $ABO_3$ ) have garnered significant attention as a versatile class of materials for electrochemical (EC) applications, owing to their distinctive structural and compositional flexibility, coupled with remarkable stability [9]. Notably, these materials are extensively utilized in electrocatalysis, offering two primary advantages: (1) they are cost-effective and can be synthesized easily, which facilitates excellent stoichiometric control, reproducibility, and homogeneity; [10] (2) they possess an exceptional ability to incorporate a diverse array of substituting and doping elements, thereby allowing for the modulation of their properties [11-15].

The electrochemical process of water splitting is a crucial method for generating green hydrogen from a sustainable resource like water [16]. To facilitate the production of oxygen and hydrogen gases via this process, both the oxygen evolution reaction (OER) and the hydrogen evolution reaction (HER) are necessary. These reaction can be regarded as environmentally benign from a sustainable resource like water. This process necessitates both the OER and HER to effectively produce oxygen and hydrogen gases. These reactions are recognized as clean and sustainable energy source [17]. Although the concept of water splitting

**To Develop An Eco- Friendly Method For Synthesizing  
Magnetic nanoparticles (MNPs)**

**A Project Report Submitted to  
Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.**



This dissertation is submitted in partial fulfillment of the  
requirements for the degree of

**Master of Science**

**in**

**Chemistry**

Submitted by

**Rekha Tirkey**

M.Sc. 4<sup>th</sup> Sem (Physical chemistry)

Enrolment No. GGV/23/07229

Roll No. 23104147

Supervisor

**Prof. Khemchand Dewangan**

Department of Chemistry

Guru Ghasidas Vishwavidyalaya

# Guru Ghasidas Vishwavidyalaya

(A Central University established under Central Universities Act 2009)

Prof. Khemchand  
Dewangan

Professor of Dept.  
Chemistry



Department of Chemistry  
Guru Ghasidas Vishwavidyalaya  
Bilaspur-495009, C.G.

## CERTIFICATE

This is to certify that Miss Rekha Tirkey has completed the project dissertation entitled "**To development An eco- friendly method for synthesizing magnetic nanoparticles**" under my supervision for the partial fulfilment of required degree of "Master of Science in Chemistry". Throughout this project, he has demonstrated diligence, a methodical approach, and a sincere commitment to collecting and reviewing relevant literature. In the process, he has gained a comprehensive understanding of various aspects of chemical science related to the topic at hand.

To the best of my knowledge and belief of the project

- 1) is original and has not been submitted anywhere for award of any degree.
- 2) Fulfils the requirement of the Ordinance relating to the M.Sc. degree of the university.

I wish him every success in the future life.

Date:

Place: Bilaspur, (C.G)

  
15/05/2025  
Signature of the Supervisor

## TABLE CONTENTS

<b>Entry</b>	<b>Content</b>	<b>Page No.</b>
1.	Abstract	07
2.	Introduction	08-12
3.	Aims and Objectives	13
4.	Materials and Methods	13-16
5.	Characterization	17
6.	Application	18-22
7.	Result and discussion	23
8.	Conclusion	24
9.	Future perspective	24-25
10.	Reference	26

# Localization of Coated Iron Oxide ( $\text{Fe}_3\text{O}_4$ ) Nanoparticles on Tomato Seeds and Their Effects on Growth

A dissertation submitted in partial fulfillment of the requirement for the degree  
of Masters of Science (M.Sc.) In Chemistry



**M.Sc. Project Report (May 2025)**

**Submitted By**

Satya Tamboli

(Enrollment No.: GGV/23/07233)

(Roll No.: 23104151)

**Under Supervision of**

Dr. Khemchand Dewangan

HOD & Professor

**Department of Chemistry**

**Guru Ghasidas Vishwavidyalaya**

**Koni Bilaspur 495009 (C.G), India**

## CERTIFICATE

This is to certify that the thesis entitled "Localization of Coated Iron Oxide ( $\text{Fe}_3\text{O}_4$ ) Nanoparticles on Tomato Seeds and Their Effects on Growth" is the work carried by **Miss Satya Tamboii** (Enrollment no. GGV/23/07233, Roll no. 23104151) of Department of Chemistry, **Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.)** is a verified record of the work completed under my direction and supervision. The thesis work has not been submitted to another university or organization for a degree or professional certification. She wrote this thesis alone, and it is free of plagiarism and clear enough in its grammar to be read. I certify that, unless otherwise mentioned in this thesis, the work contained within it is entirely my own original research.

Date: 15/May/2025

Place: GGV, Bilaspur



**Dr. Khemchand Dewangan**

Head of Department & Project Supervisor

**Department of Chemistry**

Guru Ghasidas Vishwavidyalaya,

Koni Bilaspur-495009, C.G, India



## CONTENT

- Statement
- Certificate
- Acknowledgement
- Abstract

### Chapter 1. Introduction

- 1.1 Background and Agricultural Context
- 1.2 Metal and Metal Oxide Nanoparticles in Agriculture
- 1.3 Importance of Surface Functionalization
- 1.4 Role of Iron Oxide ( $\text{Fe}_3\text{O}_4$ ) Nanoparticles
- 1.5 Objectives of the Study

### Chapter 2. Nanoparticles: Definition, Structure, and Classification and Synthesis of Metal Nano Particles (MNPs)

- 2.1 Definition of Nanoparticles
  - 2.2 Structure and Morphology of Nanoparticles
  - 2.3 Classification of Nanoparticles
  - 2.4 Significance in Agricultural Applications
- Synthesis of  $\text{Fe}_2\text{O}_3$  Metal Nano Particles

Chapter 3. Characterization of Black Metal Nano Particles (MNPs)  
UV-Visible Spectroscopy Characterization of Synthesized  $\text{Fe}_2\text{O}_3$   
Metal Nanoparticles

3.1 Sample Preparation

3.2 Instrumentation and Conditions

3.3 Results and Interpretation

Chapter 4. Application

Chapter 5. Conclusion

Future Prospects

Reference

# **GREEN SYNTHESIS OF SILVER NANOPARTICLE BY ALOE VERA PLANT EXTRACTION**

A dissertation submitted in partial fulfilment of the requirement for the degree of Master of Science  
(M.Sc.) in chemistry

**M.Sc. Project Report By**  
**Shrutl Rai**  
(Enrollment No.: GGV/23/07235)

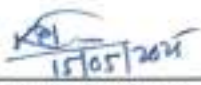



**Department of Chemistry**  
**Guru Ghasidas University, Koni (Bilaspur),**  
**495009 (C.G.), India**

## 1.2 Certificate

It is to certify that the work in the project report titled "green synthesis of silver nanoparticle by aloe vera plant extraction and In Situ generation of bimetallic nanoparticle and its applications" by Shruti Rai has been approved under my supervision that this work has not been submitted elsewhere.

GGU BILASPUR  
15/05/2025

  
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## 1.4 Table of Contents

*Cover page*

*Statement*

*Certificate*

*Acknowledgement*

*Abstract*

### **Chapter 1. INTRODUCTION**

- 1.1 Nanotechnology and Green Synthesis
- 1.2 Background and Significance
- 1.3 In Situ Generation of bimetallic nanoparticle
- 1.4 Role Of Aloe vera In Nanoparticle Synthesis
- 1.5 Objectives of the Study

### **Chapter 2. LITERATURE REVIEW**

- 2.1 Silver Nanoparticles: Properties And Applications
- 2.2 Green Synthesis Methods: An Overview
- 2.3 Aloe Vera Phytochemistry
- 2.4 Bimetallic Nanoparticles And Their Importance
- 2.5 In Situ Synthesis Techniques

### **Chapter 3. METHODOLOGY**

- 3.1 Materials And Chemicals Used
- 3.2 Preparation Of Aloe Vera Extract
- 3.3 Green Synthesis Of Silver Nanoparticle
- 3.4 In Situ Generation Of Bimetallic Nanoparticle

### **Chapter 4. CHARACTERIZATION TECHNIQUES AND RESULT DISCUSSION**

- 4.1 UV- Visible Spectra analysis

#### **4.2 Comparison Between Mono And Bimetallic Nanoparticle**

### **Chapter 5. APPLICATION**

#### **5.1 Silver Nanoparticle**

##### **5.1.1 Antimicrobial Activity**

##### **5.1.2 Catalytic Applications**

##### **5.1.3 Environmental And Biomedical Relevance**

#### **5.2 Bimetallic Nanoparticle (Ag/Cu)**

##### **5.2.1 Food Preservative**

##### **5.2.2 Nanocosmetic**

### **Chapter 6. CONCLUSION**

#### **6.1 Summary of Findings**

#### **6.2 Future Prospects**

### ***Reference***

## **A Project Report**

**On**

**Synthesis and Characterisation of Lanthanum-based double perovskite oxides of LSFZ  
and LSFC by Sol gel method**



**Submitted for**

*Partial Fulfilment of the Requirement for the Degree of  
Master of Science in Chemistry*

**Session 2023-2025**

### **GUIDED BY**

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(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



DEPARTMENT OF CHEMISTRY

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)

(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



## CERTIFICATE

This is to certify that Ms. Shyama rani Kar has carried out this project under my supervision in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) on the topic "Synthesis and Characterisation of Lanthanum-based double perovskite oxides of LSFZ and LSFC by Sol gel method".

She has worked diligently, methodically and collected the literature very sincerely and carefully. During this project work, she has learnt about various synthesis and characterization techniques related to the entitled topics.

To the best of our knowledge, the work presented in this project is original and has not been submitted anywhere. I recommend that the project report be forwarded to the respective examiners for evaluation. I wish her all the success in her career and life.

**Dr. Ashish Kumar Singh**  
Professor  
Department of Chemistry  
Guru Ghasidas Vishwavidyalaya  
Bilaspur (C.G.)





DEPARTMENT OF CHEMISTRY

GURU GHASIDAS VISHWAVIDYALAYA, BILASPUR (C.G.)

(A Central University Established by Central Universities Act 2009 No. 25 of 2009)



## FORWARDING CERTIFICATE

This is to certify that **Ms. Shyama rani Kar** has carried out this project in the Department of Chemistry, Guru Ghasidas Vishwavidyalaya, Bilaspur (C.G.) on the topic "Synthesis and Characterisation of Lanthanum-based double perovskite oxides of LSFZ and LSFC by Sol gel method". This project is submitted for the partial fulfilment of requirements for the degree of M.Sc. in Physical Chemistry and forwarded to the examiner for evaluation.

I wish her every success in her life.

**Prof. Khemchand Dewangan**  
Head  
Department of Chemistry,  
Guru Ghasidas Vishwavidyalaya,  
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# CONTENT

Abstract

1. Introduction

2. Experimental Section

2.1 Materials

2.2 Synthesis of LSFC and LSFZ

2.3 Electrode Preparation

2.4 Electrochemical Measurements

3. Instrumentation

4. Characterisation Techniques

5. Results and Discussions

5.1 FTIR Analysis

5.2 Powder X-ray diffraction study

5.3 CV Analysis

6. Conclusion

References

## 1. INTRODUCTION

Increasing energy demands have stimulated intense research on alternative energy conversion and storage systems with high efficiency, low cost, and environmental benignity [1,2]. Catalysts for oxygen reduction and evolution reactions are at the heart of key renewable-energy technologies, including fuel cells [3,4] and water splitting. For more effective energy conversion or storage systems, a variety of creative concepts have been put forth, including fuel, alkaline water electrolysis, cells, as well as metal-air batteries. Electrocatalysis, which utilizes applied electricity to facilitate catalytic reactions, is recognized for its ability to convert electrical energy into chemical energy, while photocatalysis harnesses solar energy for similar transformations [5]. Both methodologies necessitate the use of efficient catalysts to enhance reaction efficiencies. Among the various catalysts, noble metals like gold, silver, palladium, and iridium are favoured for their superior performance in (electro) photocatalytic reactions [6]. However, the prohibitive cost of these catalysts poses a significant barrier to their widespread use, underscoring the urgent need for the design and development of cost-effective, earth-abundant alternatives for these applications.

Several catalysts have been developed to enhance electrode kinetics and stability under the electrocatalytic OER, which has been the subject of much research in recent decades. The OER activity of metal oxide catalysts comprising transition metals [7,8], and several metal oxide families, including perovskite, has been the subject of extensive investigation. It has been discovered that the layer structure type-family ( $M(OH)_2$ ,  $MOOH$ , and  $LiMO_2$ ;  $M = Mn, Fe, Co, \text{ and } Ni$ )[9,10,11], spinel ( $A'B_2O_4$ ;  $A'$  = alkaline-earth and/or transition metals,  $B'$  = group 13 elements and/or transition metals), and ( $ABO_3$ ;  $A$  = alkaline-and/or rare-earth metals,  $B$  = transition metals)[12,13] show notable activity toward OER. These transition metal-based oxides are inexpensive, simple to make, and safe for the environment. They also exhibit moderate conductivities and are stable in alkaline solutions, making them suitable candidates for electrocatalytic OER. Additionally, promising electrocatalytic materials for HER and/or OER have been reported for organometallics (metal coordination complexes) [14,15], which may be excellent candidates for the overall reaction with water splitting. However, compared to metal oxide catalysts for electrocatalytic OER, there are very few documented instances of non-oxide catalysts for OER. It is known that ORR can involve a two-step, two-electron reaction wherein an intermediate stable peroxide can be formed that further gets reduced to water at high potentials. Even in cases where the ORR involves two steps, a two-electron process, efforts have been directed towards improving the reaction conditions such that a direct

**Comparative Study on Adsorption of Cationic Dye  
Mixtures Using Fe/Cr-BDC Metal-Organic  
Framework and Parthenium Leaf Ash**

*A Project Report Submitted to*  
**Guru Ghasidas Vishwavidyalaya, Bilaspur, C.G.**



*In partial fulfillment of the requirement for the degree of*

**Master of Science  
in  
Chemistry**

**Submitted by**

**Tushar Ranjan Sarangi**

**M.Sc. 4<sup>th</sup> Sem**

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**May 2025**

# Guru Ghasidas Vishwavidyalaya

(A Central University established under Central Universities Act 2009)

Prof. Charu Arora



Department of Chemistry  
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## CERTIFICATE

This is to certify that *Mr. Tushar Ranjan Sarangi* has completed the project dissertation entitled "*Comparative Study on Adsorption of Cationic Dye Mixtures Using Fe/Cr-BDC Metal-Organic Framework and Parthenium Leaf Ash*" under my supervision for the partial fulfillment of required degree of "*Master of Science in Chemistry*". She has worked diligently, methodically and also collected the literature very sincerely. During this project work she has learnt about various aspects of chemical science to the entitled topic.

To the best of my knowledge and belief of the project

- 1) is original and has not been submitted anywhere for award of any degree.
- 2) Fulfills the requirement of the Ordinance relating to the M.Sc. degree of the university.

I wish her every success in the future life.

Date: 15.5.25

Place: Bilaspur, C.G.

Signature of the Supervisor

# Guru Ghasidas Vishwavidyalaya

(A Central University established under Central Universities Act 2009)

Prof. K. Dewangan  
Head of the Department



Department of Chemistry  
Guru Ghasidas Vishwavidyalaya  
Bilaspur - 495009, C.G.

## FORWARDING CERTIFICATE

This is to certify that *Mr. Tushar Ranjan Sarangi* has completed the project work entitled as "*Comparative Study on Adsorption of Cationic Dye Mixtures Using Fe/Cr-BDC Metal-Organic Framework and Parthenium Leaf Ash*" under the supervision of *Prof. Charu Arora*, for the partial fulfillment of required degree of "*Master of Science in Chemistry*".

To the best of my knowledge and belief of the project

- 1) is original and has not been submitted anywhere for award of any degree.
- 2) Fulfills the requirement of the Ordinance relating to the M.Sc. degree of the university.

I recommend the project report be forwarded to the respective examiners for evaluation.

Date:

  
15.05.2025

Place: Bilaspur, C.G.

Signature of the HoD

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## TABLE OF CONTENTS

<b>Entry</b>	<b>Content</b>	<b>Page No.</b>
1.	CHAPTER I	07
2.	ABSTRACT	08
3.	INTRODUCTION	09-15
4.	LITERATURE REVIEW	16-20
5.	AIM AND OBJECTIVE	21
6.	EXPERIMENTAL SECTION	21-23
7.	RESULTS AND DISCUSSION	23-29
8.	CONCLUSION	30

<b>Entry</b>	<b>Content</b>	<b>Page No.</b>
1.	CHAPTER 2	32
2.	ABSTRACT	33
3.	INTRODUCTION	34-38
4.	LITERATURE REVIEW	39-42
5.	AIM AND OBJECTIVE	42
6.	EXPERIMENTAL SECTION	42-43
7.	RESULTS AND DISCUSSION	43-46
8.	CONCLUSION	47
9.	REFERENCES	