

# **SREE NARAYANA COLLEGE, CHATHANNUR**

## **RESEARCH COMMITTEE**

The Research Committee was established to oversee the research activities of the college. It aims to disseminate and promote innovative research ideas. The committee works closely with departments to promote and facilitate research and scholarly activities in all disciplines. Members meet regularly and share R&D related views, ideas and concerns. The Research Committee encourages departments with no research activity to apply for Research Centre status. The Committee encourages existing faculty members to engage in high-quality research and pursue a doctoral degree. Teachers are provided with ample support to undertake major- minor research projects. The committee motivates faculty and students to publish their products in peer-reviewed national and international publications. Promotes maximum participation of students and teachers in national and international seminars, conferences, workshops, orientation and refresher courses. Several informative sessions of eminent personalities from R&D organizations and institutions are arranged by the Research Committee for students to have better insights of research methodology and practices presently followed. The departments are encouraged to initiate MoU's with other organizations for collaborative research and interactions.

### **MEMBERS:**

- Dr. M S Latha (Principal)
- Dr. N B Sreekala (Coordinator)

# ACTIVITIES

**2017-18**

## 1. Research Methodology Seminar:

The seminar on Research Methodology organized by the Department of Chemistry and Science club of Sree Narayana College, Chathannur was inaugurated on 7<sup>th</sup> October 2017 at 10.00 am with Dr. R. Raveendran, UGC Emeritus professor, S. N. college, Kollam and Dr. Subhash Chandran C. S., College Principal. The inaugural keynote address was delivered by Dr. R. Raveendran who lectured on the topic 'Introduction to Research', focusing on characteristics of the scientific method and scientific knowledge and general approaches to research. Dr. Subhash Chandran C S; Principal, Dr. N. B. Sreekala; Head of the Department, Department of Chemistry spoke at the event. Several UG and PG students and teachers in the college actively participated in the seminar. Undergraduate and postgraduate students and teachers participated in the seminar. The vote of thanks was delivered by Mrs. Muthu S, Assistant professor in Chemistry.

The poster features the college logo on the top left. The main title is 'SREE NARAYANA COLLEGE, CHATHANNUR' with the affiliation 'Affiliated to University of Kerala'. Below this, it states 'Department of Chemistry and Science club organise Seminar on Introduction to Research'. A central box identifies the 'Resource person' as Dr. R. Raveendran, Principal (Retd.) of S. N. College, Varkala & UGC Emeritus professor of S. N. College, Kollam. A photograph of Dr. Raveendran speaking is shown next to a word cloud containing terms like 'RESEARCH', 'EXPERIMENT', 'INFORMATION', 'DATA', 'KNOWLEDGE', 'PRACTICE', 'FACTS', 'LINK', 'MISSION', 'LEARNING', 'EXPLORE', 'SCAN', 'THINK', 'EDUCATION', 'ROOF', 'PRACTICE', 'LINK', 'INFORMATION', 'EXPERIMENT', 'KNOWLEDGE', 'PRACTICE', 'LINK', 'MISSION', 'LEARNING', 'EXPLORE', 'SCAN', 'THINK', 'EDUCATION'. At the bottom, the date is 'DATE : 7<sup>th</sup> October 2017 @ 10.00 am' and the organizers are listed: Principal Dr. Subhash Chandran C. S., HoD Dr. Sreekala N. B., and Coordinator Mrs. Muthu S.

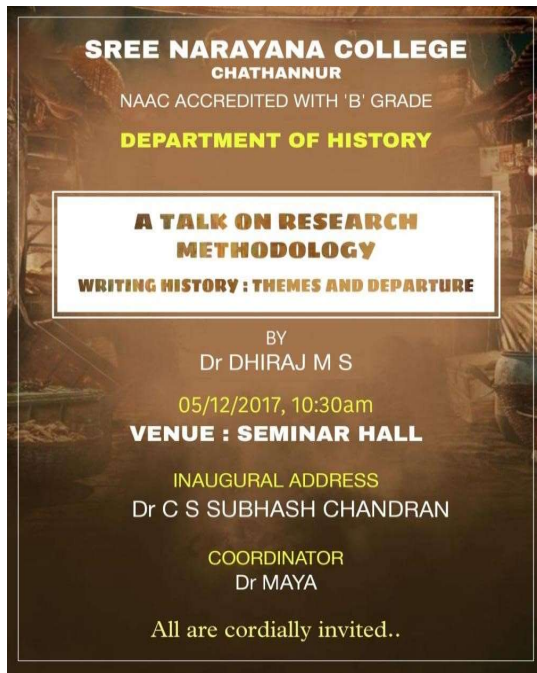
## 2. A Talk on Research Methodology- "Research Methodology for Beginners"

As a primary step for beginners in understanding data gathering and cataloguing as part of research methodology seminar was conducted on seminar hall at 08/11/2017 Rtd. Professor, IDE, University of Kerala, Dr. T K Vijayamohan engaged the students on the various techniques of data collection and cataloguing for enabling easy research. Newer techniques of cataloguing were also delved into. Systematic assemblage of facts and interpretation was stressed with examples.



### 3. A Talk on Research Methodology- Writing History: Themes and Departure

A novel initiative for understanding the writing of history and its methodology was begun the department for students to ponder deep into the discipline. A seminar entitled ‘Writing History: Themes and Departures’ was organized on 5<sup>th</sup> December, 2017 in the Seminar Hall at 10.30 am, with Dr. Dhiraj M S, Assistant Professor, School of Historical Studies, Thunchath Ezhuthachan Malayalam University lecturing on the topic and delving into the ways of dealing history, major themes, new departures and methods of approaching them. The College Principal Dr. C S Subash Chandran delivered the inaugural address and Head of the Department, Ms. Maya welcomed the gathering.



#### 4. Seminar on Preparation of Report or Thesis

The Post Graduate Department of Mathematics conducted a seminar on **"PREPARATION OF REPORT OR THESIS"** on 23<sup>rd</sup> January 2018 at 02.00 pm. An eminent personality Dr. Manil T Mohan, Visiting Scientist, Indian Statistical Institute handled the session. The difference between Report and Thesis was discussed in this session. After the presentation, there was a healthy discussion about the topic. The audience asked so many questions to the resource person and cleared their doubts. A total of 62 earnestly participated in this session.



The poster features the college logo at the top left. The text reads: **SREE NARAYANA COLLEGE CHATHANNUR**, Post Graduate Department of Mathematics. The event details are: On 23rd Jan 2018 at 02.00 pm, Venue: Seminar Hall. The title is **A Seminar on PREPARATION OF REPORT OR THESIS**. The resource person is **Dr. Manil T Mohan**, Visiting Scientist, Indian Statistical Institute (ISI) Bangalore. Organizers listed are Dr. C S Subhash Chandran (Principal), Smt. Rasmi K (HOD&Convener), and Sri. Salu (Coordinator).



#### 5. Basics of Research

The Post Graduate Department Of Commerce, Sree Narayana College, Chathannur had organized a seminar on Research Methodology titled, **BASICS OF RESEARCH** “, on 3<sup>rd</sup> March, 2018 from 10 am to 1 pm at Seminar Hall. An eminent personality Dr Soju S, Assistant Professor PG & Research Department of Commerce, Sree Narayana College, Kollam handled the session.

Through this session, the students got an idea about the Basics of research, how to formulate a research problem and how do a project as a part of their curriculum.



## 6. Introduction to Research Methodology

Seminar on Research Methodology organized by the Department of Chemistry and Science club of Sree Narayana College, Chathannur was inaugurated on 3<sup>rd</sup> March 2018 at 10.00 am with Dr. Latha M S, Principal, TKMM College, Nangiarkulangara and Dr. C. S. Subhash Chandran, College Principal. Mrs. Muthu S, Assistant Professor in Chemistry welcomed all the participants in the session. The inaugural keynote address was delivered by Dr. Latha M. S. She lectured on the topic 'Introduction to Research Methods', focusing on understanding the scientific methods, formulation and role of hypothesis in a research study, and the concept of research methods and methodology.

**SREE NARAYANA COLLEGE, CHATHANNUR**  
 AFFILIATED TO UNIVERSITY OF KERALA

Department of Chemistry and Science club organise Seminar on

**Introduction to Research Methods**

**Resource person**  
 Dr. M. S. Latha,  
 Principal,  
 TKMM college,  
 Nangiarkulangara  
 Alappuzha




DATE : 3<sup>rd</sup> March 2018 @ 10.00 am

Principal: Dr. Subhash Chandran C. S.      HoD: Dr. Sreekala N. B.      Coordinator: Mrs. Muthu S.



**2018-19**

1. Doing Oral History Methods and Preservance

Research methodology seminar on the topic ‘Doing Oral History: Methods and Preservance’ was conducted on November 8, 2018 at 10.30 am for the benefit of students in doing research for projects and dissertations. Dr. Prathibha P R, Assistant Professor, PG Department of History & Research Centre, SN College, Chempazhanthy lectured on the ways of approaching oral sources and methods of collection, analysing and preserving oral sources. Dr. T Pradeep, Principal of the College delivered the inaugural address and Maya L (HOD) welcomed the gathering.

**SREE NARAYANA COLLEGE  
 CHATHANNUR**  
 NAAC ACCREDITED WITH 'B' GRADE  
 DEPARTMENT OF HISTORY

**SEMINAR ON RESEARCH  
 METHODOLOGY**  
 DOING ORAL HISTORY METHODS AND  
 PRESERVANCE

BY  
 Dr PRATHIBHA P R

**2018 November 8, 10:30am**  
 VENUE : SEMINAR HALL

INAUGURAL ADDRESS  
 Dr T PRADEEP (Principal)

COORDINATION  
 Dr MAYA S

All are cordially invited

## 2. Research Models and Methodologies

Department of Chemistry and Science club, Sree Narayana College, Chathannur had organised a seminar on Research Methodology titled, 'Research Models and Methodologies' on 17<sup>th</sup> November 2018 at 10.00 am. An eminent personality Dr. R. Raveendran, UGC Emeritus professor, S. N. College, Kollam and Principal (Rtd.), S. N. College, Varkala in the field of handled the session. The session introduces the different approaches of research model, concepts and statements of research models and methodologies and the concept of research design. The participants actively involved in the end session of interactive session.



**SREE NARAYANA COLLEGE, CHATHANNUR**  
Affiliated to University of Kerala

Department of Chemistry and Science club organise Seminar on

**Research Models and Methodologies**

**Resource person**  
Dr. R. Raveendran  
Principal (Rtd.),  
S. N. College, Varkala &  
UGC Emeritus professor  
S. N. College, Kollam.

DATE : 17<sup>th</sup> November 2018 @ 10.00 am

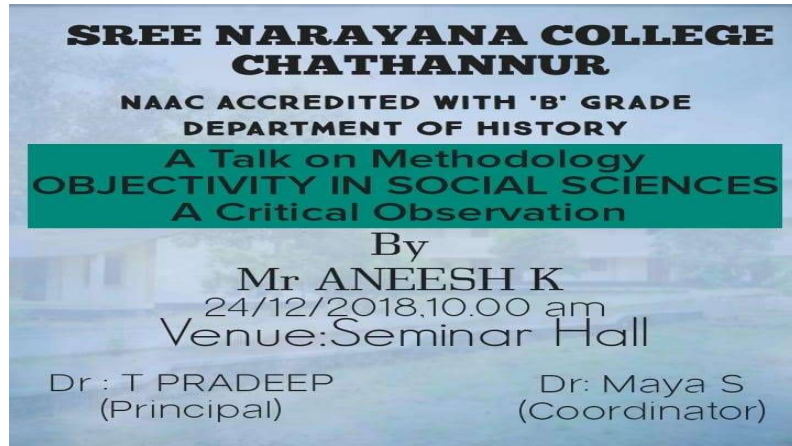
Principal Dr. T. Pradeep	HoD Dr. Sreekala N. B.	Coordinator Mrs. Muthu S.
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The poster features a central image of Dr. R. Raveendran speaking into a microphone. To his right is a hand-drawn diagram illustrating the research process: 'Search' leads to 'Data', which leads to 'Analysis', which leads to 'RESEARCH'. The word 'RESEARCH' is written in large letters, and 'Data' is written twice. There are also some scribbles and arrows indicating a flow or process.



### 3. Talk on Research Methodology Objectivity in Social Science

In order to inculcate an objective outlook in dealing with history and its practice, a research methodology seminar was conducted on " Objectivity in Social Sciences: A critical observation" was organised on 24/12/18 at Seminar Hall. Aneesh K, Assistant Professor in History, KKTM College, Pulloot, Thrissur engaged the classes on objective handling of history and its relevance in achieving proper history.



### 4. Research Designs & Methods

The Post Graduate Department of Mathematics conducted a seminar on "**RESEARCH DESIGN & RESEARCH METHODS**" on 11<sup>th</sup> February 2019 at 02.00 pm. An eminent personality Dr. Anil Kumar S, Assistant Professor, Department of Mathematics Fathima Matha National College, Kollam handled the session. The session introduced the role, purpose and type of Research Designs and Research Methods. The difference between Research Method and Methodology was discussed in this session. After the presentation, there was a healthy discussion about the topic. The audience asked so many questions to the resource person and cleared their doubts





## 5. Qualitative Research Methods

The seminar on Research Methodology organized by the Department of Chemistry and Science club of Sree Narayana College, Chathannur was inaugurated on 16<sup>th</sup> February 2019 at 10.00 am with Dr. Latha M. S., Principal, TKMM College, Nangiarkulangara and Dr. T. Pradeep, College Principal. The inaugural keynote address was delivered by Dr. Latha M S. She lectured on the topic ‘Qualitative Research Methods’ and the session introduces purpose of research, and functions and advantages of qualitative research in the present scenario. Also, she explained the kinds of skills required for qualitative research.



**SREE NARAYANA COLLEGE, CHATHANNUR**  
Affiliated to University of Kerala

Department of Chemistry and Science club organise Seminar on

**Qualitative Research Methods**

*Resource person*  
Dr. M. S. Latha,  
Principal,  
TKMM college,  
Nangiarkulangara  
Alappuzha

DATE : 16<sup>th</sup> February 2019 @ 10.00 am

Principal: Dr. T. Pradeep  
HoD: Dr. Sreekala N. B.  
Coordinator: Mrs. Muthu S.

Research problem

hypothesis test analysis concept

method definition data



## 6. Overview of Sampling Techniques & Methods

The PG Department of Commerce Sree Narayana College organized a seminar on Research Methodology titled “Overview of Sampling Techniques and Methods” by Dr Vishnu S (Assistant Professor, PG& Research Department of Commerce, Sree Narayana College, Kollam) on 1<sup>st</sup> March 2019 at 10 am. Dr. Vishnu gave an enlighten speech on the sampling techniques, methods and importance of sample in research work.



**SREE NARAYANA COLLEGE CHATHANNUR**

**PG DEPARTMENT OF COMMERCE**

**SEMINAR ON**

**RESEARCH METHODOLOGY**

**Topic: Overview of Sampling Techniques and Methods**

**RESOURCE PERSON :**  
Dr S Vishnu  
PG and Research Department of Commerce  
SREE NARAYANA COLLEGE KOLLAM

**1st March 2019 10.00am**  
**Venue: Seminar Hall**

Dr. Pradeep T  
Principal

Smt Jiji P, Smt Divya B  
Cordinators

## 7. Hands On Training on SPSS

The Core objective of the workshop was to equip the graduate and post graduate students with set of skills and potentiality to undertake the research very effectively in the discipline of commerce and to turn completed projects in to publishable material of high quality in the form of articles, journals and book. The workshop is designed to offer the practical guidelines and direct the students through all stages of research from identifying a research problem to the submission of project. The work shop consists of theory and practical. The workshop started with a formal inauguration session at 10am by our principal, Dr. Pradeep T. The coordinator of seminar, Smt. Divya B (Department of Commerce) welcomed all to the session. The workshop was attended by 35 students. Majority of the participants are PG Students. Through this workshop, the students realized how to conduct analysis by using SPSS and how to interpret the result. Through this workshop the students understand how to enter data in SPSS and how to interpret the result.



**SREE NARAYANA COLLEGE  
CHATHANNUR**

**PG DEPARTMENT OF COMMERCE**

**HANDS ON TRAINING ON  
SPSS**

**RESOURCE PERSON  
DR. K PRADEEP KUMAR**  
ASSOCIATE PROFESSOR, GOVT COLLEGE, ATTINGAL

**3rd MARCH 2019  
10.00 am**

**Smt Divya B & Smt Biji B  
coordinators**

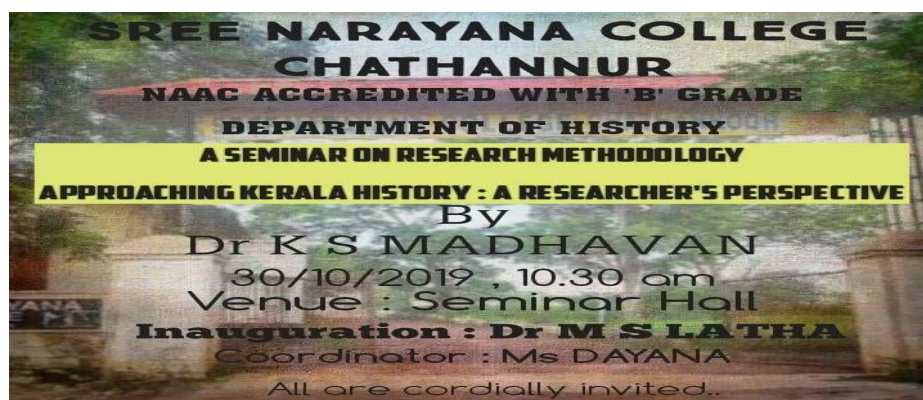
**DR.T PRADEEP  
principal**



**2019-20**

1. Seminar on Research Methodology- Approaching Kerala History: A Researcher's Perspective

Seminar on Research Methodology entitled 'Approaching Kerala History: A Researcher's Perspective' was held on October 30, 2019 at 10.30 am in the Seminar Hall. Professor of History, Calicut University, Dr. K S Madhavan lectured on the complexities of research and on the perspective of research approach that shall be taken care of by the students in doing history with special reference to Kerala History. The methodology class was in tune with the curriculum specifying on a project on Kerala History. The limitations, scope, vastness, sub fields etc of Kerala history and cultural history was focused. Principal, Dr. M.S. Latha, delivered the inaugural address and Ms. Dayana A (HOD) gave the welcome address.



2. Fundamentals of Research Methodology

The Science Club and Department of Chemistry, Sree Narayana College, Chathannur had jointly organized a seminar on Research Methodology titled, 'Fundamentals of Research Methodology' by Mr. Binoy S, Assistant professor, Department of Commerce, Sree Narayana College, Chathannur on 23<sup>rd</sup> November 2019 at 10.00 am. Mr. Binoy gave informative speech on Research methodology and explained the objectives and motivation of research, ethics in research, research approaches, significance of approaches, research strategy and criteria of good research in detail. The felicitation was given by Dr. Subhash Chandran C S, Principal and explained the importance of research in the present scenario. The seminar was attended by all the teachers, undergraduate and graduate students in the college.

**SREE NARAYANA COLLEGE, CHATHANNUR**  
Affiliated to University of Kerala

Department of Chemistry and Science club organise Seminar on

**Fundamentals of Research Methodology**

*Resource person*  
Mr. Binoy S.  
Assistant Professor,  
Department of Commerce,  
S. N. College,  
Chathannur.



DATE : 23<sup>rd</sup> November 2019 @ 10.00 am

Principal Dr. Subhash Chandran C. S.	HoD Dr. Sreekala N. B.	Coordinator Mrs. Muthu S.
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### 3. Empiricism & History

A Research Methodology Seminar on "Empiricism and History" was conducted on 25/11.2019 at 10 am in the Department of History. Vineeth R, Assistant Professor, Department of History, University of Calicut lectured on the acquisition of knowledge, evidence-based research, and making of concept.

**SREE NARAYANA COLLEGE  
CHATHANNUR**  
NAAC ACCREDITED WITH 'B' GRADE  
DEPARTMENT OF HISTORY

**A Talk on Methodology  
EMPIRICISM AND HISTORY**

By  
VINEETH R  
25/11/2019, 10.00 am

**Venue: Seminar Hall**

Dr. M S LATHA (Principal) Ms DAYANA (Coordinator)


### 4. Introduction to Research

Science club and Department of Chemistry, Sree Narayana College, Chathannur jointly organised a seminar on research methodology, titled 'Introduction to Research' on 4<sup>th</sup> January 2020. The resource person for the event was Dr. Divya V., Assistant professor, Department of Chemistry, Sree Narayana College, Punalur. Dr. Divya gave an enlightening speech on 'Introduction to Research'. Dr. Divya discussed designing strategies for development, discovering hidden facts, explaining unexplained social phenomena and challenging existing theories.

**SREE NARAYANA COLLEGE, CHATHANNUR**  
Affiliated to University of Kerala


Department of Chemistry and Science club organise Seminar on

**Introduction to Research**



Principal  
Dr. C. S. Subhash Chandran

**Resource person**  
Dr. Divya V.  
Assistant professor,  
Department of Chemistry,  
Sree Narayana College,  
Punalur.



Coordinator  
Mrs. Muthu S.

**DATE : 4<sup>th</sup> January 2020 @ 10.00 am**

HoD  
Dr. Sreekala N. B.



### 5. How to Start a Research Work?

The Post Graduate Department of Mathematics conducted a one- hour webinar on " HOW TO START A RESEARCH WORK?" on 16<sup>th</sup>January 2020 at 03.00pm in the seminar hall. Smt. Rasmi. K, the HOD in charge of department of Mathematics, delivered the welcome speech. The presidential address was delivered by Dr. C S Subhash Chandran, Principal-in-charge of the college. Very effective and informative session was done by Dr. Mathew Varkey T K, Associate Professor, Department of Mathematics TKM College of engineering Kollam. The session introduced the values of research and some essential ideas for good research work. The session was very useful to those who wishes to be in research fields and also to those who aim for their doctorates. The participants actively involved in the end session of interactive session. A total of 48 students were participated in the program.



## 6. Explorations in Business Research

The PG Department of Commerce Sree Narayana College organized a Webinar on Research Methodology titled “EXPLORATIONS IN BUSINESS RESEARCH” on 22<sup>nd</sup> May 2020 at 3 pm via Google Meet. The resource Person of the webinar Dr. Lekshmy Prasannan (Asst. Professor, Sree Narayana College, Varkala). Through this webinar the students got an idea about different types of research including exploratory research, its types, importance and exploratory techniques. All the faculties & students from commerce department actively participated in the webinar.



## 7. Research Design & Measurement

The PG Department of Commerce, during the covid pandemic period organized a Webinar under the leadership of Dr. Parvathy Nand & Smt. Biji B. The resource person of the webinar was Dr. Simu Rajendran, Asst. Professor, PG & Research Department of Commerce, S N College, Kollam. The topic of the webinar was RESEARCH DESIGN & MEASUREMENT. The webinar was inaugurated by our Principal, Dr. M S Latha. All faculties from commerce department and all PG Students from

the department joined the webinar. The resource clearly explained to the students about the methodologies, tools & techniques to conduct research and how to measure the data also.

SREE NARAYANA COLLEGE  
CHATHANNUR

PG DEPARTMENT OF COMMERCE

**WEBINAR ON  
RESEARCH  
METHODOLOGY**

TOPIC: RESEARCH DESIGN AND MEASUREMENT

27th MAY 2020 3.00pm GOOGLE MEET

RESOURCE PERSON

**DR. SIMU RAJENDHRAN**  
ASSISTANT PROFESSOR,  
PG AND RESEARCH DEPARTMENT OF  
COMMERCE, SREE NARAYANA COLLEGE,  
KOLLAM

DR. PARVATHY NAND & SMT. BIJI B  
Cordinators

DR. MS. LATHA  
principal

**2020-21**

1. Understanding Research Various Ways of Appreciating History & the Application of Methodology in Writing Project

A Webinar on Research Methodology was held on July 20, 2020 at 11.00 am for the benefit of students in doing history. Being a part of the curriculum, the webinar was intended to provide an overall view of writing a proposal and project sticking within the ambit of scientific writing. Dr. Vysakh A S, Assistant Professor and Research Supervisor, SN College, Chempazhanthy lectured on 'Understanding Research'-various ways of approaching history and the application of methodology in writing projects/ dissertation/ theses.

**SREE NARAYANA COLLEGE  
CHATHANNUR**

NAAC ACCREDITED WITH 'B' GRADE  
DEPARTMENT OF HISTORY

An Online Webinar on Research Methodology  
Understanding Research Various Ways of Appreciating History and the  
Application of Methodology in Writing Projects

By  
**Dr VYASHAK A S**  
20/07/2020. 11 am  
On GOOGLE MEET

**INAUGURATION : DR M S LATHA**  
Coordinator: Dr ARDRA S

All are Cordially Invited...

## 2. Research Methodology: Colonial Sources in Constructing Kerala History

Stressing on the sources of writing history, a methodology seminar was conducted on " Colonial Sources in constructing Kerala History " on 06/09/20 at Seminar Hall, Renjitha V.R, Govt HSS Teacher, Elamkulam, Malappuram led the session on the myriad dimensions of colonial sources, the places of its availability, repositories, the way of reading them, statistical accounts, colonial perspective on natives and the methods of penning them in to text.



## 3. Introduction to Research Methodology

The webinar on Research Methodology organized by the Department of Chemistry and Science club of Sree Narayana College, Chathannur was inaugurated on 20<sup>th</sup> October 2020 at 7 pm on Google Meet Platform (meeting link: <http://meet.google.com/vtg-xomv-vtm>). The inaugural keynote address was delivered by Dr. R. Raveendran, UGC Emeritus professor S. N. College, Kollam and Principal (Rtd.), S. N. College, Varkala who presented an informative speech on 'Introduction to Research Methodology'. The session introduced utility of research, finding research problem, characteristics of research, need for research and scope/significance of research. UG and PG students and teachers actively participated in the webinar. Also, the participants actively involved in the end session of interactive session through google meet. The vote of thanks was delivered by Dr. Vidhya R. V., Assistant professor in Chemistry.



**SREE NARAYANA COLLEGE, CHATHANNUR**  
 Affiliated to University of Kerala

Department of Chemistry and Science club organise Webinar on

**Introduction to Research Methodology**

*Resource person*  
**Dr. R. Raveendran**  
 Principal (Retd.),  
 S. N. College, Varkala &  
 UGC Emeritus professor  
 S. N. College, Varkala.



**DATE : 20<sup>th</sup> October 2020 @ 7.00 pm**

Principal: Dr. M. S. Latha      HoD: Dr. Sreekala N. B.      Coordinator: Mrs. Muthu S.

Webinar link: <http://meetgoogle.com/vtg-xomy-vtm>


#### 4. Fundamentals of Research Methodology

The science club and department of Chemistry, Sree Narayana College, Chathannur jointly organized a webinar on research methodology, titled, ‘Fundamentals of Research Methodology’ by Dr. Divya V., Assistant professor, Department of Chemistry, Sree Narayana College, Punalur on 5<sup>th</sup> January 2021 at 7.00 pm on Google Meet Platform (meeting link: <http://meet.google.com/gwo-bcho-byx>). Dr. Divya V gave an enlighten speech on the fundamentals of research methodology and discussed the concept of research, research method and methodology, understanding the pedagogy of research and making familiar with the relation between theory and research. Dr. M. S. Latha, Principal and Dr. N. B. Sreekala, Head of the Department, Department of Chemistry spoke at the event. The webinar was coordinated by science club members Dr. Vidhya R. V., Assistant professor, Department of Chemistry and Mrs. Muthu S., Assistant professor, Department of Chemistry. Faculties of all departments, undergraduates and graduate students in the college attended the webinar held via google meet.


**SREE NARAYANA COLLEGE, CHATHANNUR**  
 Affiliated to University of Kerala

Department of Chemistry and Science club organise Webinar on

**Fundamentals of Research Methodology**



*Resource person*  
**Dr. Divya V.**  
 Assistant professor,  
 Department of Chemistry,  
 Sree Narayana College,  
 Punalur.



**DATE : 5<sup>th</sup> January 2021 @ 7.00 pm**

Principal: Dr. M. S. Latha      HoD: Dr. N. B. Sreekala      Coordinators: Dr. Vidhya R. V. and Mrs. Muthu S.      Webinar link: <http://meetgoogle.com/gwo-bcho-byx>

## 5. Research Avenues in Mathematics

The Department of Mathematics had organized a webinar on RESEARCH AVENUES IN MATHEMATICS on 19<sup>th</sup> February 2021 Friday at 5.00 pm. An eminent personality Dr. Dilipkumar, Assistant Professor, Dept. Of Mathematics, Kerala University handled the session. The Head of the Department, Dr. Rani Rajeevan welcomed all the participants in the session. The session introduces the research avenues in mathematics and gives an idea about how to do research in mathematics. The participants actively involved in the end session of interactive session. A total of 48 students were participated in the program.



**SREENARAYANA COLLEGE**  
CHATHANNUR, KOLLAM  
POST GRADUATE DEPARTMENT OF MATHEMATICS

RESOURCE PERSON

**RESEARCH AVENUES  
IN MATHEMATICS**

On 19th Feb. 2021, Friday  
at 05:00 pm  
Platform: Google Meet

**DR. DILIP KUMAR**  
Assistant Professor, Dept. of Mathematics, Kerala  
University, Karyavattom Campus, Trivandrum

Dr. LATHAM S  
PRINCIPAL

Dr. RANI RAJEEVAN  
HOD & CONVENER

RASMI KUNDANCHERI  
COORDINATOR


## 6. Data Analysis & Regression

The one-day workshop on Data Analysis and Regression was composed by the PG Department of Commerce on 16<sup>th</sup> March 2021 at 10.00 am. The workshop intends to explain the variability in dependent variable by means of one or more of independent or control variables. The resource person is Dr. Berny B Raj, HOD and Assistant Professor in Commerce, Sree Narayana College for Women, Kollam. The session was welcomed by Smt. Jiji P. The inaugural address was delivered by Dr. M S Latha, Principal of the college. The morning session the discussed the theoretical part of Linear Regression Analysis and its 3 stages i.e., analysing the correlation and directionality of the data, estimating the model, i.e., fitting the line, and evaluating the validity and usefulness of the mode. The afternoon session incorporated the discussion of Data analysis, its applicability and its types such as Descriptive analysis, exploratory analysis, Inferential analysis, Predictive analysis, Causal analysis and Mechanistic analysis. The vote of thanks was delivered by Smt. Divya B, Assistant Professor in Commerce.

**SREE NARAYANA COLLEGE  
CHATHANNUR**  
PG DEPARTMENT OF COMMERCE

**WORKSHOP ON  
DATA  
ANALYSIS AND  
REGRESSION**  
ON GOOGLE MEET

16th MARCH 2021 10.00 AM



**RESOURCE PERSON  
BERNY B RAJ**  
ASSISTANT PROFESSOR,  
DEPARTMENT OF COMMERCE, SREE  
NARAYANA WOMEN'S COLLEGE,  
KOLLAM

Jiji P. & Smt Divya B  
coordinators

Dr MS Latha  
principal

7. Data Processing & Research Methodology

The webinar of Research Methodology with special focus in Data Processing and Research Methodology was organised by the PG Department of Commerce on 3<sup>rd</sup> March 2021 @ 3.00 pm by the invited resource person Dr. Rinku Babu, Assistant Professor in Commerce, SN College, Varkala. The webinar was designed for the PG students, research scholars and faculties who are engaged in research work and are planning to do the activity.

**SREE NARAYANA COLLEGE  
CHATHANNUR**  
PG DEPARTMENT OF COMMERCE

**WEBINAR ON  
RESEARCH  
METHODOLOGY**

TOPIC: DATA PROCESSING AND RESEARCH METHODOLOGY  
3rd MARCH 2021 3.00 PM



**RESOURCE PERSON  
Dr. RINKU BABU**  
ASSISTANT PROFESSOR, DEPARTMENT OF  
COMMERCE AND HOTEL MANAGEMENT,  
SIVAGIRI SREE NARAYANA COLLEGE, VARKALA

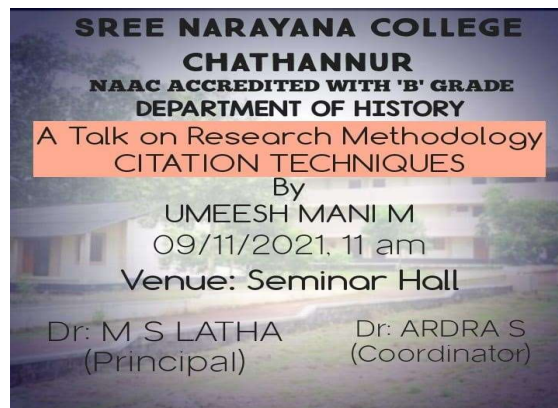
Smt Parvathy Nandh & Smt Bijl B  
coordinators

DRMS LATHA  
principal

**2021-22**

1. Talk on Research Methodology Citation Techniques

A research methodology seminar on Citation was conducted for the degree students to enable them in understanding various citation styles, particularly in use for their dissertation and future purposes. Umesh Mani M, Assistant Professor, Dept. of History, University of Kerala lectured on the topic. The seminar was held on 9/11/21 at 11 am. In the Department of History Mock practice of various citation styles were also conducted.



2. Art of Writing Questionnaire

Compared to other research methods such as the interview, the questionnaire helps bring greater structure to any research, which can help maximize the success of whatever the researcher trying to investigate and answer. Keeping in mind, the PG Department of Commerce a webinar in Research Methodology on the topic titled, Art of Writing Questionnaire on 10<sup>th</sup> December 2021 @ 3.00 pm. The session was handled by the eminent personality Dr.Archa.S.S. Assistant Professor, PG and Research Department of Commerce, SN College, Kollam.



### 3. Basic knowledge of Research

The seminar on Research Methodology organized by the Department of Chemistry and Science Club, Sree Narayana College, Chathannur was inaugurated on 12<sup>th</sup> December 2021 at 10.00 am with Dr. Sruthy B, Research Associate, Phytochemistry and Phytopharmacology Department, KSCSTE-JNTBGRI, Palode, Thiruvananthapuram and Dr. M. S. Latha, Principal. The welcome address was given by Dr. Sreekala N. B., Head of the Department, Department of Chemistry.

**SREE NARAYANA COLLEGE, CHATHANNUR**  
Affiliated to University of Kerala

Department of Chemistry and Science club organise Seminar on

**Research Methodology: Basic knowledge of Research**

**Resource person**  
Dr. Sruthy B.  
Research Associate  
Phytochemistry and  
Phytopharmacology Department  
KSCSTE- JNTBGRI, Palode,  
Thiruvananthapuram

**DATE : 10<sup>th</sup> December 2021 @ 10.00 am**

Principal  
Dr. M. S. Latha

HoD  
Dr. Sreekala N. B.

Coordinator  
Mrs. Muthu S.



### 4. Research Methodology

The Science Club and Department of Chemistry, Sree Narayana College, Chathannur had jointly organized a webinar on Research Methodology by Dr. Achuthsankar S. Nair, Professor, Department of computational Biology & Informatics, University of Kerala, on 15th January 2022. Dr. Achuthsankar gave an enlightening speech on Research methodology discussing various steps in research process and how to write research articles, its publication procedures etc. The event was coordinated by science club members Dr. Vidhya R. V., Assistant Professor, Department of Chemistry and Ms. Muthu S., Assistant Professor, Department of Chemistry. Faculties of all departments, undergraduate and graduate students attended the webinar held via Google Meet.



## 5. Research Methodology: Report Writing

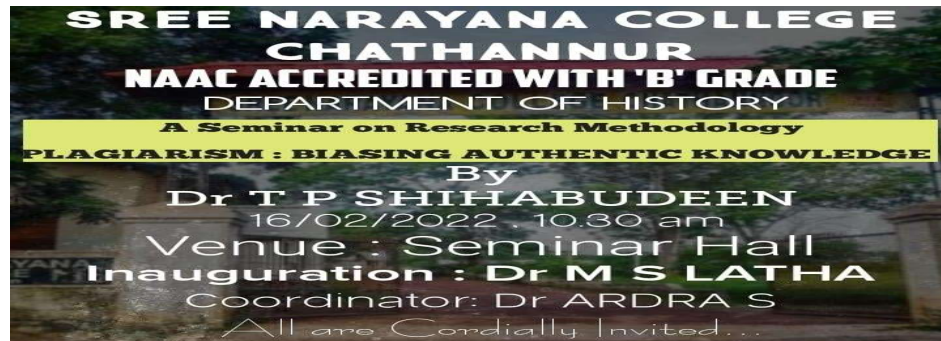
For final year PG & UG students, The PG Department of Commerce organized a Seminar on Research Methodology on the Topic ‘REPORT WRITING’ on 4/2/2022 at 10 am. The resource person of the seminar was **Dr. A RAJASEKARAN**, Assistant Professor, PG & Research Department of commerce, Sree Narayana College, Kollam. The Resource person explained How to write a Good Report & qualities needed for a good report & what are the contents of a Good Research Report. After the presentation of the Resource Person, an interactive session started and the students actively participated in it by asking question related to Report Writing. 44 students from both Final B. Com and PG classes participated this programme.



## 6. Plagiarism: Biasing Authentic Knowledge

Seminar on Research Methodology entitled ‘Plagiarism: Biasing authentic Knowledge’ was held on February 16, 2022 in the Seminar Hall at 10.30 am. The focus of the seminar was Plagiarism and its implications to real knowledge transmission. Dr. Shihabudheen T P, Assistant Professor,

School of Distance Education, University of Calicut lectured on the ethics in research, types of plagiarism, impediments to research, plagiarism checkers and how it affects knowledge transmission. The seminar was pertinent as plagiarism is frequent in research in various forms.



#### 7. Identification of Research problem

The PG Department of Commerce Sree Narayana College organized a Webinar on Research Methodology titled “IDENTIFICATION OF RESEARCH PROBLEM” on 5<sup>th</sup> March 2022 at 3 pm via Google Meet. The resource Person of the webinar Dr. Nithya U S (Asst Professor, Sree Narayana Women’s College, Kollam). The Resource person clearly explained how the researcher identifies a research problem through his observation, knowledge, wisdom and skills. All the faculties & students from commerce department actively participated in the webinar. Total 40 students participated the webinar.



## 8. Research Methodology

The Post Graduate Department of Mathematics in Association with IOAC, S N College, Chathannur conducted a webinar on “Research **Methodology**” on 18<sup>th</sup> March 2022 at 7.30 pm via Google Meet. The aim of the webinar was to provide awareness about the concept of Research Methodology. The session started at 7.30 pm. Welcome speech was delivered by the convener, Dr Rani Rajeevan, HOD, Department of Mathematics. The session was presided over by Dr. M.S Latha, Principal, S N College Chathannur. The class was handled by Dr. N. Suresh Babu, Associate Professor & Research Guide, Department of Mathematics, University College, Thiruvananthapuram. There were 25 participants in the webinar. The aim of the webinar was well achieved. The session was very useful to those who wishes to be in research fields and they got an insight in the concept of research methodology.



The poster features a central portrait of Dr. N. Suresh Babu. The text is arranged in a structured layout with a mix of bold and italicized fonts. The background is a light, abstract pattern.

**SREE NARAYANA COLLEGE  
CHATHANNUR**  
PG Department of Mathematics  
*Organizes*  
**A Webinar on Research Methodology**  
In Association with IQAC, S N College  
Chathannur  
*Resource person*  
**Dr. N Suresh Babu**  
*Associate Professor & Research Guide  
Dept. of Mathematics, University College  
Thiruvananthapuram*  
**On 18.03.2022 at 7.30 pm**  
**Platform : Google Meet**  
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**Dr. N B Sreekala**  
IQAC Co ordinator  
Convener  
**Dr. Rani Rajeevan**  
HOD, Dept. of Mathematics  
Principal  
**Dr. M S Latha**

## 9. Data Analysis with Selected Multivariate Methods

The PG Department of Commerce, S N College, Chathannur organised a one-day workshop on Data Analysis on Selected Multivariate Methods on 23<sup>rd</sup> March 2022 at 10.00 am. The coordinator of the program Smt. Biji B commenced the program with a silent prayer and welcomed the quorum. The invited resource person to the program is Dr. Vishnu S, Assistant Professor in Commerce. The session highlights the Dependence and Independence Techniques for the research studies and also discussed the means of evaluating the multiple variables to identify the possible association among them. It also focussed on eleven multivariate analysis techniques such as Initial Step—Data Quality, Multiple Regression Analysis, Logistic Regression Analysis, Discriminant Analysis, Multivariate Analysis of Variance (MANOVA), Factor Analysis, Cluster Analysis,



Multidimensional Scaling (MDS), Correspondence Analysis, Conjoint Analysis, Canonical Correlation, Structural Equation Modelling and its applicability. The session was ended with vote of thanks delivered by Dr. Parvathy Nand, Assistant Professor in Commerce. Total 49 students participated the seminar.

**SREE NARAYANA COLLEGE  
CHATHANNUR**

**PG DEPARTMENT OF COMMERCE**

**WORKSHOP ON  
DATA ANALYSIS  
WITH SELECTED  
MULTIVARIATE  
METHODS**

23rd MARCH 2022 10.00AM

**RESOURCE PERSON**  
**DR.VISHNU S**  
ASSISTANT PROFESSOR  
PG DEPARTMENT OF COMMERCE SREE  
NARAYANA COLLEGE CHATHANNUR

**DR. PARVATHY NANDH & SMT BIJI B**  
coordinators

**DR.MS LATHA**  
principal


**LIST OF FACULTIES AWARDED DOCTORAL DEGREE**

<b>Sl No</b>	<b>Name of the Faculty</b>	<b>Department</b>	<b>Year</b>
1.	Dr. Sumithra I S	Chemistry	2018
2.	Dr. Rani Rajeevan	Mathematics	2019
3.	Dr. Parvathy Nand	Commerce	2020
4.	Dr. Kiran Mohan M	Malayalam	2021
5.	Dr. Sarika S	Chemistry	2022
6.	Dr. Deepa M J	Chemistry	2022

# PAPER PUBLICATIONS

2017-18

- **Dr. Rani Rajeevan:** Department of Mathematics



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Vol. 6, Issue 6, June 2017

## On PFSE Domination and PFSE-t Domination

**T K Mathew Varkey, Rani Rajeevan**  
Assistant Professor, Department of Mathematics, T.K.M College of Engineering, Kollam, Kerala, India  
Assistant Professor, Department of Mathematics, Sree Narayana College, Chathannur, Kollam, Kerala, India

**ABSTRACT:** Let  $T \subseteq E$  be an edge dominating set of a fuzzy soft graph (FSG)  $G_{A,V}$ . Then  $T$  is said to be a **Perfect fuzzy soft edge dominating (PFSED) set** if for every edge in  $E - T$  is adjacent to exactly one edge in  $T$  for each parameter  $e \in A$ . The minimum cardinality of a minimal perfect fuzzy soft edge dominating set is called a **perfect fuzzy soft edge domination number** and is denoted by  $\gamma_{ps}^1(G_{A,V})$ .

**KEYWORDS:** Perfect fuzzy soft edge domination, perfect fuzzy soft edge domination number, perfect fuzzy soft edge domination and perfect fuzzy soft t-edge domination number.

### I N T R O D U C T I O N

The concept of domination in fuzzy graphs was first introduced by A Somasundaram and S Somasundaram [10]. C.Y Ponnappan, S Basheer Ahmed and P Surulnathan [6] discussed edge domination in fuzzy graphs. S Ramya and S Lavanya[5] discussed perfect vertex(edge) domination in fuzzy graphs. The notion of fuzzy soft graphs and some operations in fuzzy soft graphs was introduced by Sumit Mohinta and Samanta[9]. Muhammed Akram and Saira Nawas[8] introduced different types of fuzzy soft graphs and their properties and later on T K Mathew varkey and Rani Rajeevan introduced the concept of edge domination in fuzzy soft graphs[3] and perfect vertex domination in fuzzy soft graphs[4]. In this paper we introduce the concepts of perfect edge domination in fuzzy soft graphs, perfect fuzzy soft edge domination number, perfect fuzzy soft t-edge domination and perfect fuzzy soft t-edge domination number.

### II. PRELIMINARIES

**Definition 2.1[7]** Let  $G$  be a graph with  $V$  be the set of all vertices and  $E$  be the set of all edges. If there exist two functions  $\rho: V \rightarrow [0, 1]$  and  $\mu: V \times V \rightarrow [0, 1]$  such that  $\mu(x, y) \leq \rho(x) \wedge \rho(y) \forall x, y \in V$ . Then  $G(\rho, \mu)$  is called a fuzzy graph.

**Definition 2.2 [8]** Let  $V = \{x_1, x_2, x_3, \dots, x_n\}$  (non empty set)  $E$  (parameters set) and  $A \subseteq E$ . Also let  $\rho_e: V \rightarrow [0, 1]$  such that each  $x_i \in V$  mapped to  $\rho_e(x_i)$ , where  $\rho_e = \rho(e)$  is the  $\rho$  image of  $e \in A$  and  $\mu_e: V \times V \rightarrow [0, 1]$  such that each  $(x_i, x_j) \in E$  mapped to  $\mu_e(x_i, x_j)$ , where  $\mu_e = \mu(e)$  is the  $\mu$  image of  $e \in A$ , then the pair  $((A, \rho), (A, \mu))$  is called a fuzzy soft graph if and only if  $\mu_e(x_i, x_j) \leq \rho_e(x_i) \wedge \rho_e(x_j) \forall e \in A$  and  $\forall i, j = 1, 2, 3, \dots, n$  is denoted by  $G_{A,V}$ .

**Definition 2.3 [8]** The underlying crisp graph of a fuzzy soft graph  $G_{A,V} = ((A, \rho), (A, \mu))$  is denoted by

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## Perfect Vertex Domination in Fuzzy Soft graphs

**T K Mathew Varkey\* and Rani Rajeevan\*\***

\*Department of Mathematics, T.K.M College of Engineering,  
Kollam-5, Kerala, India.

\*\*Department of Mathematics, Sree Narayana College, Chathannur,  
Kollam, Kerala, India.

### Abstract

Let  $G_{A,V}$  be a fuzzy soft graph and let  $x_i$  and  $x_j$  be two vertices of  $G_{A,V}$ . If  $\mu_e(x_i, x_j) \leq \rho_e(x_i) \wedge \rho_e(x_j)$  for each parameter  $e \in A$  and  $\forall i, j = 1, 2, 3, \dots, n$ , then we say that  $x_i$  dominates  $x_j$  in  $G_{A,V}$ . A subset  $S$  of  $V$  is called a **fuzzy soft dominating set** if for every  $x_j \in V - S$ , there exist a vertex  $x_i \in S$  such that  $x_i$  dominates  $x_j$ . In this paper we introduce the concepts of perfect fuzzy soft vertex domination, perfect fuzzy soft vertex domination number, perfect fuzzy soft t-vertex domination.

**Keywords:** Perfect fuzzy soft vertex domination, perfect fuzzy soft vertex domination number, perfect fuzzy soft t-vertex domination, perfect fuzzy soft t-vertex domination number.

### INTRODUCTION

The concept of domination in fuzzy graphs was first introduced by A Somasundaram and S Somasundaram [8]. Perfect vertex (edge) domination in fuzzy graphs was studied by S Ramya and S Lavanya[4]. In 2015, Sumit Mohinta and Samanta[7] introduced the notion of fuzzy soft graphs and some operations in fuzzy soft graphs

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## Some Connected Domination in Fuzzy Soft Graphs



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Authors: Rani Rajeevan and T.K. Mathew varkey

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Rani Rajeevan and T K Mathew varkey "Some Connected Domination in Fuzzy Soft Graphs", *International Journal of Mathematics Trends and Technology (IJMTT)*. V56(3):173-179 April 2018. ISSN:2231-5373. [www.ijmttjournal.org](http://www.ijmttjournal.org). Published by Seventh Sense Research Group.

### Abstract

Let  $G_{A,V}$  be fuzzy soft graph. A fuzzy soft accurate dominating set  $S_a \subseteq V$  is said to be a fuzzy soft connected accurate dominating set if for each parameter  $a \in A$ ,  $S_a$  is connected.

### ON FUZZY SOFT EDGE DOMINATION

Mathew Varkey T.K.<sup>1</sup>, Rani Rajeevan<sup>2</sup> §

<sup>1</sup>Department of Mathematics  
T.K.M. College of Engineering  
Kollam-5, Kerala, INDIA

<sup>2</sup>Department of Mathematics  
Sree Narayana College  
Chathannur, Kollam, Kerala, INDIA

**Abstract:** Let  $G_{A,V}$  be a fuzzy soft graph (FSG). A subset of  $T$  is  $E$  said to be a *fuzzy soft edge dominating (FSED)* set if for every edge in  $E - T$  is adjacent to at least one edge in  $T$  for each parameter  $e \in A$ . The minimum fuzzy soft cardinality of an edge dominating set is called a fuzzy soft edge domination number and is denoted by  $\gamma^1(G_{A,V})$ .

**Key Words:** Edge domination, fuzzy soft edge domination, fuzzy soft edge domination number, fuzzy soft  $t$ -edge domination and fuzzy soft  $t$ -edge domination number

#### 1. Introduction

A Somasundaram and S Somasundaram [8] first introduced the concept of domination in fuzzy graphs. C.Y ponnappan, S. Basheer Ahamed and P. Surulnathan [5] discussed edge domination in fuzzy graphs. Sumit Mohinta and Samanta [7] introduced the notion of fuzzy soft graphs and some operations in fuzzy soft graphs and later on Muhammed Akram and Saira Nawas [6] introduced different types of fuzzy soft graphs and their properties.

In this paper we introduce the concepts of edge domination in fuzzy soft graphs, fuzzy soft edge domination number, fuzzy soft  $t$ -edge domination and fuzzy soft  $t$ -edge domination number.

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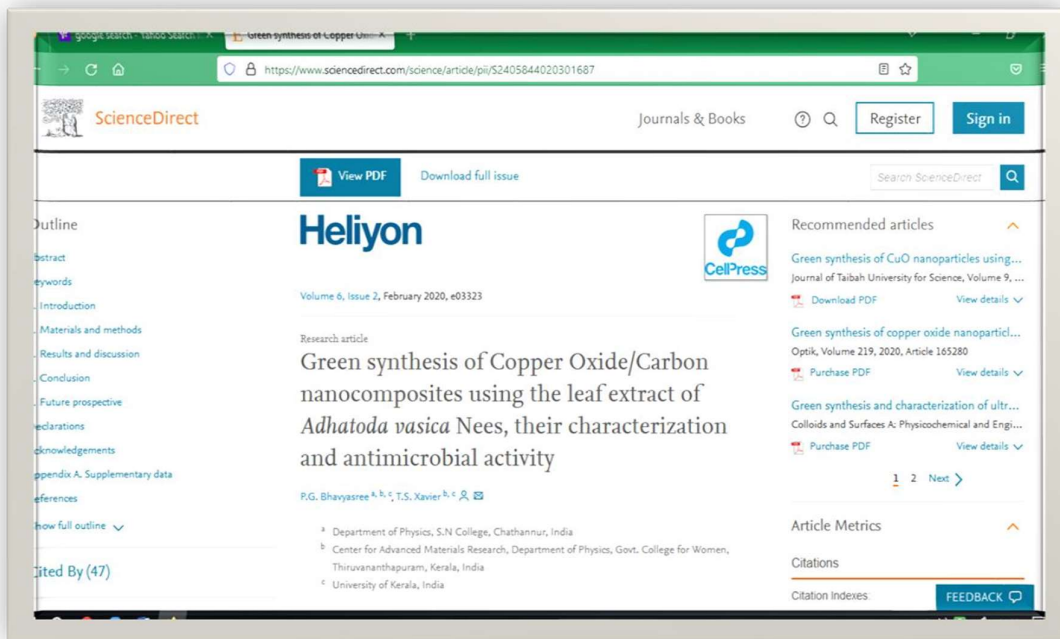
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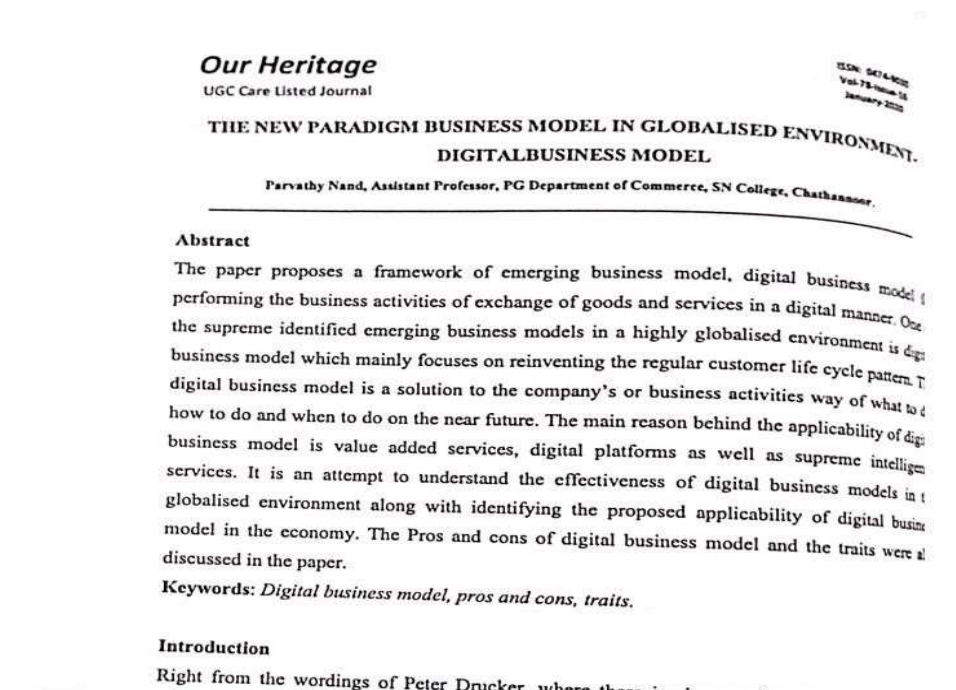
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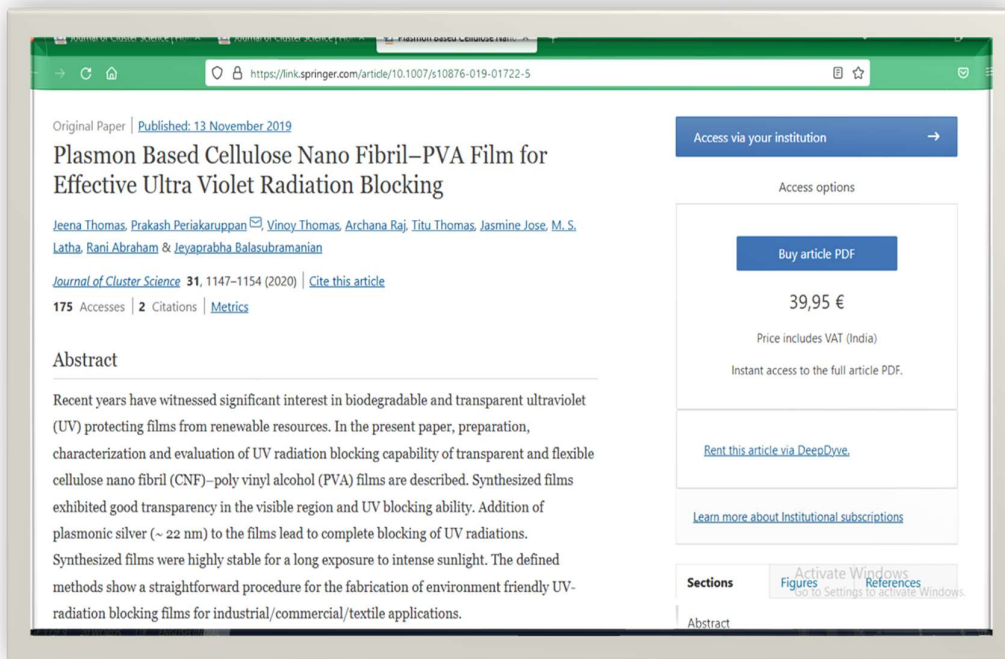
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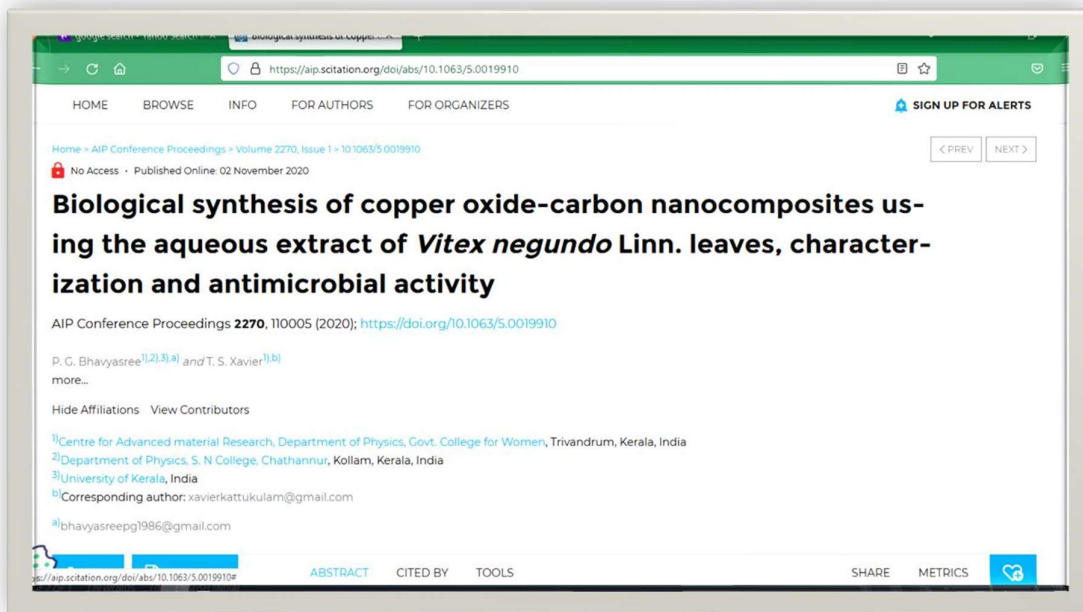
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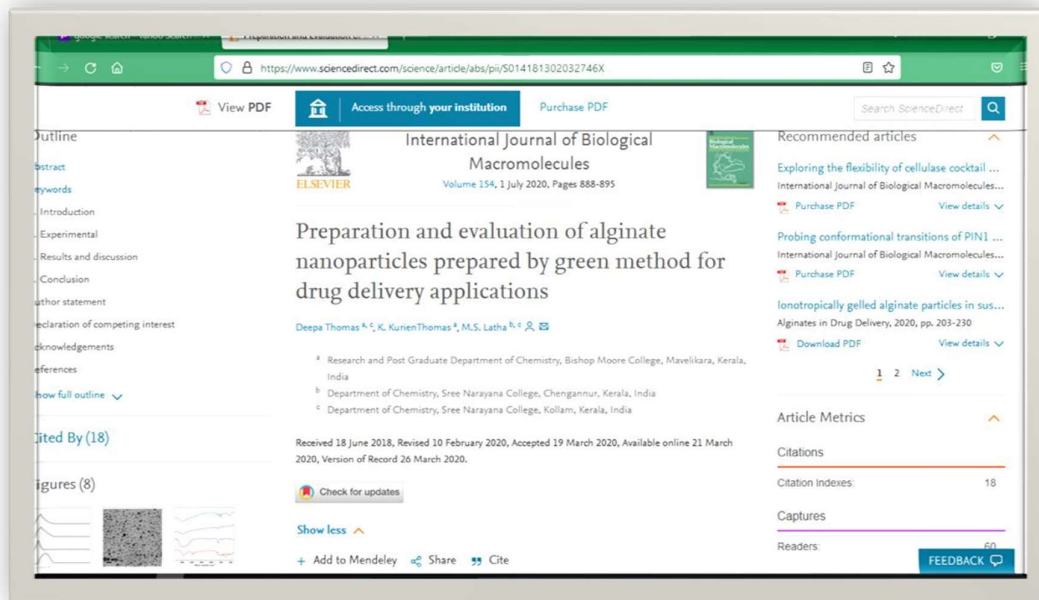
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Research paper

### Alginate film modified with aloevera gel and cellulose nanocrystals for wound dressing application: Preparation, characterization and in vitro evaluation

Deepa Thomas <sup>a</sup>, Megha S. Nath <sup>a</sup>, Neethu Mathew <sup>a</sup>, Reshmy R <sup>a</sup>, Eapen Philip <sup>a</sup>, M.S. Latha <sup>b</sup>

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IN-SILICO ANALYSIS OF POTENTIAL ANTIMYCOBACTERIAL COMPOUNDS PRESENT IN CYNODON DACTYLON

Sheeba Baby Alex <sup>1,2</sup> and M. S. Latha <sup>\*2,3</sup>

Department of Chemistry <sup>1</sup>, St. Stephen's College, Pathanapuram - 689695, Kerala, India.  
Department of Chemistry <sup>2</sup>, Sree Narayana College, Kollam - 691001, Kerala, India.  
Department of Chemistry <sup>3</sup>, Sree Narayana College, Chathannur - 691578, Kerala, India.

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## EVALUATION OF ANTICANCER PROPERTY OF AMBLYONE FROM AMORPHOPHALLUS PAEONIFOLIUS (ELEPHANT FOOT YAM) USING IN SILICO ANALYSIS.

- **Source:** Journal of Advanced Scientific Research. 2020 Supplement, Vol. 11, p184-189. 6p.
- **Author(s):** Latha, M. S., Alex, Anju, John, Divya Mariam
- **Abstract:** The present work aims at evaluating the anticancer activity of Amblyone, a phytochemical present in the tuber of Amorphophallus Paconifolius (Elephant foot yam) and compare its activity with the commonly used antiapoptotic drug Tetrahydroisoquinoline amide substituted phenyl pyrazole derivative. Anti cancer activity is analyzed by docking the ligands against the antiapoptotic B-Cell Lymphoma-2 protein (Bcl-2) [PDB ID: 2w3l] using AutoDock Tool software. A docking score of -12.2 kcal/mol is obtained for the phytochemical Amblyone compared with -7.7 kcal/mol for Tetrahydroisoquinoline amide substituted phenyl pyrazole derivative. The better docking score is an indication that the amblyone can bind firmly on the groove of Bcl-2 protein which regulates the activity of pro-apoptotic proteins by direct binding and sequestration. The absorption, distribution, metabolism, excretion (ADME) and toxicity properties of the ligands are studied using Pre ADMET software. The in silico studies are further supported by in-vitro studies of the crude sample using A549 (Lung cancer) cells by direct observation of cells using Inverted phase contrast microscope followed by colorimetric assay method (MTT) and direct microscopic observations.
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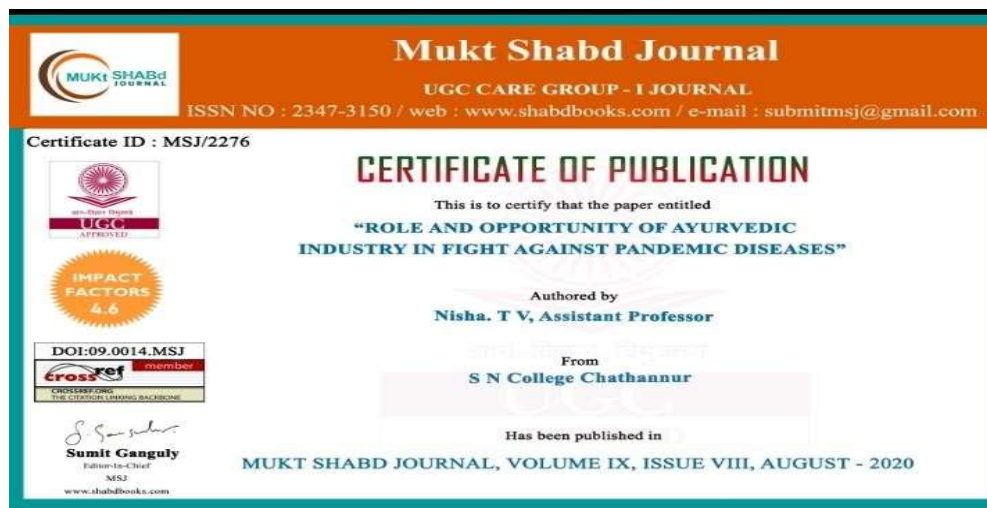
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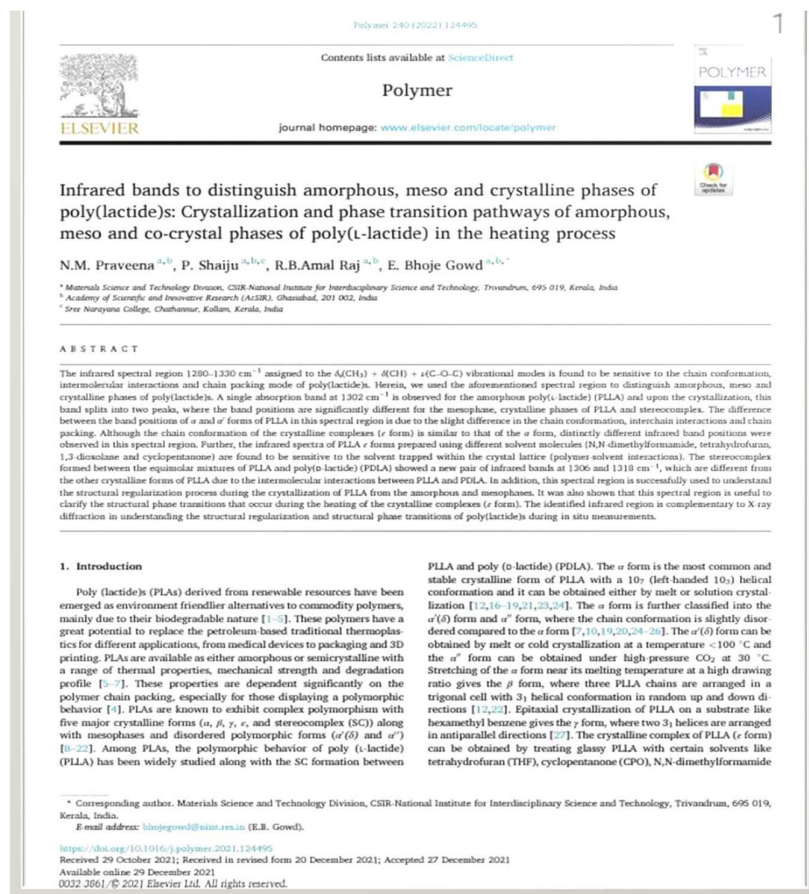


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2021-22

- Dr. Shaiju P: Department of Chemistry



• **Dr. Deepa M J:** Department of Chemistry

## BiVO<sub>4</sub>-TiO<sub>2</sub> Composite-Based Zinc Phosphate Coating for High NIR Reflectance and Sustainable Energy-Saving Applications

Mohandas J. Deepa, Sasidharan R. Arunima, Liju Elias, Thaju C. Bhagya, Chanassery V. Geethanjali, Viswanathan S. Saji, and Sheik Muhammad Aboobakar Shibli\*

Cite This: <https://doi.org/10.1021/acs.jecr.2c00504>

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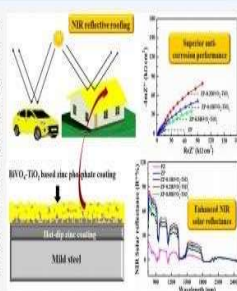
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**ABSTRACT:** A near-infrared (NIR) reflective BiVO<sub>4</sub>-TiO<sub>2</sub> composite pigment was synthesized using a combined precipitation-sol-gel process and successfully assimilated to a zinc phosphate conversion coating on a hot-dip zinc-coated steel sheet. The combination of BiVO<sub>4</sub> with TiO<sub>2</sub> resulted in reducing crystallite size and band gap, which improved the NIR reflectance. The BiVO<sub>4</sub>-TiO<sub>2</sub> composite-based zinc phosphate coating presented a compact hierarchical structure with a high degree of crystalline coverage. The coating with enhanced yellow coloration exhibited good NIR solar reflectance (80.72%) with long-term NIR reflectivity and thermal durability. The composite-based zinc phosphate coating presented excellent corrosion resistance to the hot-dip coated mild steel with high charge transfer resistance (90.86 kΩ cm<sup>2</sup>) and low corrosion current density (0.33 μA/cm<sup>2</sup>). The coating presented high durability during aggressive salt spray exposure and bend tests. The present coating formulation has a high potential for energy-saving applications in automobiles and buildings to reduce heat buildup.



### 1. INTRODUCTION

Global warming is a severe issue owing to the formation of heat islands and CO<sub>2</sub> pollution in urban areas; consequently, the energy crisis and environmental protection are critical problems at present. A significant part of the heat in solar radiation comes from infrared (IR) radiation (52%), and its wavelength range spans between 700 and 2500 nm.<sup>1-3</sup> IR radiation conveys heat to the entire earth's atmosphere, thereby increasing the temperature in buildings and automobiles, which causes various health problems.<sup>4</sup> The significant rise of heat inside cars and buildings causes enhancement of energy consumption because of excess air conditioning and contributes to global warming.<sup>5</sup> Hence, the exploration of sustainable cool pigments incorporated into high near-IR (NIR) reflective coatings for automobiles and building envelopes (roofs and walls) has considerable importance in the emerging world to mitigate global warming, especially in urban areas.

Mild steel is the most frequently used metal in almost all industries, including electrical, construction, and automobile applications, because of its excellent mechanical properties, economic viability, sustainability, recyclability, and durability.<sup>6-8</sup> However, it readily undergoes corrosion, resulting in severe economic and ecological issues. Among the different approaches to safeguard steel from corrosion, hot dip

galvanized coating is a cost-effective and straightforward method.<sup>9-11</sup> Hot-dip coating protects the metal from corrosion through both physical barrier effect and sacrificial anode effect, even if some damage or minor discontinuity is formed on the surface of the coating.<sup>9-11</sup> A suitable chemical conversion coating could be helpful to seal the coating defects and further augment the corrosion resistance of galvanized coatings.<sup>12</sup> Among the different chemical conversion methods, phosphating is often applied on galvanized coatings.<sup>13,15</sup> The phosphate coating has many industrial applications because of its economic feasibility, excellent wear and corrosion resistance, speed of operation, and excellent adhesion and lubricative properties.<sup>13,15</sup> Supplementary addition of metals or metal oxides in the phosphating bath could significantly modify the coating's microstructure and thereby enhance anticorrosion performance.<sup>14,15</sup> In this study, we developed a modified zinc phosphate coating on a hot-dip zinc-coated steel by incorporating a NIR reflective BiVO<sub>4</sub>-TiO<sub>2</sub> composite.

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## Tuning of WO<sub>3</sub> nanoparticles integration into Fe-Zn intermetallic layers of hot-dip zinc coating to control corrosion

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### ARTICLE INFO

### ABSTRACT

**Keywords:**  
Hot-dip galvanization  
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Composite coating  
Intermetallics  
Corrosion

The paper reports about an in-depth analysis on the dissolution study of  $\eta$ ,  $\zeta$ , and  $\delta$  phases of composite zinc coating developed by integrating WO<sub>3</sub> nanoparticles, and assessment of their anti-corrosion characteristics. The composite coating with WO<sub>3</sub> nanoparticles effectively integrated into the  $\eta$  phase than the mixed  $\zeta$ ,  $\delta$  phases or  $\gamma$  phase offers the best corrosion protection characteristics. The superior anti-corrosion performance of composite zinc coating with distinct amount of nanoparticles integration into the  $\eta$  phase than the other intermetallic phases is due to the formation of compact and crack free Fe-Zn intermetallic layer with strong W-Zn bonds. The work is proposed as a cost-effective and simple method for the evaluation of high-temperature coatings, where the performance is influenced by the formation and stability of intermetallics.

### 1. Introduction

Corrosion is a global issue and its consequences are associated with great loss of energy and economy [1]. Surface coating is one of the major techniques for the protection of metals from corrosive attack [2,3]. Organic based coatings are not environmentally friendly and give only barrier protection. Any crack or breakage of such coatings can lead to corrosion. Hence an environmentally friendly coating with long-term stability should be explored [4-10]. Hot-dip Galvanization (HDG) is an economical, reliable and oldest method used to apply zinc based coating to protect steel from corrosion [11]. The combined effects of barrier properties, sacrificial nature and zinc patina ensures three fold protection to hot-dip galvanized steels and hence, they find extensive application in industrial fields [12].

The HDG process results in the formation of a new phase mainly composed of Fe and Zn through the heterogeneous assembly of different phases [13]. Hence, the corrosion prevention efficacy of the hot-dip coatings rely mainly on the nature and extent of alloy formation, and the composition of inner and outer alloy layers [14]. The incorporation of additives such as metal oxides and mixed oxides into the galvanic zinc bath play a crucial role to improve the alloying characteristics of Zn-Fe alloy phases. This can result in the formation of improved inner alloy structures and also helps to make the process more economical by

reducing zinc consumption [13,15,16-18]. Therefore the selection of a suitable additive with electrochemical stability and natural abundance such as tungsten oxide (WO<sub>3</sub>) can offer better coating characteristics. In recent years, nanoparticles are drawing more attention, since their large surface area could provide a smoother surface morphology with well-defined grain structure with spangle formation [19-21]. The n-type semiconductor material, WO<sub>3</sub> (band gap = ~2.6-2.8 eV), has been widely explored for many potential applications in the field of photocatalysis, gas sensors, solar energy devices and heterogeneous catalysts. In the last few decades, researchers have focused on monoclinic WO<sub>3</sub> due to its high stability than any other WO<sub>3</sub> structure [22].

Although there are many reports on the modification of zinc bath during galvanization by the addition of metal oxides and rare earth oxides, a detailed interpretation of the formation of different intermetallic layers of hot-dip zinc coating and the role of oxides in corrosion prevention of the intermetallic layers have not been reported yet. In this context, the development and in-depth characterization of WO<sub>3</sub> nanoparticles integrated into hot-dip zinc coating followed by the tuning of WO<sub>3</sub> nanoparticles in intermetallic layers for enhanced corrosion protection are the main objectives of the present study. The paper reports the nature of alloy formation during hot-dip galvanization through layer-by-layer electrochemical analysis. The work focuses on exploring the role of tungsten oxide and different intermetallic layers in anti-

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Green synthesised copper and copper oxide based nanomaterials using plant extracts and their application in antimicrobial activity:  
Review

P.G. Bhavyasree<sup>a, b, c</sup>, T.S. Xavier<sup>a, b</sup>

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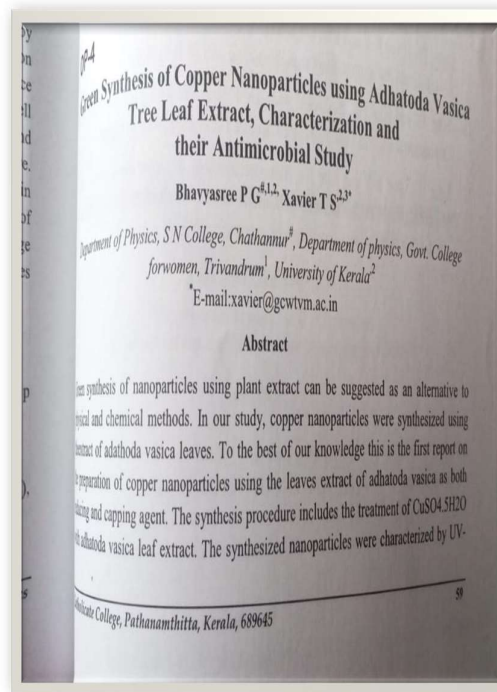
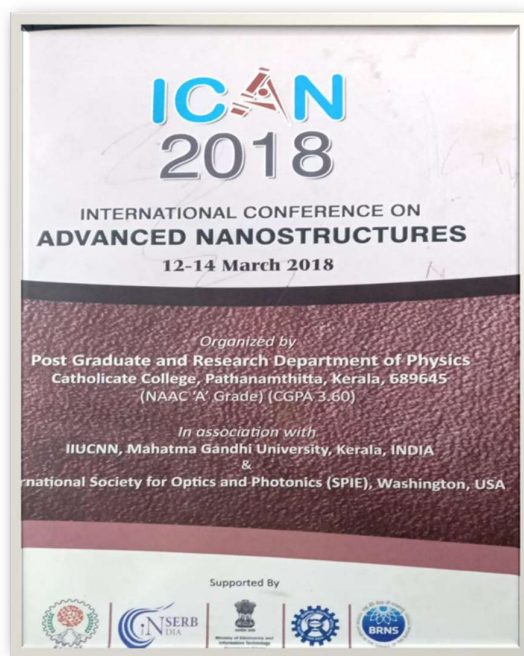
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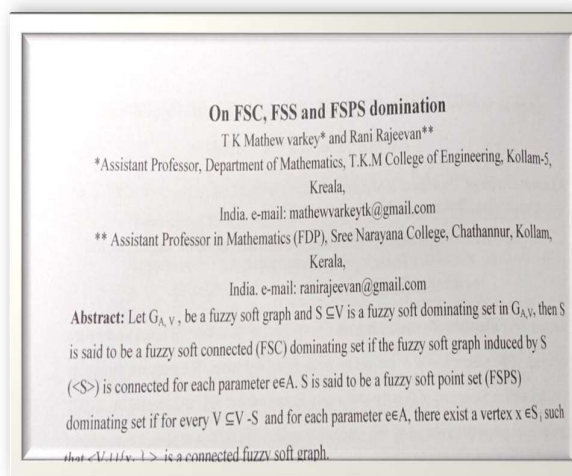
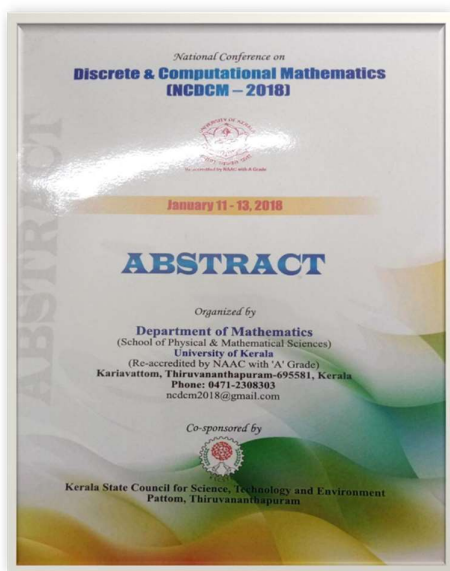
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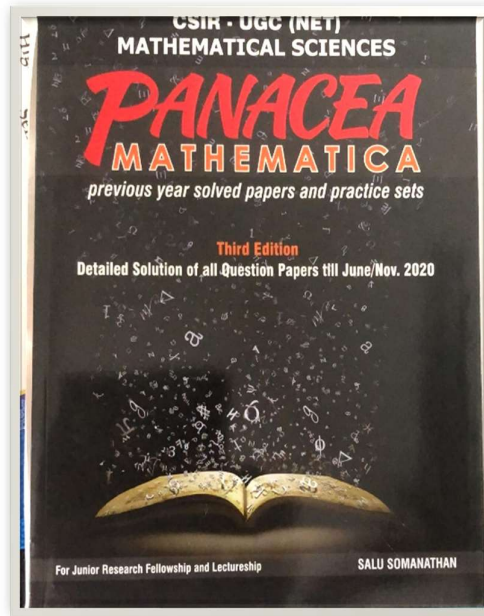
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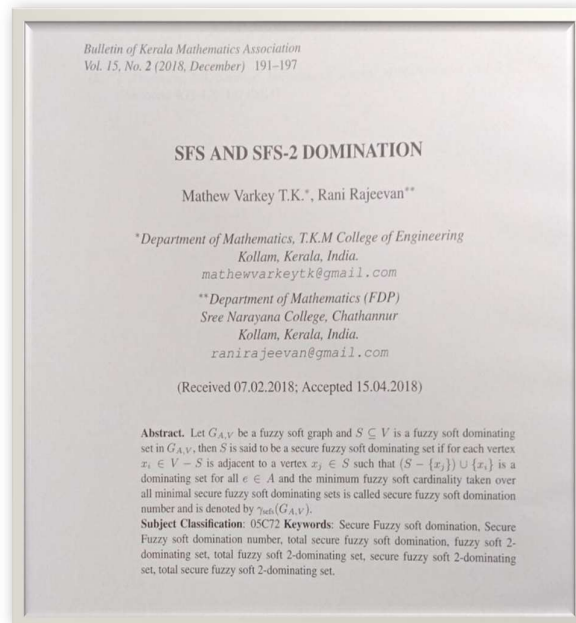
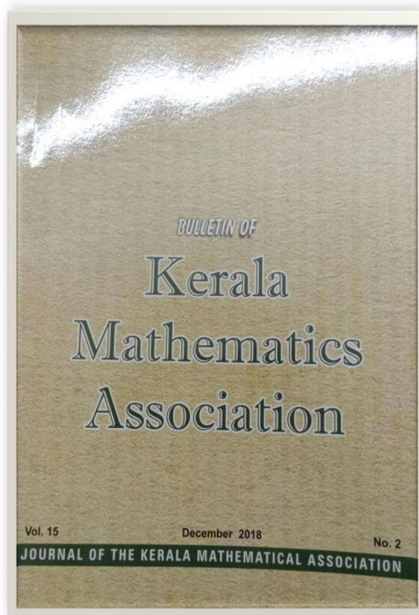


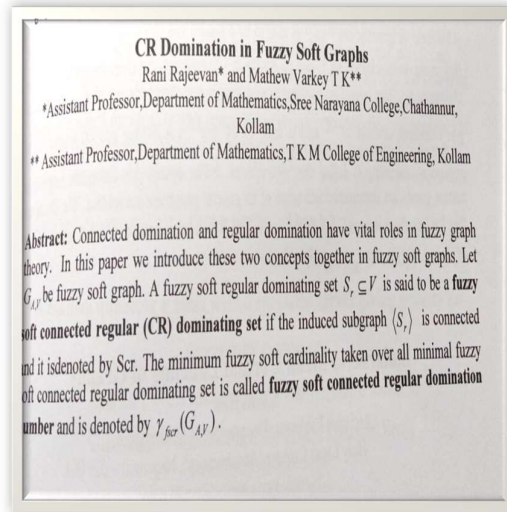
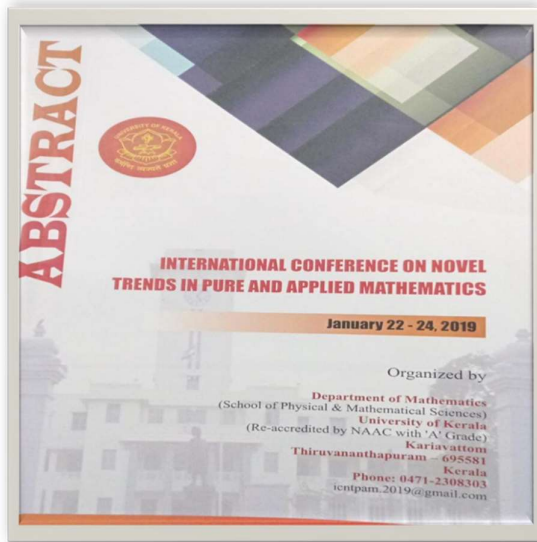
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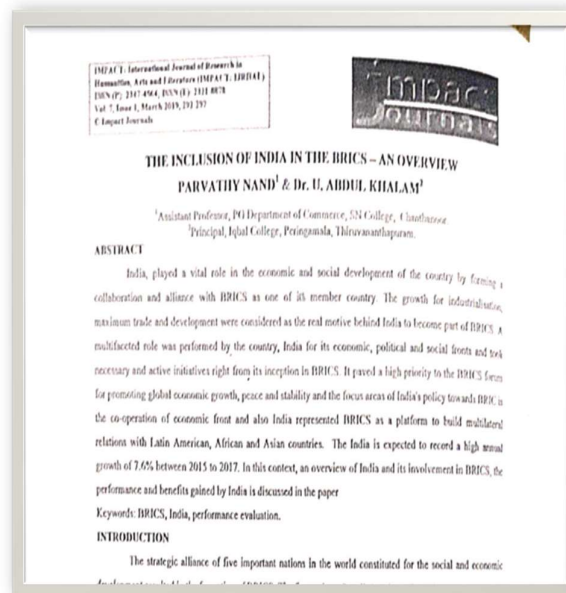
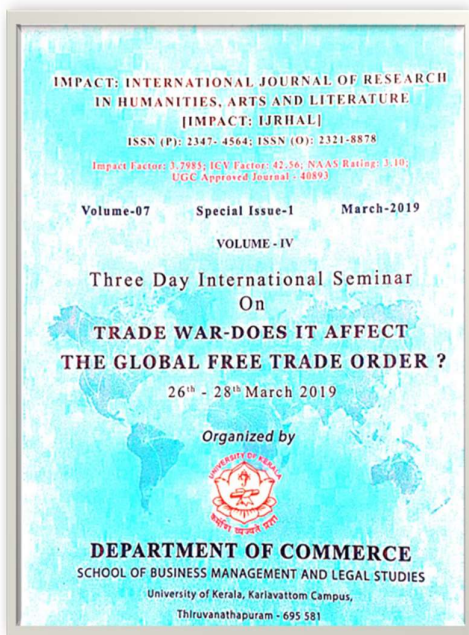
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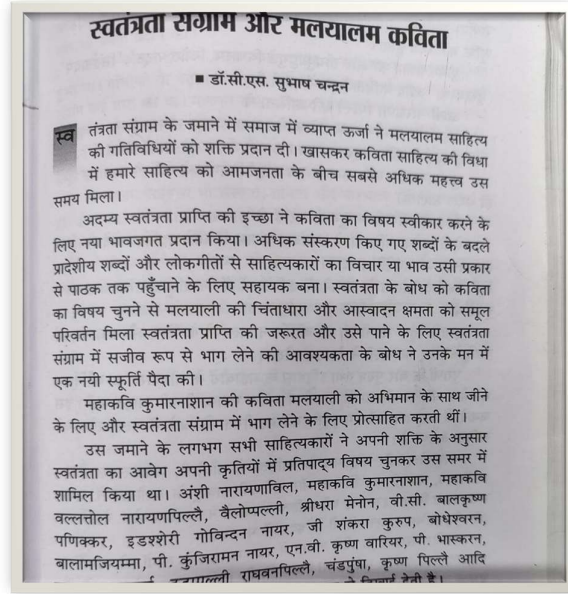
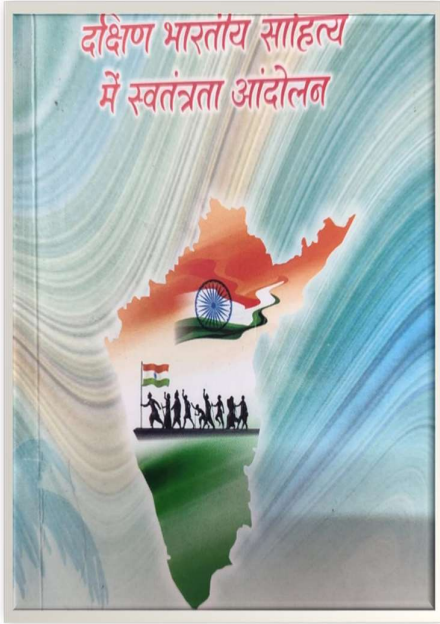


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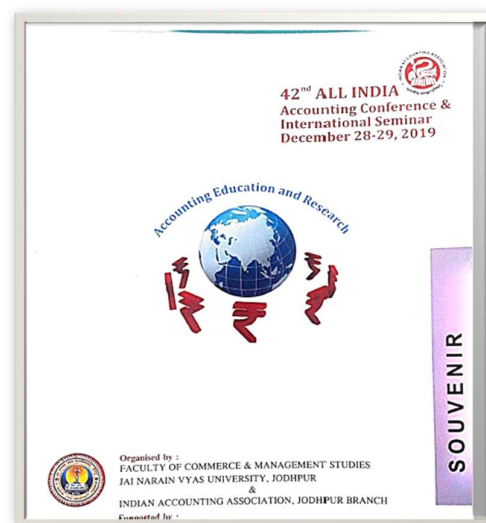
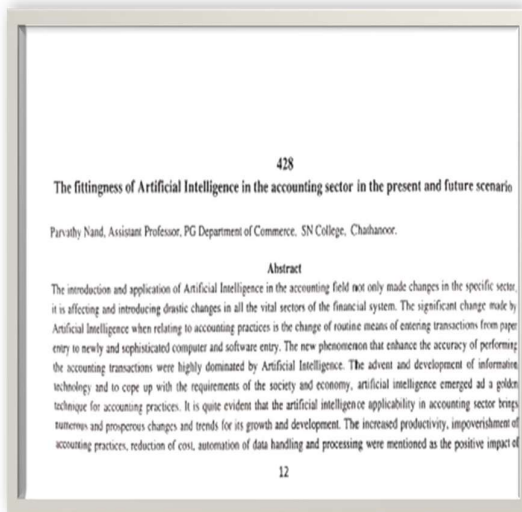


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**ദക്ഷ (പഠനം)**

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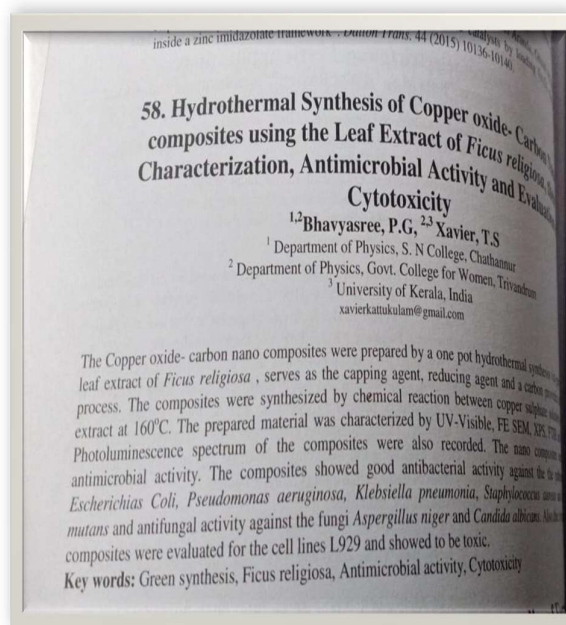
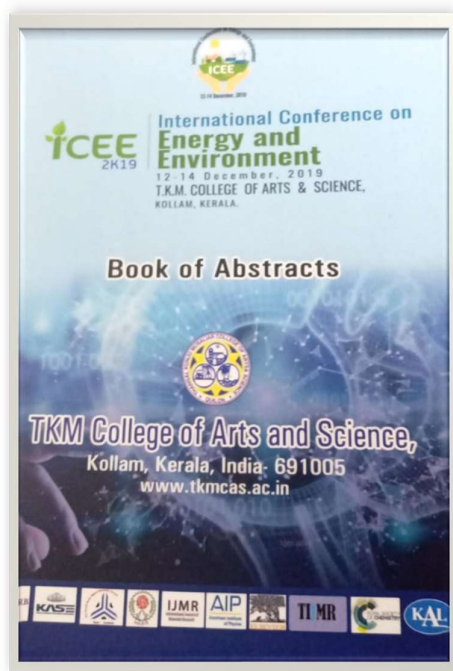
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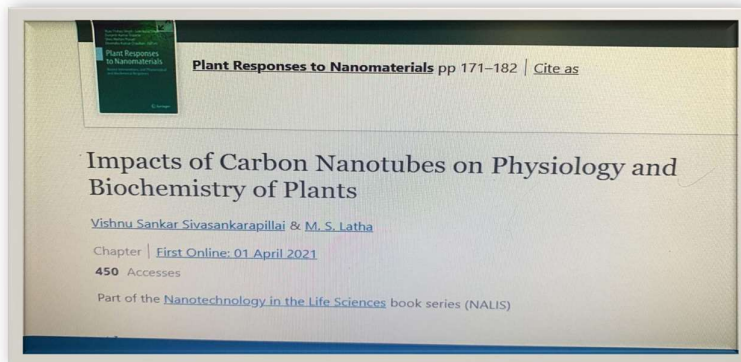


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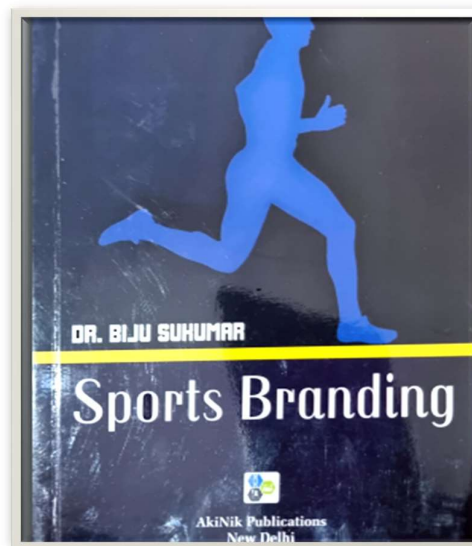
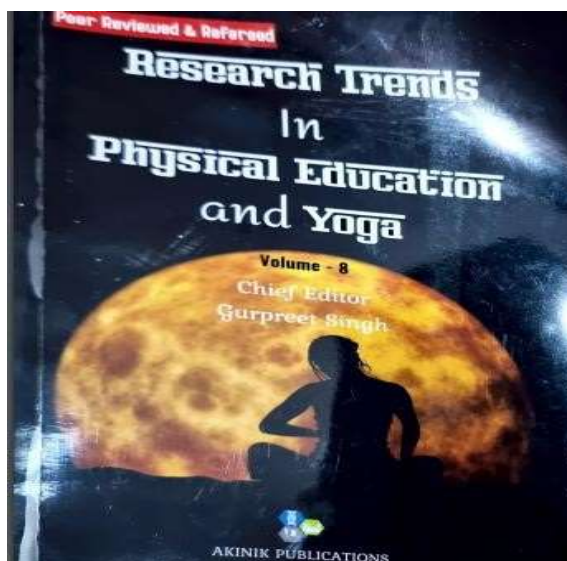
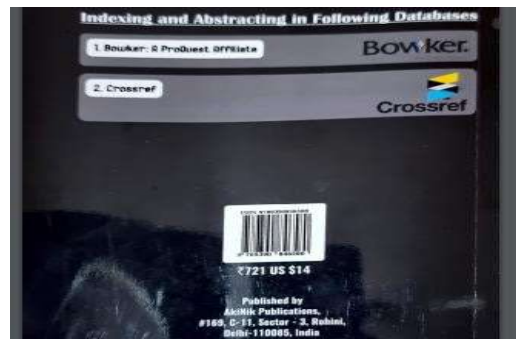
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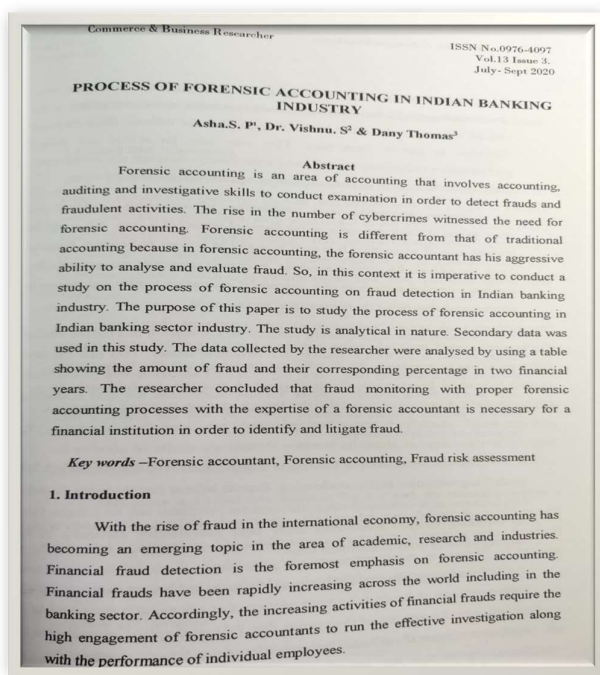


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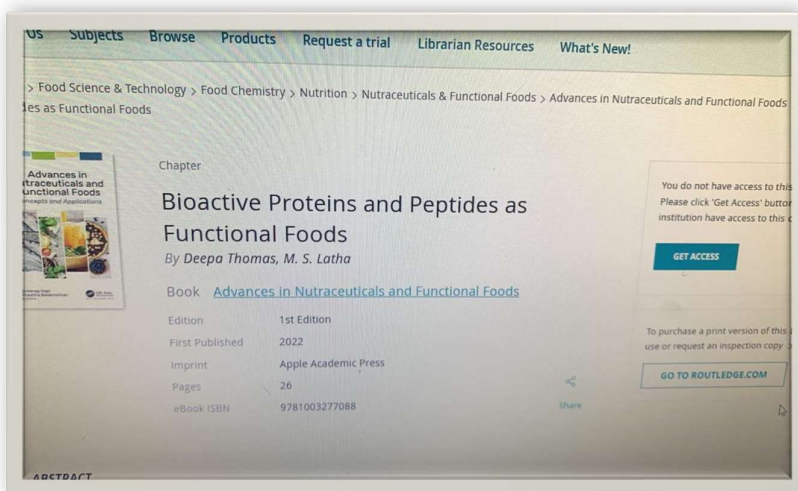


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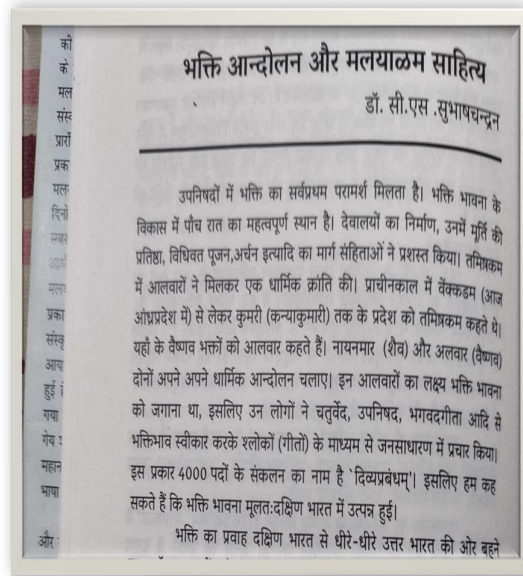
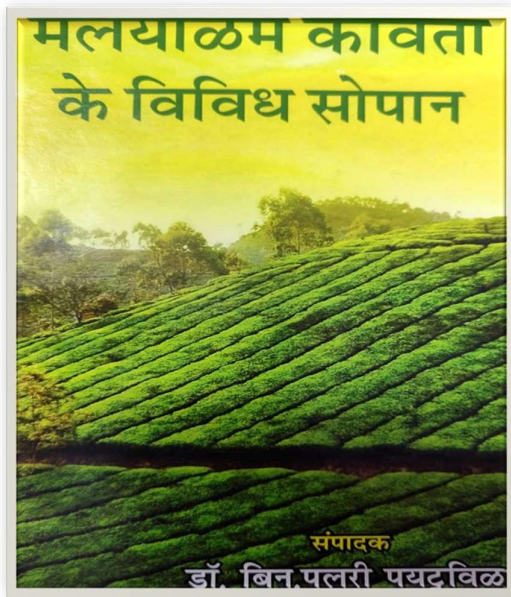


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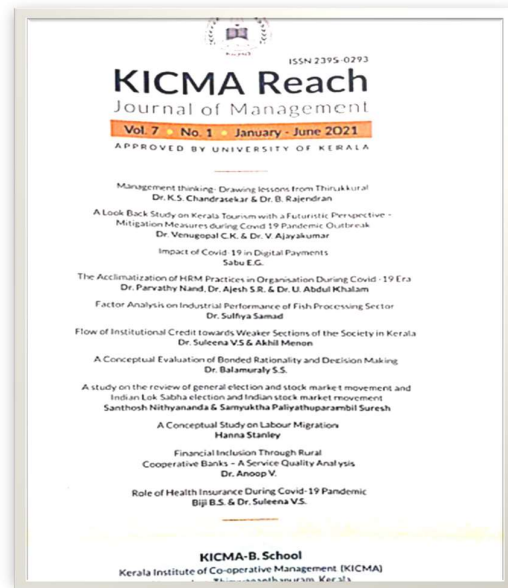
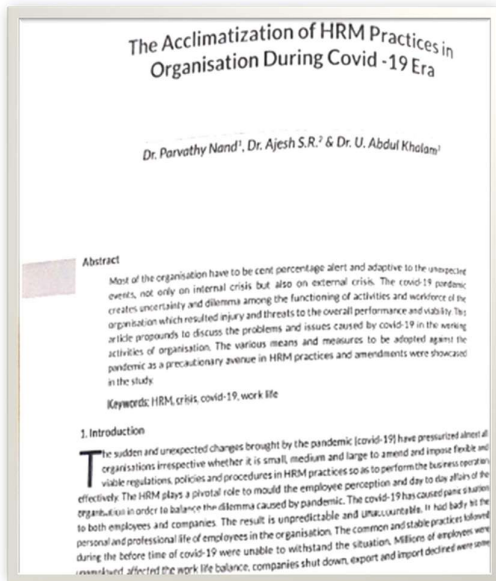
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